An Experiment on Interspecific Competition Between Two Species of Grasshoppers, *Melanoplus flavidus* and *Melanoplus scudderi*

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ABSTRACT

Two species of grasshoppers found on the UNDERC property were used in an experiment to determine if interspecific competition occurs between the two species. *Melanoplus flavidus* and *Melanoplus scudderi* were the two species used. The experiment ran from June 6, 2003 until July 16, 2003 and was ended when the numbers of grasshoppers surviving was near zero.

While more *M. flavidus* grasshoppers survived, it was shown using ANOVA that this species did not outcompete *M. scudderi* and in the treatment in which there were more *M. scudderi* than *M. flavidus*, there was a trend that the *M. flavidus* were outcompeted by *M. scudderi*. Improvements in the study include running the experiment for a longer period of time and counting the grasshoppers more often.

INTRODUCTION

When two species coexist, interspecific competition can occur between the two species. They can compete for the same resources and one species could outcompete the other, possibly driving it to near-extinction in that area.

Interspecific competition can be modeled using the Lotka-Volterra model. Two competitors can entirely overlap in their range of resources but their proportional use of the resources in that range can differ between the two species when applied to an exploitative competitive system (Chase and Belovsky 1994).

Ritchie and Tilman (1992) tested for interspecific competition between two different sets of grasshoppers. One experiment examined the competitive relationship between *Arphia conspersa* and *Pardalophora apiculata* and the competitive relationship between *M. femurrubrum* and *M. bivittatus* were compared in a second experiment. They determined interspecific competition only occurred when the grasshoppers significantly reduced plant biomass. They also determined that grasshoppers are possibly food limited at higher densities.

Chase (1996) conducted a study in which the interspecific competition was examined between *M. sanguinipes* and *Arphia pseudoneitana* and between *M. sanguinipes* and *Trachyrhachys kiowa*. He found that both the *A. pseudoneitana* and *T. kiowa* were able to out compete the generalist feeder species, *M. sanguinipes.* He also found that the relative abundance and coexistence of the non-generalist species within an included niche were dependent on per capita effects of both the species in regards to the shared resources and the proportion of exclusive to shared resources that were made available to the generalist species.

In a study by Evans (1995), application of carbaryl bran bait reduced the densities of three out of four grasshopper species (*Oedaleonotus enigma*, *M. sanguinipes* and *M. packardii*). Conversely, the density of the fourth grasshopper species (*M. bivittatus*) was significantly raised by the application of carbaryl suggesting that interspecific competition occurred between *M. bivittatus* and the other three grasshopper species and that *M. bivittatus* is the dominant competitor. This may be due to the fact that *M. bivittatus* is a larger sized species.

A study by Beckerman (2000) used a manipulative field experiment to test the included-niche competition hypothesis as the determinant of the distribution of a generalist grasshopper species, *M. femurrubrum*. A second grasshopper species, *Chorthippus curtipennis*, was used to determine if interspecific competition occurred. The included-niche hypothesis was supported by the distribution and foraging data. However, the field experiments showed that the cause of grasshopper distribution patterns was not interspecific competition.

Two species found on the UNDERC property were used in an experiment testing interspecific competition. The species used were *M. flavidus* (also known as Species A) and *M. scudderi* (also known as Species B). It is predicted that there will be interspecific competition between these two species.

MATERIALS AND METHODS

M. flavidus, commonly known as Yellowish spur-throat grasshopper, is a species with a range from Alberta to Manitoba south to Arizona, Texas and Illinois. Its preferred habitat is common vegetation, such as tall grass. The average size of an adult male is 20mm; adult females average 25mm in size.

M. scudderi, commonly known as Scudder's spur-throat grasshopper, has a range covering the eastern United States south to northern Florida and extending west to Nebraska and Texas. This species also prefers grass as its habitat. Adult males average 14-18.5mm in size and average adult female size is 22-24mm.

Both *M. flavidus* and *M. scudderi* occur naturally at the experiment site and are the dominant species there. The grasshoppers were collected using insect nets.

This experiment was conducted in a grassy field of common vegetation on the UNDERC property, Michigan (Figure 1). The grasshoppers were kept in cages made out of aluminum screening attached to a base of aluminum flanking with a size of 0.36 m^2. The cages were placed over natural vegetation and into the ground so that the grasshoppers could not escape.

The density of grasshoppers used in this experiment was based on the field density and this was determined by sampling quadrats of 0.1m^2. There were twenty cages used in this experiment: four replicates of five different proportions of the two grasshopper species (Figure 2). Ten grasshoppers were put in each cage. The cages were randomly assigned treatments.

The cages were stocked with the grasshoppers on June 6, 2003. The cages were counted on June 15, June 24, and July 11 and again when the cages were emptied on July 16. The number of grasshoppers steadily declined between each of the days in which the grasshoppers were counted.

RESULTS

M. flavidus survived better than *M. scudderi* based on the number of grasshoppers alive at the end of the experiment. There was 1 individual of *M. scudderi* found when the cages were emptied compared to 18 individuals of *M. flavidus*. The proportion of surviving individuals of each species declined over time and as the density of the other species in the treatment increased (Figures 3A, 3B, 4A and 4B).

Looking at the number of individuals surviving at the end of the experiment, it appears that *M. flavidus* was able to outcompete *M. scudderi*. However, when the proportion of each species versus density of its competitor was analyzed using ANOVA, *M. flavidus* did not outcompete *M. scudderi* at any of the densities in the experiment. Comparing proportion surviving of *M. flavidus* to starting density of *M. scudderi*, the P value was 0.172, the df value was 3 and the F-ratio was 1.975. *M. scudderi* seemed to outcompete *M. flavidus* in the treatment in which there were 3 individuals of *M. flavidus* and 7 of *M. scudderi* when the cages were stocked, but the results were insignificant. In the comparison of proportion surviving of M. scudderi to starting density of M. flavidus, the P value was 0.853, the df value was 3 and the F-ratio was 0.260.

DISCUSSION

Even though the statistical results were not significant, there is a trend that *M. scudderi* outcompetes *M. flavidus* when *M. scudderi* occurs at a higher density that *M. flavidus*. This would only have implications in nature if *M. scudderi* occurred at a higher density. At the site where the experiment was conducted, the two species occur at similar densities so competition most likely does not naturally occur there. If the two species do not compete when sharing the same habitat, this could be due to there being enough of a food source to support both species or one of the species uses a food source that the other doesn't, allowing that species to not be decimated by competition.

If the experiment were run for a longer period of time, the results may have more pronounced in that *M. scudderi* may have significantly outcompeted *M. flavidus* when it is at a higher density than *M. flavidus*. Since both of the species were at low numbers when the experiment ended, future experiments could be started earlier in the summer for better results. In the future, higher densities of grasshoppers could be used in the same size cages to see if interspecific competition exists when the food supply is more limited. Also, the cages should be counted on a more regular basis, such as every five days. The results of this experiment may have been more pronounced if the cages were counted more often than they were, especially between June 24 and July 11. There could also be a more extensive study to determine the exact niches of the two species in this area.

LITERATURE CITED

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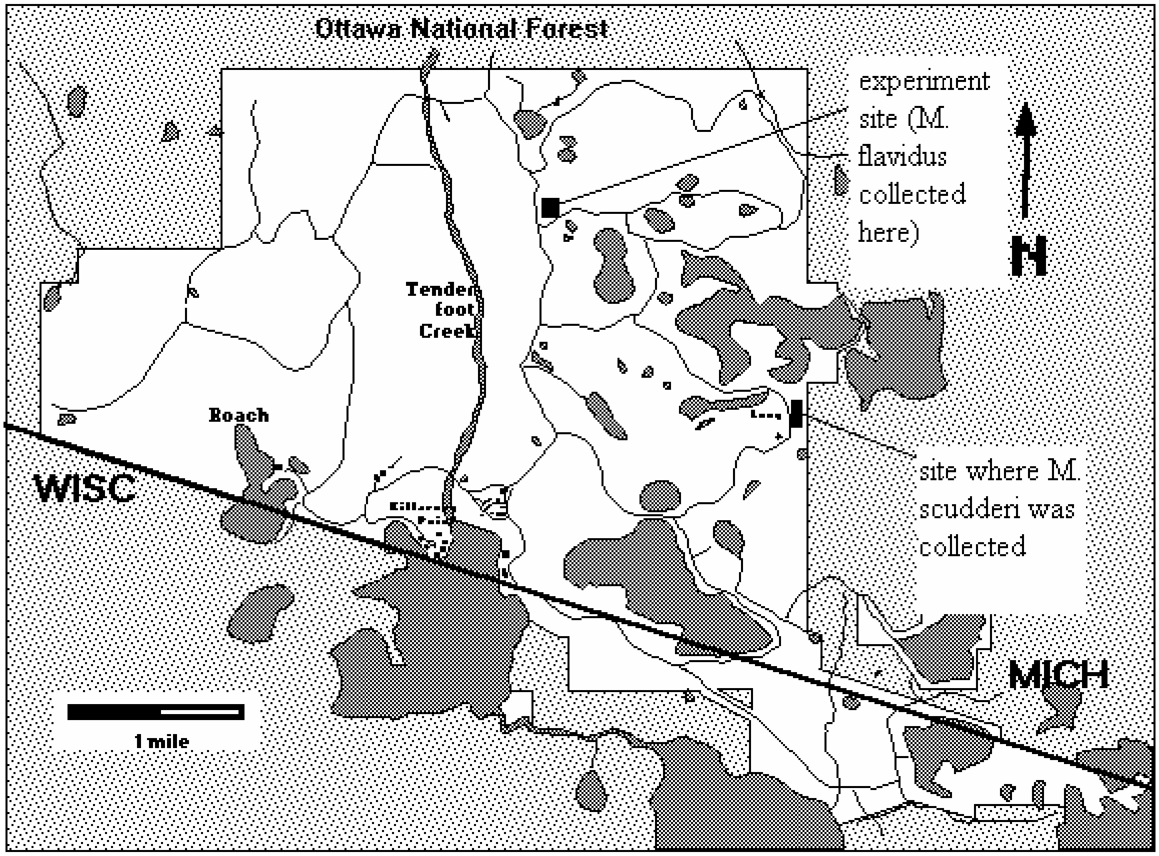
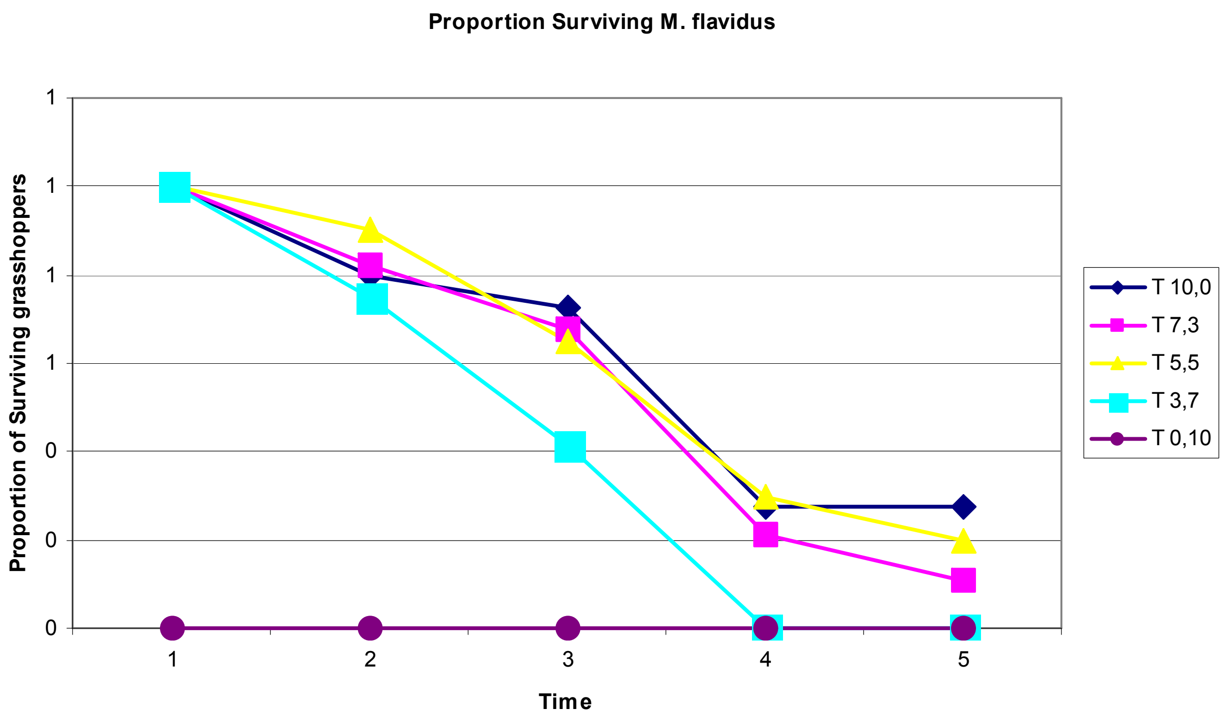
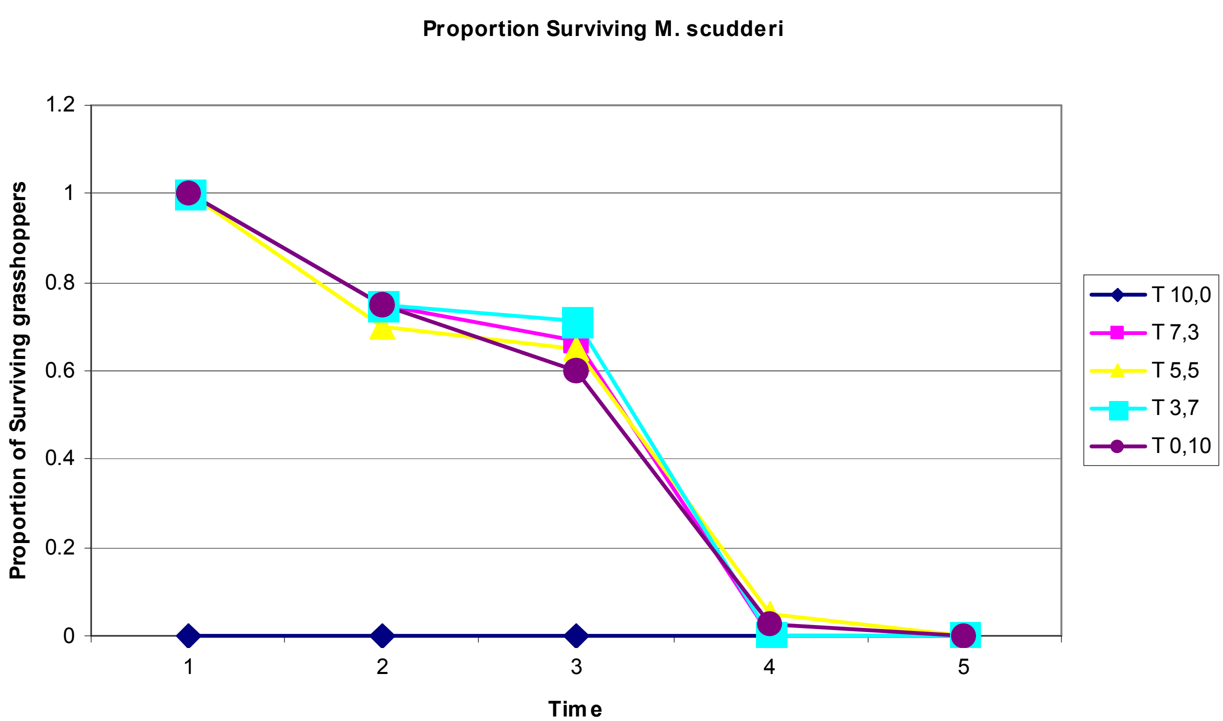


Figure 1. Map of the UNDERC property, detailing where the experiment site is located as well as the site where *M. scudderi* was collected.

M. flavidus	10	7	5	3	0
M. scudderi	0	3	5	7	10

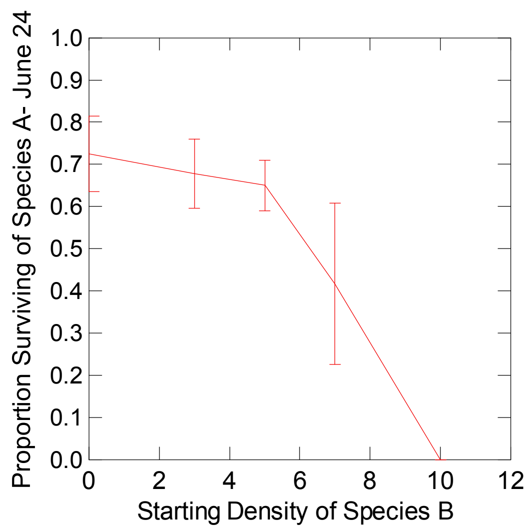
Figure 2. Five different treatments used in the experiment. There were four replicates of each treatment for a total of 20 cages.


Proportion Surviving M. flavidus
Proportion of Surviving grasshoppers
1
1
1
1
0
0
0
1
2
3
4
5
Time
T 10,0
T 7,3
T 5,5
T 3,7
T 0,10

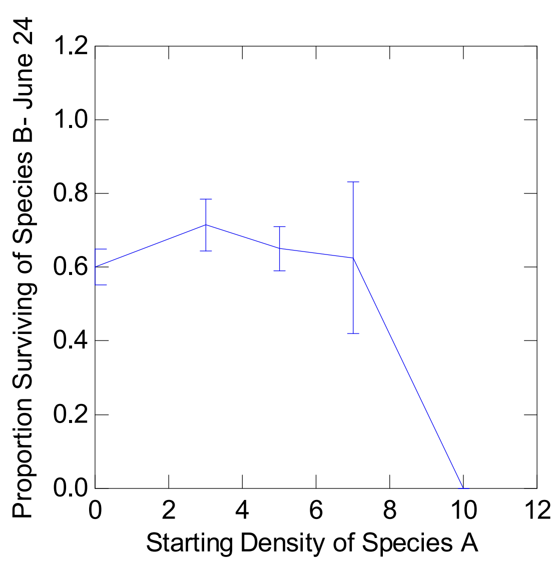

Proportion Surviving M. scudderi
Proportion of Surviving grasshoppers
1.2
1
0.8
0.6
0.4
0.2
0
1
2
3
4
5
Time
T 10,0
T 7,3
T 5,5
T 3,7
T 0,10

Figures 3A and 3B. Proportion of each species surviving over time. The only treatment that seems to have interspecific competition is the 3 *M. flavidus*, 7 *M. scudderi* treatment in which *M. scudderi* appears to outcompete *M. flavidus*.

Proportion Surviving of Species A versus Starting Density of Species B



Proportion Surviving of Species B versus Starting Density of Species A



Figures 4A and 4B. Proportion surviving of each species compared to the starting density of the other species. Species A was more affected by increasing numbers of Species B that vice versa.