Empirical modeling of vole habitat suitability in a restored tallgrass prairie

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Introduction

Edge effects are commonly cited as a source of biodiversity loss in fragmented habitat, through factors including increased predation rates and predator avoidance (Lidicker 1999)(Pusenius and Schmidt 2002).

Previous study of voles in the Arb

- Recorded voles (*Microtus spp.*) with baited camera traps at 70 points in our study area, the tallgrass prairie of the Carleton College Cowling Arboretum (“the Arb”) (Freymiller et al. 2014)
- Found an unusual edge effect: voles favored middle distances (8 and 16 m) over close (0, 2, and 4 m) and far (32 and 64 m).

This edge effect is inconsistent with the hypothesized mechanism (human and dog avoidance), which would predict vole frequency to increase with distance. We set out to perform further spatial analysis to reveal whether other spatial variables are confounding or are responsible for the observed edge effect pattern.

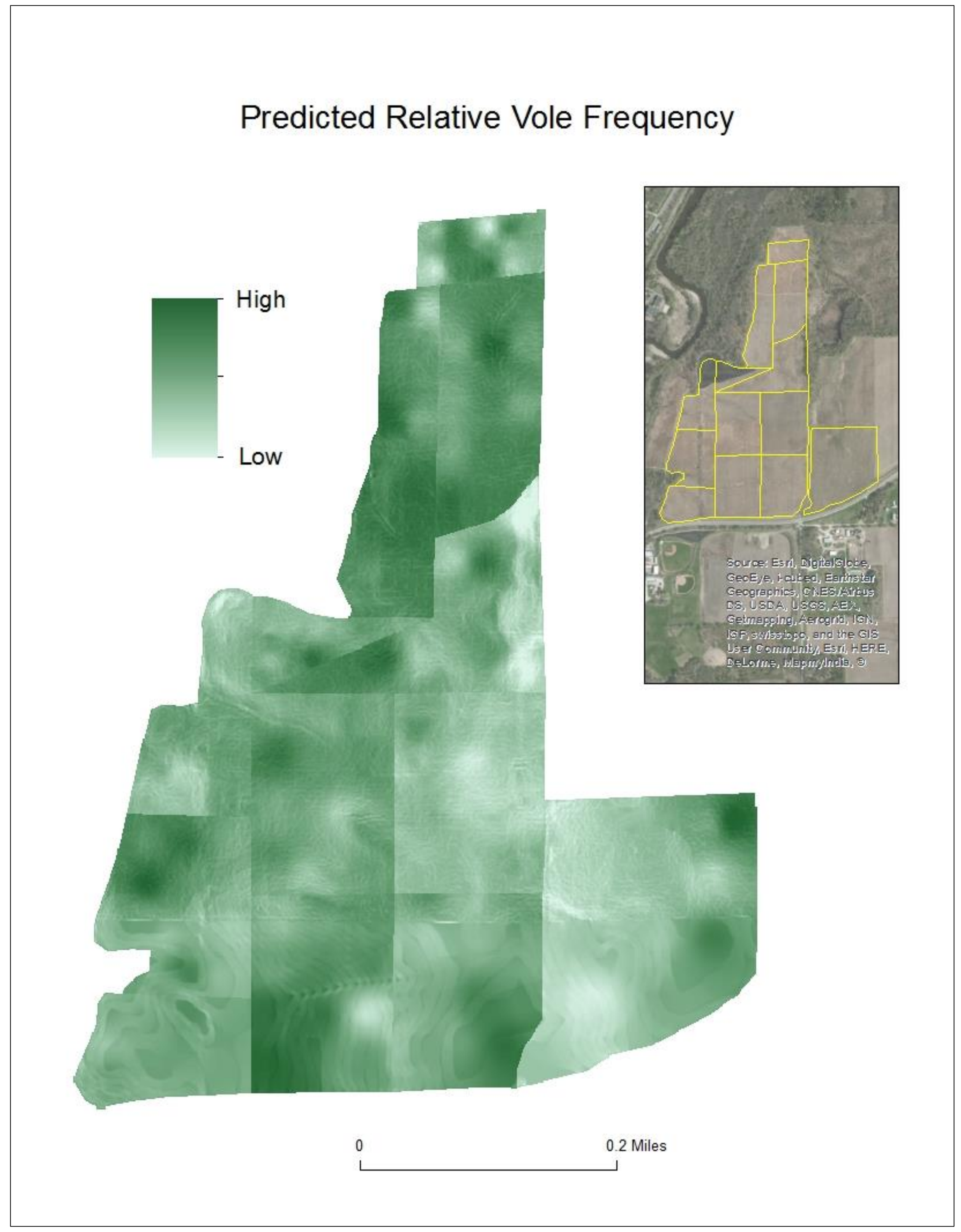
Research questions

1. What is the importance of trail edge effects on vole frequency relative to other spatial habitat variables?
2. Given what we find about vole habitat preferences and the Arb landscape, what vole frequencies do we expect throughout the study area?

Methods

1. Determining the impact of spatial variables
   - Data collection and processing: See Table 1.
   - Multivariate regression
     - We used Exploratory Regression (ArcMap) to run all possible regression models. From the models with the highest R^2 value (0.14), we selected the model with the lowest AICc (90.49).
       - R^2 gives the percentage of variance accounted for by the model. A low AICc indicates the model explains the highest percentage of variability with the fewest variables.
     - We calculated variable coefficients using regression analysis (R).
2. Predicting relative habitat suitability
   - Input coefficients in Raster Calculator (ArcMap) to develop a predicted frequency surface.

Results



The formula used to produce this map was

Vole Frequency = - 0.026681 (Slope) + 0.014624 (Percent Grass Cover) - 0.386852

References

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Table 1. Initial inputs to the habitat model.

Variables			Methods and notes
Independent	Edge	**Distance from trail**	Euclidean distance from nearest walking trail.
Independent	Vegetation	**Species richness**	Surfaces interpolated from 143 sample points. • Inverse distance-weighted • i = 2 (standard) • n = 4 • strong local influence reflects patchy vegetation • 4 points reflects grid pattern of sample points • Interpolation constrained to planting year.
		% C3 grass	
		% C4 grass	
		% Total grass	
		% Legumes	
		% Forbs	
Independent	Management	**Planting year**	The year the prairie (formerly in agriculture) was seeded with native plants.
		Summers since last burn	Deeper litter could facilitate predator avoidance and nest building.
Independent	Topography	**Elevation**	DEM model.
		Slope	Calculated from Elevation.
		Aspect	Calculated from Slope.
Dependent	Habitat suitability	**Vole frequency**	Number of vole sightings per hour (from motion-activated cameras). Reflects vole-hours spent rather than number of individuals: nuanced metric of habitat suitability.

Discussion

- The predicted frequency map was created using a formula derived from frequency of vole visits to baited traps per hour. While it isn’t possible to predict actual vole frequency values using these data, we have used the map to predict relative probability of vole presence.
- When we took into account additional variables, distance from trail was not significant in any resulting model.
- Our best model incorporated only percent grass cover (P=0.000689) and slope (P=0.116053). However, this model only explains 14% of variation in vole frequency.
- The regression performed was only capable of predicting the linear impact of independent variables on vole presence. It is possible that there is an edge effect trend which follows a non-linear formula, but we have no empirical data to suggest what that formula might be.

Acknowledgments

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