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Jennifer Hixon  
*College of DuPage*

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## The Effects of Microhabitat on the Foraging Behavior of Vertebrate Seed Predators in Restored Grassland

by Jennifer Hixon

(Biology 103)

The Assignment: Students conducted an ecological study in restored prairie at the College of DuPage and wrote scientific papers on this investigation following the format of the peer-reviewed journal *Ecology*.

### ABSTRACT

In order to assess the effects of microhabitat variation on vertebrate seed predators we measured giving up densities of seed trays placed in a covered and uncovered microhabitat. Treatments were done for rodents and birds together, birds alone, and rodents alone values were calculated using the data from the other two treatments. These treatments were done in restored grassland in Northwestern Illinois, using burned prairie as the uncovered microhabitat and unburned prairie as the covered microhabitat.

Foraging activity was highest (lower giving up density) in the covered microhabitat for both rodents and birds. This was most likely due to predation risk. Rodents showed almost no foraging activity (high giving up density) at all in the uncovered microhabitat; whereas birds showed a significant amount of foraging in the uncovered microhabitat. This foraging behavior of birds was correlated, using previous studies, to birds use of sight to forage, thus cover would conceal seeds from view.

### INTRODUCTIONS

Many factors influence foraging behavior of organisms in their natural environment. These may include microhabitat variation, time spent traveling to find food, amount of energy needed to find or consume the food, predation risk, competition with other organisms (Feldhamer 1999). By using experimental field studies, we can examine one or more variables at a time to show ecological factors that aid in shaping foraging behavior.

Foraging behavior of vertebrate animals can be examined through food consumption under different conditions. In this study we used food patches set out in different microhabitats of a restored tall-grass prairie, to test the effects of a covered microhabitat (unburned prairie) versus an uncovered microhabitat (burned prairie) on the foraging behavior of granivorous birds (e.g. sparrows) and rodents (e.g. mice). Using seed trays set out in each treatment area we measured giving up densities (GUD), the amount of resource remaining following use by an organism, for birds and rodents. The observations enable one to examine a pattern of foraging behavior for the granivorous birds and rodents in the community studied. I expect to find overall lower giving up densities, more foraging, in areas of cover than areas of no cover. I also expect birds to show lower giving up densities in areas of no cover than the rodents; and rodents to produce lower giving up densities in areas of cover than the birds.

A previous study of seed predation in relation to the distance from the forest edge showed seed predation intensity decreased with distance from the forest edge (Meiners and Handel 1997). Thus, seed predation was negatively correlated with distance from the forest edge. Predation risk may have affected the seed predation intensity in this study, because the other area being tested here was mowed grass which provides very little cover for the rodent species that were tested. Other factors may affect seed predation in areas other than a forest edge, like mowed grass or dense grassland cover.

Many rodents rely heavily on olfaction to find food items. Granivorous rodents use olfaction to find seeds scattered in or on the surface of the soil, to locate buried seed caches, and to assess the quality of seed once they have been located it (Vander Wall 1998). Therefore, rodents would have an easier time finding food located under heavy litter or plant cover than a bird, because foraging birds run along the ground and scan visually for seeds and dense cover would conceal seeds from view (Thompson et al.

1991).

In a study of the indirect facilitation of granivorous birds by desert rodents, it was determined that the running or foraging patterns of desert rodents through dense cover or dead plant litter indirectly allowed granivorous birds to forage successfully in dense cover (Thompson et al. 1991). In the same study it was observed that by removing rodents from the community long term, granivorous birds did not forage successfully in dense cover.

## METHODS

### *Study Site*

The experiments were performed in the West Prairie of the College of DuPage in Glen Ellyn, Illinois, northeastern Illinois. This area of tall-grass prairie restoration, with a date of restoration from 1984-1986, contained soils composed of clay and rubble (gravel) with a thin layer of topsoil. Restored grasslands were reseeded and planted with seedlings of a mixture of native grasses and forbs. Once plants were established, the area has undergone a cycle of annual burning (spring or fall) since the date of restoration. Half of the site was burned in early April 2003 and was used as our no cover microhabitat. The other half of the site remained unburned and was used as our covered microhabitat.

### *Experimental design*

Seed trays, comprised of standard size petri dishes filled with 5g. of sunflower seeds and a substrate of 25ml. of fine sand, were set out in the treatment areas at optimal feeding times for each group species being tested. On Tuesday, April 22, 2003 at dawn, 40 seed trays were set into the uncovered treatment area and 40 seed trays were set into the covered treatment area. These trays remained in the treatment area for 24 hrs. and were picked up the following day at dawn on Wednesday, April 23, 2003. These trays were used to measure giving up densities for both rodents and birds. Based upon previous observations, general assumptions were made that granivorous rodents at the site are nocturnal and granivorous birds at the site are diurnal. On Wednesday, April 23, 2003 at dawn, when the seed trays from the previous day were removed, 80 additional seed trays were set out; as previously 40 were set in the covered and 40 were set in the uncovered microhabitats. These trays were picked up later that same day at dusk and were used to measure the giving up densities of birds alone. Each individual seed tray was numbered from 1 to 160 and marked as to which treatment area it came from, whether it was from rodent-bird cover, rodent-bird no cover, bird cover, or bird no cover. Each seed tray was held in place with two small metal stakes to prevent dumping. The seeds of each tray were sifted from the substrate and any debris was removed and each tray's final seed weight (giving up density) was measured and recorded.

Rodent species that have been observed in the area and that might have been included were *Microtus pennsylvanicus* (Meadow vole) and *Peromyscus leucopus* (White-footed mouse). *M. pennsylvanicus*' diet mostly consists of herbaceous plants and roots, but has also been observed consuming grains and seeds (Burg 1972). *P. leucopus*' diet consists chiefly of seeds, nuts, and insects (Burt 1972). The home range of both of these species of rodents is never more than one acre (Burt 1972). No evidence of diurnal rodents (e.g. tree or ground squirrels) has been observed in the vicinity of the treatment areas.

Bird species that have been observed in the area and that might have been included were *Carduelis tristis* (American Goldfinch), *Sturnus vulgaris* (European Starling), and *passer domesticus* (House Sparrow). *C. tristis* is the only native species out of the three. *S. vulgaris* was first introduced into Central Park in New York City, in 1890 and 1891; they rapidly spread across the continent, reaching

the west coast by the 1950's (Rising 2001). *P. domesticus* was introduced to North American from 1850 and 1867 and rapidly increased; soon the birds were considered pests because of their messy nesting habits and aggressive foraging style (Groschupf 2001).

## RESULTS

### *Rodent + Bird Treatment*

Rodent plus bird measurements were taken over a 24 hr. period to encompass the assumed nocturnal foraging habits of rodents and the assumed diurnal foraging habits of birds. These measurements were used to determine all giving up densities and measurements for rodents alone (discussed later in the results). Both the total giving up density (GUD) (Fig. 1) and the average GUD (Fig. 2) were lower for this treatment in the covered microhabitat than in the uncover microhabitat. This treatment showed the lowest total GUD than any of the other treatments in the covered microhabitat (Fig.1). The rodent plus bird treatment also showed the lowest average GUD in the covered microhabitat than any other treatment (Fig. 2).

### *Bird Only Treatment*

The seed trays for this treatment were only left out for 12 hrs. during the day in order to exclude rodents assumed nocturnal habits from this treatment. The bird only treatment showed a lower total GUD in the covered microhabitat than in the uncovered microhabitat (Fig.1). This treatment also showed a lower average GUD in the covered versus the uncovered microhabitat. Birds alone also showed a lower total GUD (Fig. 1) and a lower average GUD (Fig. 2) in the uncovered microhabitat than the rodents alone.

### *Rodent Only Treatment*

The values for this treatment were determined by subtracting the total amount consumed in the birds only treatment from the total amount consumed in the rodent plus bird treatment. This resulted in the total amount consumed by rodents alone. This value was then subtracted from the total original weight of all seed trays and resulted in the total giving up density (GUD) for rodents alone. By then dividing the total GUD by the number of seed trays in a treatment (40) the average GUD was then determined for each rodent treatment. The calculated values for the total GUD (Fig. 1 ) and the average GUD (Fig. 2) for the rodent only treatment were both lower in the covered microhabitat than in the uncovered microhabitat. The total GUD for rodents was lower in the covered microhabitat than that of the birds (Fig.1).

## DISCUSSION

### *Effects of Microhabitat Variation*

The results of seed tray experiments demonstrated the preference by vertebrate seed predators to forage in a covered microhabitat versus an uncovered microhabitat. All treatments showed lower GUD's in covered microhabitat showing more overall foraging in general in that area, this was as I expected. There observations can most likely be contributed to the fact that granivorous rodents and birds are themselves prey and must take into account predation risk when determining where to forage.

All predictions were supported by our results. As expected, birds showed more preference than rodents to forage in the uncovered microhabitat; this was exhibited in the lower total (Fig. 1) and average GUD (Fig. 2) of birds than rodents in the uncovered microhabitat. Both the total GUD (Fig.1) and the average GUD (Fig. 2) for the rodent only treatment were so high in the uncovered microhabitat, that we

can say there was almost no foraging at all in that area by rodents. Also as predicted, rodents showed a lower GUD than birds in the covered microhabitat, thus showing rodents have a higher preference to forage in cover than that of birds.

The preference by birds to forage more in the uncovered microhabitat than rodents might facilitate their coexistence within a community. Although birds still showed more general foraging in the covered versus uncovered microhabitat, foraging by birds in the uncovered microhabitat was still significantly shown. Birds most likely foraged in the uncovered microhabitat because birds run along the ground and scan visually for seeds (Thompson et al. 1991). Rodent foraging activity decreases the density of plant litter and makes trails through standing dead annuals, thus indirectly facilitating the foraging of granivorous birds in dense cover (Thompson et al. 1991). Also, when birds decide between foraging modes (walking versus flying) they must take into account energy needed for each activity and the energy received from the food found during foraging. Walking is low-cost, low-yield, where flying is the opposite (Bautista et al. 2001). This may also explain the foraging behavior of birds to foraging behavior of birds to forage in an uncovered microhabitat.

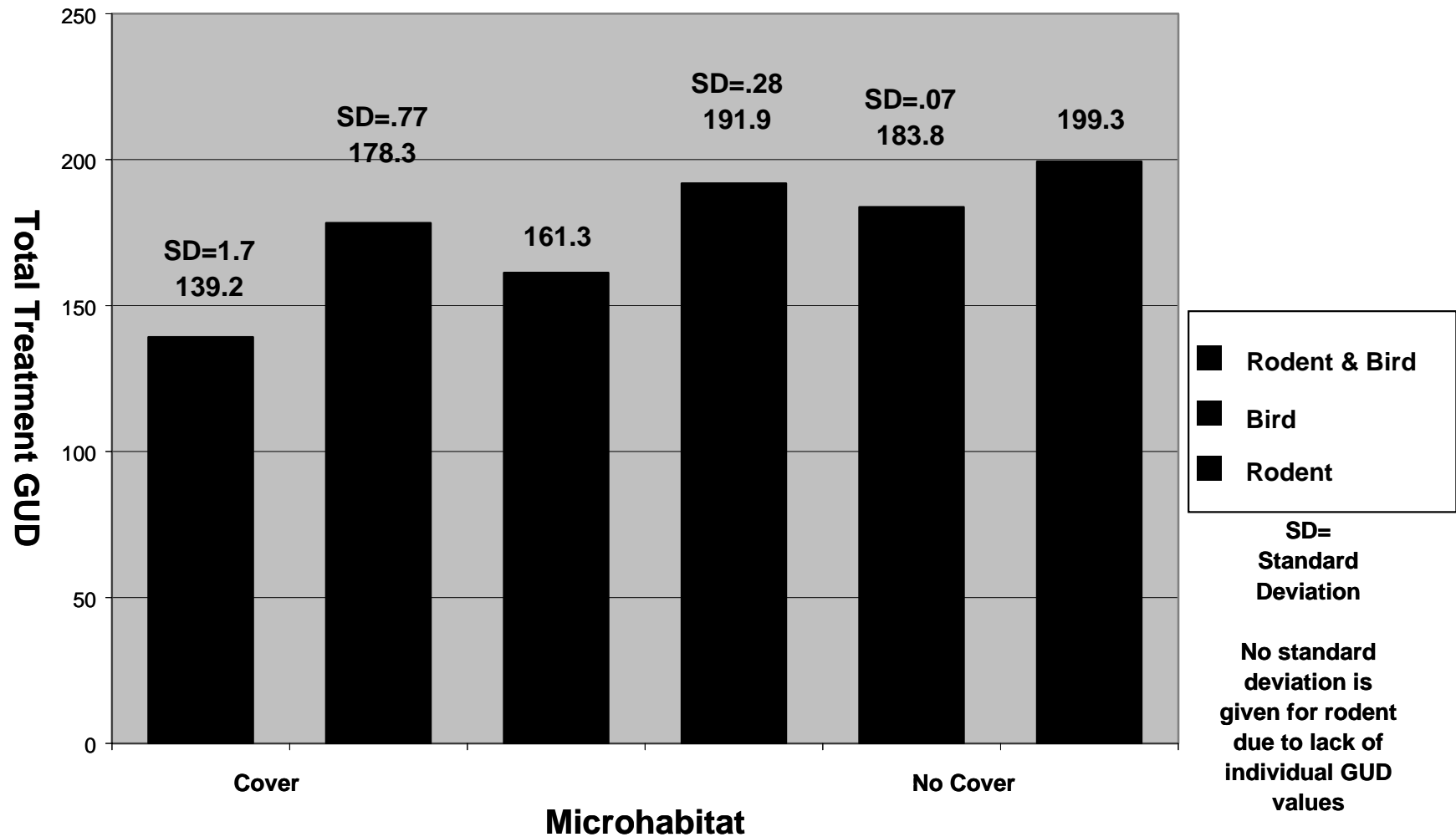
One area where error occurred was when originally weighing out seeds for the trays a few of the trays were incorrectly weighed, such that when weighed again after treatment the values came back higher than the original weight of 5g, thus indicating an error. Like most studies, there were certain aspects of our experiment that could be improved upon for better accuracy. It would have been ideal to have set out seed trays for rodents alone, rather than calculating their measurements from the other treatment as we did. It would have been much more accurate to have gotten individual GUD results for the rodents alone, because one needs individual values to determine standard deviation, which for that reason we were unable to calculate for rodents. Also, it may have proven more accurate if additional treatments had been conducted in an additional area of restored grassland as comparison.

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**Figure 1. Effects of microhabitat variation on total GUD**



**Figure 2. Effects of microhabitat on average GUD**

