Transactions of the Illinois State Academy of Science received 12/21/00
(2001), Volume 94, #2, pp. 101-109 accepted 4/7/01

Autumn Post-Harvest Density and Movements of Small Mammals on an Illinois Cornfield

Daniel J. Olson, Janene A. Issert, and Richard E. Warner
Department of Natural Resources and Environmental Sciences
University of Illinois
305 Burnsides Lab
1208 W. Pennsylvania Ave.
Urbana, IL 61801
(217) 333-9073
dolson1@uiuc.edu

ABSTRACT

We examined the densities and movements of small mammals in a post-harvest, central Illinois cornfield bordering a residential subdivision during Oct. - Dec. 1999. A total of 129 captures (78 individuals) of three genera were recorded in 3,360 live-trap nights. The three trapping sessions (four nights/session) averaged 0.0355 captures per trap night. There were significant differences in the number of captures and the number of individuals between trapping sessions ($\chi^2 = 62.12$, df = 2, $P < 0.001$ for number of captures, and $\chi^2 = 31.64$, df = 2, $P < 0.001$ for number of individuals). Two different methods were used to estimate densities of small mammals. Both methods indicate a three-fold increase in density shortly after tilling (17.0 to 22.1 ind/ha), and then a return to original values (6.3 to 10.3 ind/ha) one month after tilling. Mean daily movement of individuals and mean movement per trapping session averaged 15.5 m and 30.5 m, respectively. Daily movement of individuals did not differ between trapping periods ($\chi^2 = 2.32$, df = 2, $P = 0.31$). In addition, we conclude that there is no difference in the number of individuals captured relative to the distance from human-built structure.

INTRODUCTION

Small mammal use of agricultural areas in the Midwestern United States has been widely documented (Anderson 1951, Whitaker 1967, Getz and Brighty 1986, Hoffmeister 1989). Likewise, population size and movements of small mammals in natural habitats are well described (Stickel 1968, Terman 1968). However, very little attention has been given to mammal population size and movement during post-harvest disturbance in crop fields. The typical agroecosystem environment in Illinois is home to several species of small mammals that may impact human health and agricultural economics. Deer mice (*Peromyscus maniculatus*) and house mice (*Mus musculus*) tolerate these highly disturbed habitats and dominate the small mammal communities in agricultural ecosystems throughout the Midwest (Wooley et al. 1985). Both *Peromyscus* and *Mus* eat cultivated crop seeds as a large percentage of their diet (Whitaker 1966) and estimated rodent damage to newly planted corn (*Zea mays*) can be as high as 57% (Beasley and McKibben 1976). Conversely, these same mammals may consume up to 64% of the annual weed seed, and help control invertebrate species that are detrimental to crops (Getz and Brighty 1986). Of five habitat types that were sampled by Cummings and Vessy (1994), the deer mouse was most abundant in agricultural fields and areas surrounded by agriculture. Crop residue or waste grain left in the field may influence the composition of wildlife in the area (Warner and Havera 1989), and the distances traveled by foraging individuals (Linduska 1942). The first step to assessing potential economic loss is establishing a population size for rodents in these types of areas.

In addition, there has been an emerging concern about several bacterial and viral zoonotic diseases carried by small rodents. In particular, *Peromyscus maniculatus* is a known carrier of the frequently fatal human hantavirus (Childs et al. 1998), and in 1996 the Illinois department of public health confirmed the first known case of hantavirus in the state (Illinois Department of Public Health 1996). Thus, exposure to these diseases increases as urbanization encroaches into agricultural areas. Furthermore, agricultural disturbance adjacent to human dwellings may compound the human-rodent interaction when small mammals are displaced from their typical settings.

Our study considered the density and movements of small mammals in an agricultural setting during the fall post-harvest period. Specifically, our objectives included determining the population size of small mammals in an agricultural field relative to adjacent residential areas, and to determine if movements of mice are correlated with fall tilling or weather patterns such as rain or temperature.

MATERIALS AND METHODS

We conducted three trapping sessions, five days and four nights per session, for small mammals during fall and winter 1999. The first trapping session (23-26 Oct.) was completed three weeks after crops were harvested from the field, but before fall tilling occurred. The second session (13-16 Nov.) began three days after fall tillage. The final session (16-19 Dec.) was completed approximately 28 days after fall tillage.

The study was conducted on University of Illinois owned farmland in Champaign County. Trapping occurred on a 12 ha harvested cornfield, bordered by a residential area to the west (mean distance to buildings from edge of the study area = 15 m) consisting of several homes and outbuildings. The remaining perimeter of the field (75%) was surrounded by alfalfa (*Medicago* spp.), grass pasture (*Poa* spp.), and corn.

Sherman live-traps, which were used to capture small mammals, were baited daily with a wild birdseed mix and insulated with cotton batting. Each trap was checked twice daily. Animals were identified to genus, individually marked with numbered aluminum monel ear tags, and then released at the point of capture. Upon release, individuals were observed from a distance until they safely took cover in a burrow or under vegetation. A 31 X 10 rectangular grid system was constructed along the west edge of the field in order to sample movements of individual mice. Each 10 m^2 section of the grid contained one Sherman live trap.

We used chi-square goodness of fit (GOF) analysis to test for differences in the number of captures (including recaptures) as well as the number of individuals captured between trapping sessions. Expected values for this test were calculated by pooling captures from all three sessions.

Population densities based on mark and recapture data were estimated using two methods. The first estimate was the minimum number alive at capture (Getz 1986). This is derived by dividing the number of individuals captured during the trapping period by the number of hectares trapped. A second density estimate was performed using the MARK program. Program MARK estimates the survival probability from marked animals by computing model parameters via numerical maximum likelihood techniques (White and Burnham 1999). From this information MARK produces a population estimate with a 95% confidence interval for the study area.

Movement results of *Peromyscus* were based on individual recaptures. Individual movements were calculated by measuring the distance between successive captures of the same animal divided by the number of days in the interval. Chi-square (GOF) was used to determine differences in movements between trapping sessions. Expected values were based on pooled movement data from all sessions.

We examined the number of mammals captured relative to human structure (i.e. homes, machine sheds, and garages) in order to determine if densities of rodents were higher around areas occupied by humans. Traps were set between 15 and 105 m from structure. Captures were pooled from all three sessions, and a linear regression was used to analyze difference in the number of captures.

We recorded agricultural activity within a 0.5 km radius around the study area during the months of trapping. This data included land use, dates of harvest, and dates of tilling. Weather data were obtained from the Illinois State Water Survey for Urbana, Illinois and compared to trapping results.

RESULTS

We trapped 78 individuals of three genera, constituting 129 captures during all three sessions (0.0355 captures per trap night). The number of individuals captured per trap night (cap/tn) ranged from 0.016 in December to a high of 0.068 in November (Fig. 1). There was a significant difference in the number of captures and the number of individuals captured between the three trapping sessions ($\chi^2 = 62.12$, df = 2, $P < 0.001$ for number of captures and $\chi^2 = 31.64$, df = 2, $P < 0.001$ for number of individuals captured). *Peromyscus* accounted for 88.5% (n = 69) of the individuals, while *Mus* (n = 7) and northern short-tailed shrews, *Blarina brevicauda* (n = 2) made up 9.0% and 2.5% respectively. *B. brevicauda* is known to be intolerant of disturbance and is rarely found in tilled fields (Hoffmeister 1989). Both shrews were captured less than 2.0 m from an undisturbed alfalfa field. We did not consider this species to be a resident of our trapping plot, therefore they were not included in our density or movement estimates.

Density estimates for *Mus* and *Peromyscus* using the minimum number known alive method resulted in an average of 9.8 individuals per hectare (ind/ha) over all three sessions. Specifically, estimates for each trapping session was 6.0 ind/ha in Oct., 17.0 ind/ha in Nov, and 6.3 ind/ha in Dec. (Fig. 1). When density was calculated using the MARK program, estimates were 23 to 39% higher than those derived using the minimum number known alive method (Fig 1).

Mean daily movement between traps for *Peromyscus* through all three sessions was 15.5 m with a range of 0 to 60 m/day (Table 1). Some individuals were trapped as many as four times during a session, but the distance traveled was variable. Thirty percent of recaptured individuals moved less than 10 m/day. Forty-five percent moved 10 - 20 m/day, and 25% traveled greater than 20 m/day. The average daily movement was not different between trapping periods ($\chi^2 = 2.32$, df = 2, P = 0.31). The mean movement per session was 30.5 m with a range of 0 to 100 m/session (Table 1).

Linear regression analysis indicates an inverse relationship in the number of individuals captured relative to structure ($y = -0.18x + 12.47$, $R^2 = 0.0121$). Specifically, it shows a decrease in the number of individuals with an increasing distance from structure. However, this is a decline of less than two individuals (Fig. 2).

The mean temperature for the 26 days prior to and during trapping was as follows: October 11.58° C, November 11.03° C, and December 3.23° C. This is less than a 0.5° C change between session one to two. There was no precipitation during the first two trapping sessions and only 0.05 cm during the third session.

DISCUSSION

Our findings are unique because the second trapping session provided the highest number of captures (n = 84) and the highest density estimates (Fig. 1). Trapping for this session began three days after the study site and 50% of the surrounding landscape was tilled. In a southern Illinois study, Warburton and Klimstra (1984) trapped a greater number of new *Peromyscus* after tilling when compared with no-till fields and speculated that it was due to ingress of transients onto the sampling area. Evidence from our study supports the idea of transient influx. In addition, it has been documented that tillage practices result in a reduction of resources such as edible crop seed residue (Warner et al. 1985), and the destruction of established burrows (Houtcooper 1972). The increase in the number of individuals shortly after tillage may reflect mice moving throughout the entire landscape in order to acquire new resources.

The number of individuals captured per trap night at our site (0.016 to 0.067) was comparable to other studies carried out in similar landscapes. Warburton and Klimstra (1984) found *Peromyscus* in tilled fields to fluctuate between 0.01 and 0.18 cap/tn in central Illinois. In southern Illinois, Getz and Brighty (1986) found an average of 0.072 cap/tn in corn and soybean (*Glycine max*) fields.

Our estimated densities of small mammals using both methods (6.0 to 22.1 ind/ha) were similar to other studies. Getz and Brighty (1986) reported densities of 11.8 *Peromyscus* and 5.4 *Mus* per ha in wheat (*Triticum aestivum*) fields and Terman (1968) reported a density of 15 to 20 *Peromyscus* per ha in tilled fields. In addition, Young (1984) reported densities of deer mice at 12.0 ind/ha in no-till fields. We believe the higher estimates from the MARK program may be closer to the actual population size because density estimates from live trapping are considered conservative (Stickel 1946, McCord 1953).

Although population density and captures per trap night were highest during the second trapping session, we did not observe a difference in daily movements of individuals between sessions. This may be in part due to the fact that trapping may have biased daily movements by limiting the amount of time available for movement. Therefore the estimates in Table 1 are conservative.

Because our R^2 value and slope were low, we determined the number of captures close to human dwellings was similar to, or only slightly less than captures close to structure (Fig. 2). Our findings are supported by a similar study that noted population levels at field edges were equal to levels at greater than 100 m into the field (Young 1984).

There is evidence that environmental factors such as temperature and rainfall may influence the activity of some species of small mammals (Burt 1940). However, Getz (1961) reported that slight differences in temperature did not affect the capture of animals. He also found that rain had a variable effect on capturing mammals. Given the minimal changes in rainfall and temperature, especially during our first two trapping sessions, we dismiss weather as a cause for bias in the trapping success or movement of individuals.

We conclude that a major perturbation such as large scale, fall tillage causes mice to move throughout the entire landscape in search of resources. Evidence for this includes an immediate increase in the population size after tilling, and a decline of population size back to pre-tilling levels 28 days later. Since population estimates for the second session were more than twice the first and third, in conjunction with an influx of untagged individuals, we believe the disturbance from tillage was the largest contributor causing individuals to move across our study area. During our sampling period there was little evidence to support the hypothesis that there are a higher number of individuals closer to human structure than further away.

ACKNOWLEDGEMENTS

We would like to acknowledge the support of the Illinois Council for Food and Agricultural Research (C-FAR) and the Jonathan Baldwin Turner (JBT) Agricultural Scholarship Program at the University of Illinois, Urbana-Champaign for financial support. We also thank the numerous volunteers that helped on the project and several reviewers of this manuscript.

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Table 1. Individual movement of *Peromyscus* in a post-harvest cornfield in Illinois based on recapture data. Number of recaptures in parentheses.

	Mean Movement (m)		Range Movement (m)		Percent	Number Recaptures
Session	**Daily**	**Session**	**Daily**	**Session**	**Recaptured**	**Between Sessions**
October	17.7	50.0	10 to 33	20 to 100	33.3 (6)	One and Two = 2
November	14.8	25.3	0 to 60	0 to 80	41.7 (35)	Two and Three = 4
December	14.0	40.0	10 to 18	10 to 70	40.0 (10)	One and Three = 0
All months	15.5	30.5	0 to 60	0 to 100	40.1 (51)	-----

Figure 1. Density estimates (bars) and captures per trap night (line) of small mammals on a post harvest Illinois cornfield in 1999. Ninety-five percent confidence intervals (CI) are shown for the MARK program density estimates.

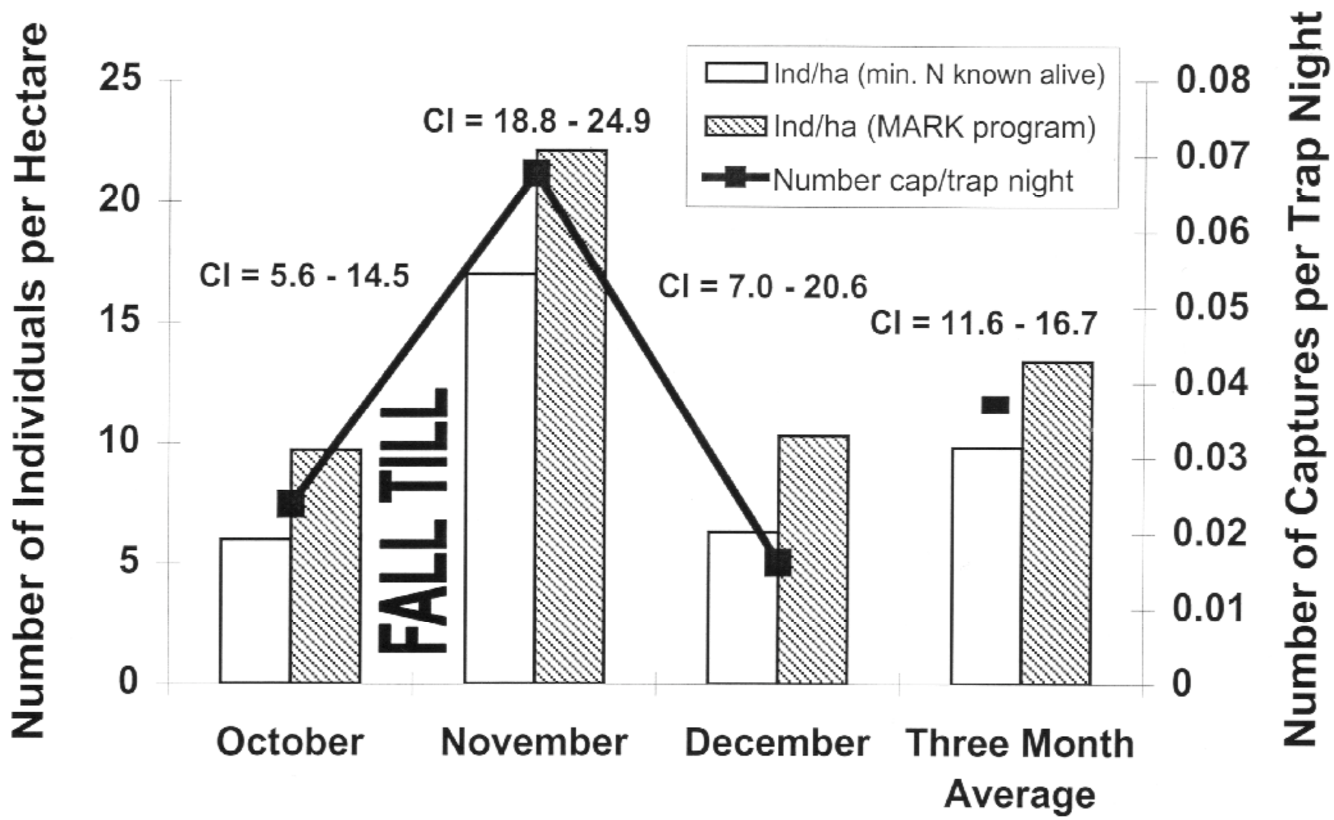

Figure 2. Number of small mammals captured in relation to human occupied buildings during three trapping sessions (Oct. – Dec. 1999) in a central Illinois farmland. Linear regression (dotted line) is calculated from data points shown.