Looking at the 'Vole' Picture: An Assessment of Distribution of Prairie Voles (*Microtus ochrogaster)* and Eastern Meadow Voles *(M. pennsylvanicus)* in Restored Prairies of East-Central Illinois

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INTRODUCTION

Two species of voles, the prairie vole (*Microtus ochrogaster*) and the Eastern meadow vole (*M. pennsylvanicus*), inhabit restored prairies in East-Central Illinois. The two species are often morphologically indistinguishable in the field, making accurate identification challenging without genetic confirmation. Though similar in appearance, these species are genetically distinct and exhibit varying social behaviors, dietary preferences, and ecological roles.

This study uses statistical models and visualizations to identify patterns in their distribution by analyzing capture rates, mass at capture, and age demographics across a latitude gradient of nine restored prairies. Voles serve as a major food source for many predators, play a role in soil nutrient cycling, and act as seed dispersers. Given the highly threatened status of Illinois prairies, understanding the distribution of these species is critical for informing conservation strategies and policy.

RESEARCH QUESTIONS

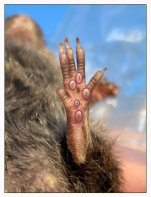
1. How does the distribution and spatial overlap of *M. ochrogaster* and *M. pennsylvanicus* vary across a latitudinal gradient?
2. What are the implications of these patterns for prairie conservation and ecosystem management?

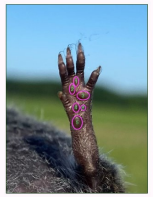
SPECIES IDENTIFICATION

Common methods for identifying vole species have significant limitations. Dental analysis requires lethal sampling, fur coloration is subjective, and counting mammae is difficult in non-lactating or immature voles.

More Practical Method

In this study, species were differentiated based on the **number of toe pads (plantar tubercles)** present on the hind foot.





Left: M. ochrogaster *identified by the presence of five plantar tubercles.*

Right: M. pennsylvanicus *identified by the presence of six plantar tubercles.*

While this method is recognized as efficient and non-invasive, it is also considered **less reliable** due to natural variation and observer error. PCR analysis confirmed only **75%** of captures were identified correctly.

METHODS

Field Collection

Voles were live-trapped from late May to early October (2024) across 21 sites.

Data Collection

Individuals were recorded by site, species, age class (juvenile/adult), and season at capture. Body mass was measured for each individual. Tissue samples from the ear were collected from 120 specimens.

Left: Microtus *caught in a live trap.*

Right: A tissue sample extraction from the ear of a specimen.

Data Processing and Cleaning

Used R and packages, such as ggplot2, dplyr, and readr, to engineer new usable features such as encoding and parsing categorical variables into numerical variables for analysis.

Statistical Analysis

Performed a 3-Way ANOVA test for effects of latitude based on species, age, and body mass, including interaction terms. The dataset was split by age to compare effects of variables separately for juveniles and adults using two-way ANOVA models. Generated residual plots to check model assumptions.

Visualizations

Created bar plots of species frequency by site to effectively visualize trends in data.

RESULTS

To assess latitudinal effects on body mass, we analyzed juveniles and adults separately using latitude as a predictor and mass as the response.

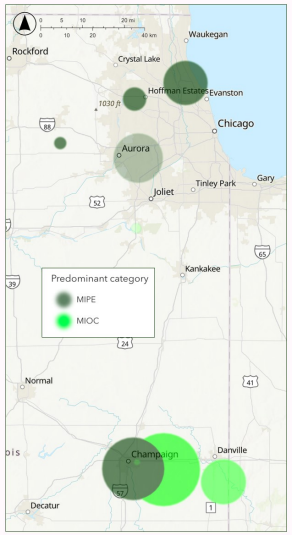
Juveniles

- Juvenile mass showed **no** significant variation by species, latitude, or their interactions.
- This suggests that both species **exhibit similar body mass** regardless of their geographical location.

Adults

- Both species and latitude **significantly** influenced body mass, which varied greatly across latitudinal gradient.
- There was no interaction between species and latitude, indicating **both species show similar patterns of mass change.**

RESULTS (continued)



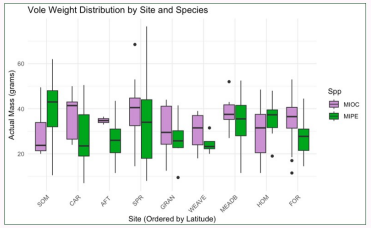
Geographic distribution and relative prevalence of captures of *Microtus pennsylvanicus* (MIPE; dark green) and *Microtus ochrogaster* (MIOC; neon green) across nine restored prairie sites in Illinois. Color transparency indicates relative species prevalence at each location, with more opaque areas representing higher capture rates of that species.

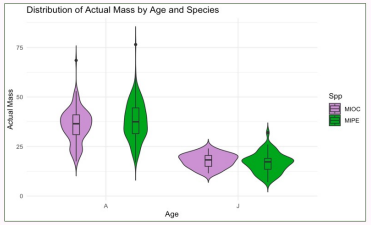
	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Spp	1	23.5	23.463	1.136	0.290
Y_coordinate	1	0.6	0.571	0.028	0.868
Spp:Y_coordinate	1	19.6	19.570	0.948	0.333
Residuals	84	1734.6	20.649		

Juvenile ANOVA (Mass ~ Species * Latitude)

	Df	Sum Sq	Mean Sq	F value	Pr(>F)	
Spp	1	398	398.0	4.951	0.02675	*
Y_coordinate	1	778	777.6	9.675	0.00203	**
Spp:Y_coordinate	1	0	0.0	0.000	0.99619	
Residuals	330	26525	80.4			

Adult ANOVA (Mass ~ Species * Latitude)





CONCLUSIONS

Our geographical results indicate significant variability in the distribution between the two species, though these ranges are different from those of prior studies.

- *M. pennsylvanicus* appears to have a **northward** distribution.
- *M. ochrogaster* may have a **southward** distribution.
- The presence of a MIPE-dense population in Champaign county is of great interest.

Our statistical analysis suffered due to a small sample size. With a greater sample size, analyzing variables, such as mass, may yield more consistent results.

FUTURE DIRECTION

To better test statistical significance, future data requires a larger, more consistent sample size and a wider range of sampled prairie sites across different regions of Illinois.

Future research can further explore vole populations in urban versus rural areas to determine whether one species shows a stronger preference for either landscape type, and how these preferences influence their distribution, habitat use, and potential for spatial overlap.

Continued funding for research is crucial to inform conservation efforts, guide habitat restoration, and ensure long-term protection of vole populations in Illinois.

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