Land Use Predicts Presence of Bat Species in Iowa

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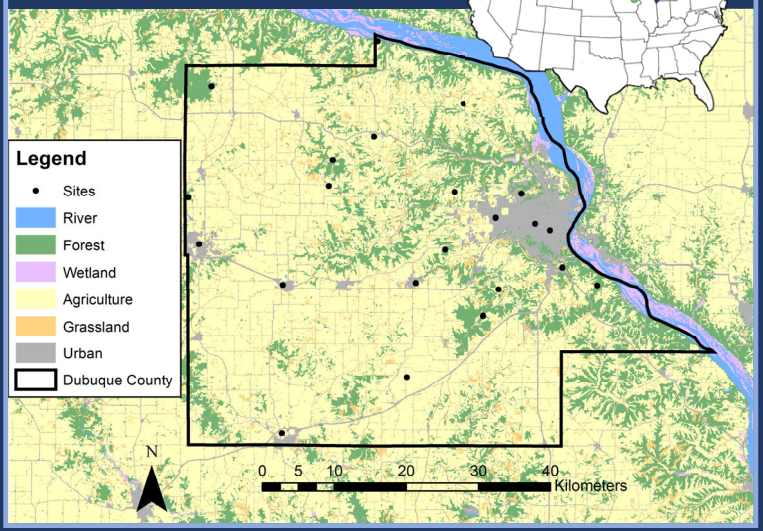
BACKGROUND

Bat species in the midwestern United States are vulnerable to population declines due to wind turbines, White-nose syndrome, habitat fragmentation, and climate change. There are 9 species of bats that have historically been documented in Dubuque County, Iowa: *Eptesicus fuscus, Myotis lucifugus, M. septentrionalis, M. sodalis, Perimyotis subflavus, Lasiurus borealis, L. cinereus, Lasionycteris noctivagans,* and *Nycticeius humeralis.* To determine how weather and the landscape impact detection and occupancy of these species, we ran models on data we collected acoustically. These models can inform management strategies of each species and maintain valuable bat ecosystem services.

Figure 1. Map of Sites in Dubuque County



METHODS

- We used SM4BATFS acoustic recorders and U2 microphones from Wildlife Acoustics to record bat activity at **22 sites** throughout Dubuque County (Fig 1). Each site was sampled on **4 nights** for a total of **88 sampling nights**.
- Nightly weather data were acquired from NOAA and include:
  - Maximum daily temperature
  - Minimum nightly temperature
  - Maximum humidity
  - Moon phase
  - Maximum windspeed
  - Julian date
- Landscape data were acquired using ArcGIS and a USGS dataset and include **distance** to types of land use and **proportion** of each type of land use within a 500 meters of the sampling site. The 6 types of land use included are:
  - Agriculture
  - Forests
  - Grasslands
  - River
  - Urban
  - Wetlands
- We ran models in Program Presence (USGS) to determine how variables predict detection and occupancy probabilities for each species.

RESULTS

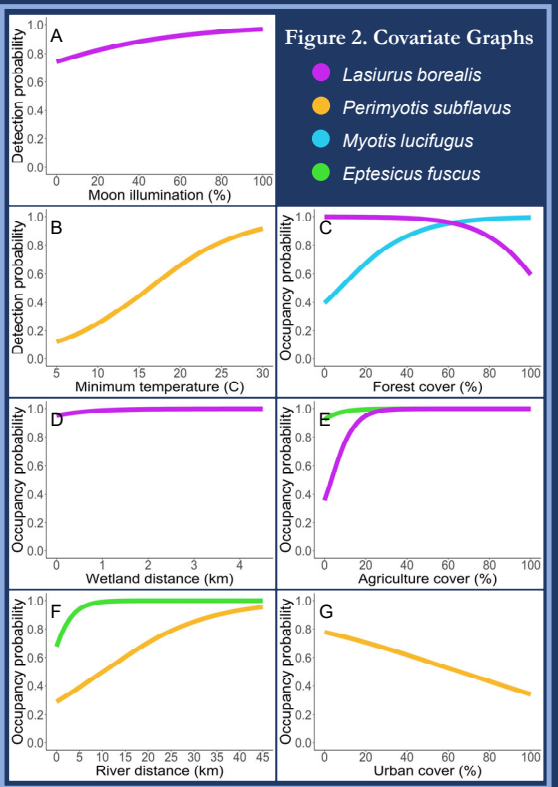
- All 9 species were identified in the county (18399).
- We ran models for 4 of 9 species (Table 1). Five species were detected too frequently or too rarely.
- Detection and occupancy models included 2 weather and 5 landscape variables.

Table 1. Detection and Occupancy Models

Detection	*Lasiurus borealis*	*Perimyotis subflavus*	*Myotis lucifugus*	*Eptesicus fuscus*
Moon illumination	+			
Minimum temperature		+		
Occupancy				
Agriculture cover	+			+
Forest cover	—		+	
Urban cover		—		
River distance		+		+
Wetland distance	+			

\+ indicates positive relationship — indicates negative relationship

Figure 2. Covariate Graphs



DISCUSSION

	Trait	Ecology	Result
❖ *Lasiurus borealis*	Migratory	Uses light to navigate	Detected with more moonlight (Fig 2A)
	Long, thin wings	Flies in open areas	Occupied unforested areas (Fig 2C)
	Relatively large	Eats large insect pests	Occupied agricultural areas (Fig 2E)
	Occupied areas far from wetland, though effect is minimal (Fig 2D)		
❖ *Perimyotis subflavus*	Very small	More difficult homeostasis	Detected with high temperature (Fig 2B)
		Eats small insects	Occupied non-urban areas (Fig 2G)
	Most urban areas are near the river (Fig 1)		Occupied areas far from river (Fig 2F)
❖ *Myotis lucifugus*	Relatively small	Eats small forest insects	Occupied forested areas (Fig 2C)
❖ *Eptesicus fuscus*	Relatively large	Eats large insect pests	Occupied agricultural areas (Fig 2E)
	More agricultural land is located further from the river (Fig 1)		Occupied areas far from river (Fig 2F)

CONCLUSIONS

- Weather predicted detection probability in 2 species models.
- Bat occupancy for all species is predicted by different land use types.
- Habitat preferences are related to species ecology, particularly prey availability and vegetative clutter.
- Unique bat ecologies demand unique management strategies.
- Multiple detections of *Myotis sodalis* and *Myotis septentrionalis* warrant further efforts to capture and identify these bats in Dubuque County to grant their preferred habitats Federal protections.

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