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TRAP ELEVATION AND BIOTIC FACTORS INFLUENCING CAPTURE FREQUENCIES OF WESTERN HARVEST MICE (*REITHRODONTOMYS MEGALOTIS*) IN PRAIRIE GRASSES OF INDIANA

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ABSTRACT. Western harvest mice, *Reithrodontomys megalotis*, are used as a prairie indicator species but low capture probabilities in Indiana may make them unreliable for this purpose at this eastern edge of their range. To increase capture probabilities, researchers have experimented with vertical trap elevation with varying degrees of success. Our objective was to investigate if elevated traps increased captures of *R. megalotis* and to determine if competition for traps with meadow voles, *Microtus pennsylvanicus,* contributes to this pattern. To investigate these questions a 5×6 grid of trapping stations with 15 meter spacing was established in the Purdue Wildlife Area. Three Sherman traps; ground, semi-elevated, and elevated, were placed at each station. Independence of frequency of capture in the vertical strata was compared between these two species using a G-test. We rejected the null hypothesis of independence between trap vertical strata and small mammal species, providing support for the role of competition for traps as contributing to differences in captures of R. megalotis across the vertical stratum. Post hoc tests were then conducted to determine significance in trap comparisons. Significance was found in ground vs. elevated and semi-elevated vs. elevated traps. Surprisingly, 24 captures of *M. pennsylvanicus* were recorded in the higher stratum traps, despite no previous records of captures of this species above the ground. These results suggest when using *R. megalotis* as an indicator species of prairie health in Indiana, investigators should elevate traps.

Keywords: Elevated traps, Indiana, *Microtus pennsylvanicus*, *Reithrodontomys megalotis*, semi-elevated

Western harvest mice (*Reithrodontomys megalotis*) are at the eastern periphery of their range in northwestern Indiana and little research has been conducted on them in Indiana. Ford (1977) hypothesized that *R. megalotis* began its eastward expansion into northwestern Indiana around the 1950s, but the first recorded captures occurred in 1969 near Morocco, Indiana (Whitaker & Sly 1970). Ford (1977) conducted research on the range, distribution, and habitat of *R. megalotis* in Indiana. Leibacher and Whitaker (1998) demonstrated that twenty years later the range of this species in Indiana continued to expand. Whitaker and Mumford (1972) documented reproduction, parasites, and food preferences of *R. megalotis* in Indiana.

Native prairie once extended into northwest and west-central Indiana (Transeau 1935), but land conversion associated with European settlement eliminated prairies from 99.9% of their former range (Samson & Knopf 1994). As of 1994, government agencies had placed less than 0.01% of the remaining prairie under protection (Samson & Knopf 1994). Subsequently, efforts to restore prairies to their native range have increased. To monitor the success of these restorations, biologists look for the presence of indicator species. Western harvest mice are one such indicator species that are associated with prairie-like habitats (Ford 1977). However, low capture success in Indiana make it difficult to estimate abundance and survival rates for *R. megalotis* (Ford 1977), impacting the suitability of this species as an indicator of prairie restoration.

Researchers in Europe and North America have experimented with vertical trap stratification and have demonstrated species specific variation in the use of the vertical vegetative stratum. In a vertical trap experiment, Jensen et al. (2001) observed no captures of *Microtus agrestis* in elevated traps, while three other rodent species exploited the upper vegetation stratum extensively, and two additional rodent species exploited that stratum to a lesser degree. Cummins and Slade (2007) reported higher

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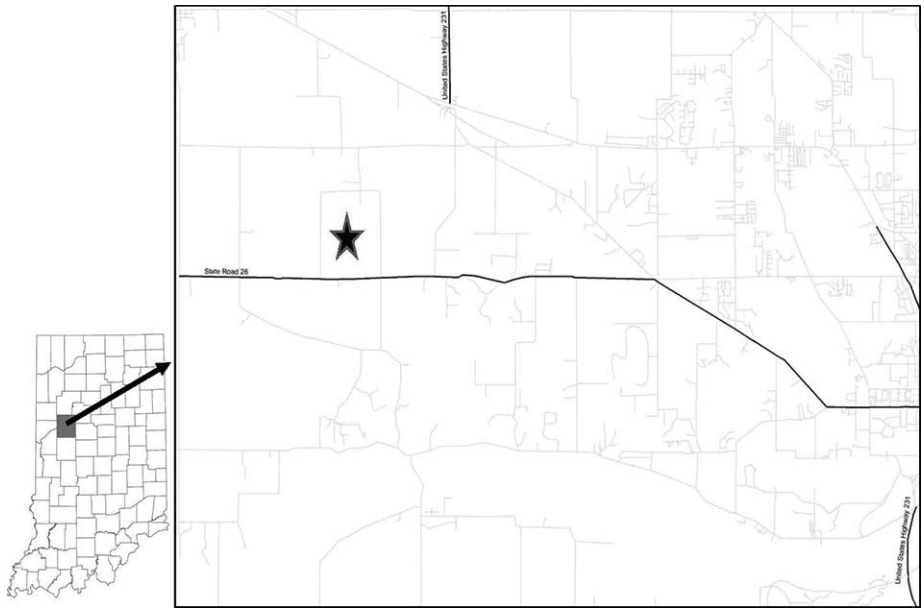

Figure 1.—The star indicates the location of the study site in relation to the closest major city in Tippecanoe county, Lafayette/West Lafayette.

captures of *R. megalotis* in elevated Sherman traps. Their research demonstrated that traps on platforms had higher success rates when compared to traps on the ground (Cummins & Slade 2007). Johnson and Gaines (1988) introduced vertical traps into their experiment to increase captures of *R. megalotis* with mixed success. Increasing probability of capture is important if *R. megalotis* is to be used as a reliable indicator species and if we are to learn more about its ecology in Indiana.

One proposed explanation for increased trapping success in elevated traps is *M. pennsylvanicus* outcompetes *R. megalotis* for traps on the ground (Meserve 1977; Johnson & Gaines 1988; Jekanoski & Kaufman 1995). In this context competition for traps means that *M. pennsylvanicus* are being captured in traps on the ground and precluding *R. megalotis* from access to this trapping stratum. An alternative explanation is that *R. megalotis* spends so much in the grass canopy that they do not often encounter traps on the ground. Our primary objective is to determine if competition for traps between these two species is influencing capture success of *R. megalotis* in elevated traps. To investigate this we will test for independence of captures of these two species across three vertical strata because we could find no records of captures of *M. pennsylvanicus* in elevated traps. We predict that if competition for traps is influencing this phenomenon then we should statistically reject a null hypothesis of frequency of captures at each strata as independent of species.

METHODS

Study site.—Our study was conducted at the Purdue Wildlife Area (PWA), a research property located in the Central Till Plain of Tippecanoe County, Indiana (Fig. 1). In 2003, a prairie restoration project converted portions of the Purdue Wildlife Area from invasive brush and agricultural land to native tall grass prairie and savannah (Benage 2007). The portion of the property where this research occurred is characterized by native prairie on a 6–7 year burn regime. This property was chosen because of its proximity to campus and a history of capturing more than two western harvest mice per year for three years prior to our experiment.

Data collection.—A 5×6 grid of trapping stations was established in the northern portion of PWA. Trapping stations had 15 meter spacing. Three Sherman traps were placed at each station. A vertical trap was placed on a wooden platform elevated off of the ground by a 0.5m wooden stake and level with the surrounding prairie grass. The semi-elevated

Figure 2.—A typical trapping station set up with three Sherman traps in different positions, ground, semi-elevated, and elevated.

trap was placed against the stake at a 45° angle with the door opening upwards. The third trap was placed on the ground at the base of the wooden stake (Fig. 2).

Traps were checked each morning and evening. For each captured animal the species, age, sex, weight, and trap position of capture were recorded. Each animal was given a uniquely numbered ear tag and released. Following identification recaptured animals had the aforementioned characteristics re-measured and were released. All trapping and handling of small mammals was consistent with American Society of Mammalogists guidelines (Gannon & Sikes 2007) and described in Purdue Animal Care and Use Protocol (07-032).

Statistical analysis.—To determine if the pattern of captures of *R. megalotis* was independent of trap position (elevated, semi-elevated, ground) we conducted a G-test to compare observed frequencies of *R. megalotis* captures in each trap position with a null expectation of even distribution of captures across all three trap positions. We then conducted post hoc tests on the three pairwise comparisons (Table 1) using Gardner and MacDonald's Bonferroni-corrected pairwise technique (2000), substituting their Chi-square test for Fisher's exact test, given our small sample size.

Table 1.—Frequency of captures for *R. megalotis* and *M. pennsylvanicus* with the resulting P-value for each pairwise comparison. G = Ground, SE = Semi-elevated, E = Elevated, M.pen = *M. pennsylvanicus* R.meg = *R. megalotis.*

	M. pen	R. meg	P-value
G	34	5	0.6739
SE	13	1	
G	34	5	2.7285E-05
E	1	8	
SE	13	1	1.5541E-04
E	1	8	

RESULTS

We recorded 14 captures of *R. megalotis*, 7 individuals, and 48 captures of *M. pennsylvanicus*, 22 individuals, in 900 trap nights. With a high degree of statistical significance (G = 42.7533, df = 2, P-value = 5.2028E-10) we rejected the null hypothesis that the frequencies of captures of individuals across these three strata was independent of species. Of the three pairwise comparisons ground vs. elevated and semi-elevated vs. elevated were significant, (P-value = 2.7285E-05, P-value = 1.5541E-04), respectively (Table 1).

DISCUSSION

Our primary objective was to determine if competition for traps with *M. pennsylvanicus* influences capture success of *R. megalotis* in elevated traps. Our findings are consistent with the observations of Cummins and Slade (2007) that elevating traps increase captures of *R. megalotis*. Our data suggests that the underlying factors may be a combination of competition with *M. pennsylvanicus* and the foraging behavior of *R. megalotis*. Despite these results our observations were based upon a small population size.

Previous researchers have shown that the introduction of vertical traps have had success in increased capture success of *R. megalotis* (Slade & Cummins 2007; Johnson & Gaines 1988). Our data has found support for these claims. After conducting the post hoc test on ground vs. elevated traps significance was found. This supported our initial assumption of selection of elevated traps by *R. megalotis*.

Our experimental design assumed that *M. pennsylvanicus* would have no access to semi-

elevated and elevated traps. We based this assumption upon previous research (Pagels & Wright 1977; Manson & Ostfeld 1996; Jensen et al. 2001) which found *Microtus spp.* exhibits the ability to climb sturdy vegetation and man-made wiring but no evidence of capture in elevated traps. Surprisingly, we recorded 23 captures of *M. pennsylvanicus* in semi-elevated traps and one capture in an elevated trap. We believe that *M. pennsylvanicus* utilized the trap and compacted vegetation to gain access to semi-elevated traps and the wooden stake to access the elevated trap. Johnson and Gaines (1988) hypothesized that *R. megalotis* utilizes the vertical stratum to avoid voles which results in trap avoidance in the lower stratum. We recorded one capture of *R. megalotis* in semi-elevated traps, which leads us to believe that the presence of *M. pennsylvanicus* in this stratum may have affected capture probabilities of *R. megalotis*. This assumption is supported by the Fisher's exact test comparing the semi-elevated and elevated trap positions which show selection by *M. pennsylvanicus* is influencing avoidance by *R.* megalotis in this stratum.

In conclusion, we have found that *R. megalotis* populations in Indiana exhibit similar behavior as other populations within its range. Our experiment was consistent with our hypothesis of competition for traps with *M.* pennsylvanicus as a mechanism contributing to disproportionate captures of *R. megalotis* in elevated traps. Additionally, our results reinforce observations made by Cummins and Slade (2007) that elevating traps increases capture success of *R. megalotis*. Such increases in capture success can have profound implications for abundance estimates, (Jensen et al. 2001) and therefore practical implications for how best to utilize *R. megalotis* as indicator species of prairie restorations.

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