



Relationships Between Land Cover and Small Mammal Presence in Barn Owl (*Tyto alba*) Pellets

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Introduction

Small mammal biodiversity contributes to natural revegetation processes, insect population control, and predator species population dynamics (Power et al., 1996, McCaffery et al., 2020). Globally, the escalation of urbanization and agriculture can reduce biodiversity (Gonthier et al., 2014). The use of owl pellets (regurgitated remains of consumed prey; Figure 1) can facilitate understanding of small mammal community dynamics (Heisler et al., 2016). The objective of this study was to determine how landcover, such as development and croplands, influenced the presence of small mammal communities found in Barn owl (*Tyto alba*) pellets.



Figure 1. Barn owl nest box and pellets. Skull dissected from Barn owl pellet.

Methods

We collected Barn owl pellets from nest box locations in Pennsylvania (Figure 2). Pellets were air dried and dissected at Millersville University (Figure 1). We focused our analysis on percentage of mice, shrew, and vole skulls per location. We used QGIS (www.qgis.org) to determine landcover area within a 3km² Barn owl hunting radius around each location (Purger & Szép., 2021; Figure 2). Landcover data was obtained from the National Land Cover Database (USGS 2019) and included forest, developed land, wetland, pasture, shrub/grassland, and cropland (Figure 3).

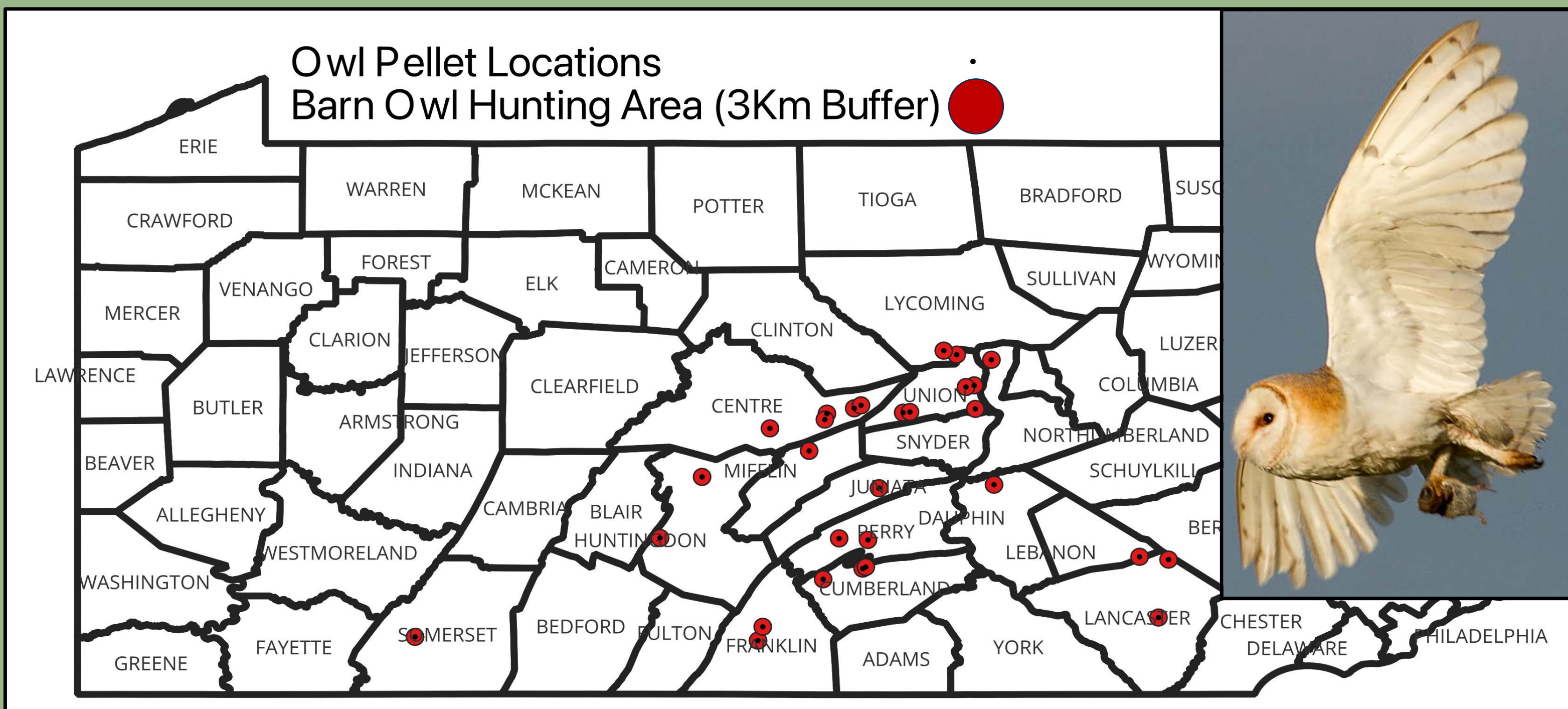


Figure 2. Barn owl pellet collection locations surrounded by a 3km² Barn owl hunting radius.



Figure 3. Examples of land cover types: Developed, Forest, Cropland, and Pasture.

Analysis & Results

We isolated 4,279 mammal skulls from all nest box locations, with 79% of skulls identified as voles, 6% Mice and 14% Shrews. We used general linear regression models in the R statistical program (R version 4.2.3 2023) to determine which landcover types were most associated with percentage of mammal skulls. Models of best fit were determined by lowest AIC and BIC scores (Table 1). Based on our models, we found a lower percentage of vole skulls associated with cropland and pasture (Figure 4), and a lower percentage of shrew skulls associated with cropland, developed land, and forest (Figure 5). A higher percentage of mouse skulls were associated with cropland, developed land, and pasture, with a lower percentage associated with forest (Figure 6).

Table 1. Landcover types most associated with percentage of mammal skull type.

Mammal Skull	Land Cover Type	Estimate	P-value	AIC and BIC
Vole	Pasture	-1.58	0.02	197
	Crop	-0.63	0.14	
Shrew	Developed	-1.93	0.15	188
	Forest	-1.11	0.06	
	Crop	-0.73	0.11	
Mouse	Developed	9.87	0.06	190
	Forest	-9.58	0.05	
	Pasture	9.64	0.04	
	Crop	9.84	0.05	

Discussion

This is the first United States study to associate small mammal community structure to land cover based on Barn owl pellet analysis. Similar studies in Europe also found a higher percentage of vole skulls in Barn owl pellets (Szép et al., 2017; Riegert et al., 2021; Horváth et al., 2022), and Bontzorlos et al., (2023) found that the percentage of vole skulls decreased as area of pasture cover increased. We found that shrews were less associated with pasture and cropland, while mice showed a positive association. In Europe, Battisti et al., (2019) reported that the use of chemical products caused an increase in mice and a decrease of shrews in agricultural areas. Since some of our models had weak relationships (p-value > 0.05), we recommend that future efforts utilize a Barn owl hunting radius of 2km² around nest box sites, which may better represent landcover preference of small mammal prey (Szép et al., 2019).

Acknowledgements

Annabel Kaufman, Dan Mummert, and Hunter Slear

References:
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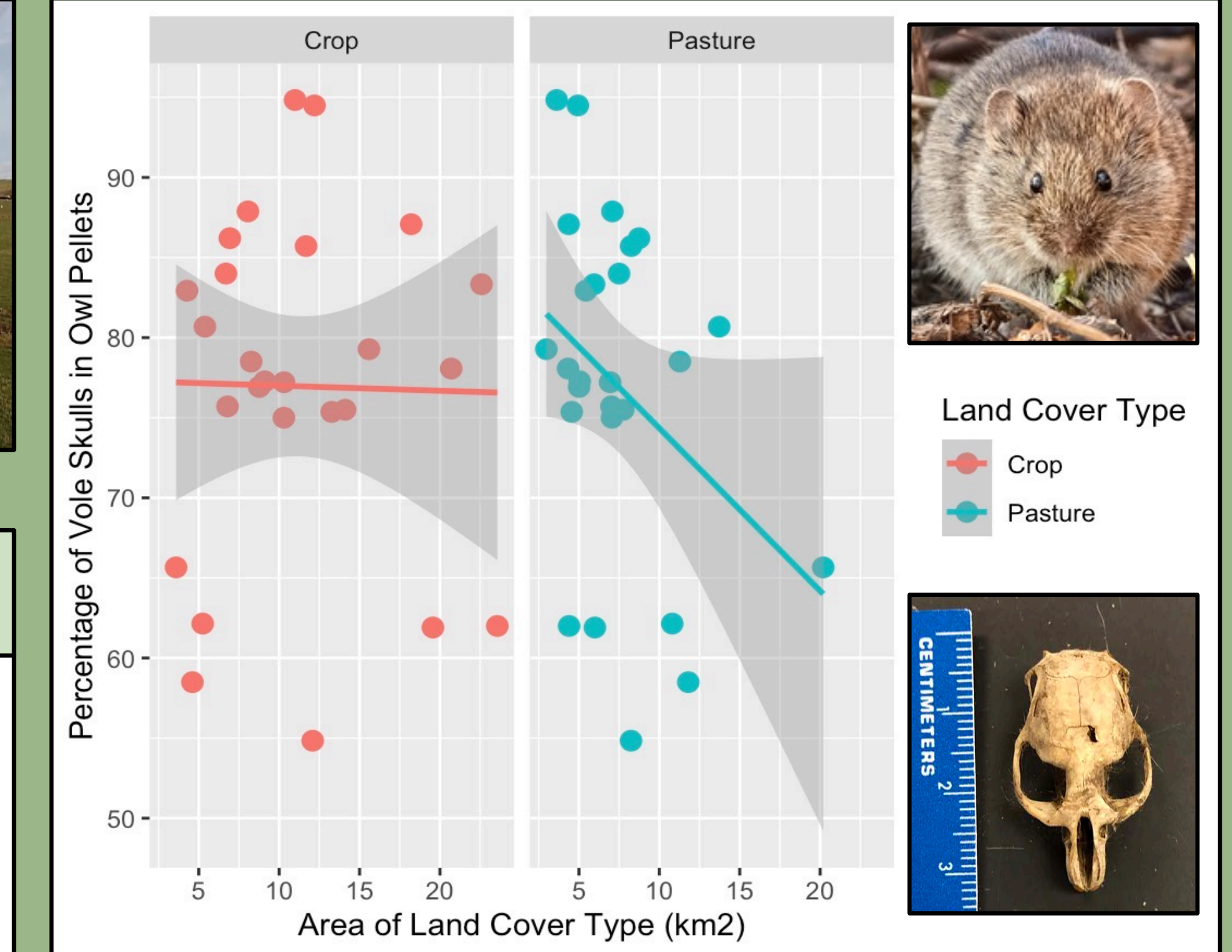


Figure 4. As area of cropland and pasture increased, percentage of vole skulls found in Barn owl pellets decreased.

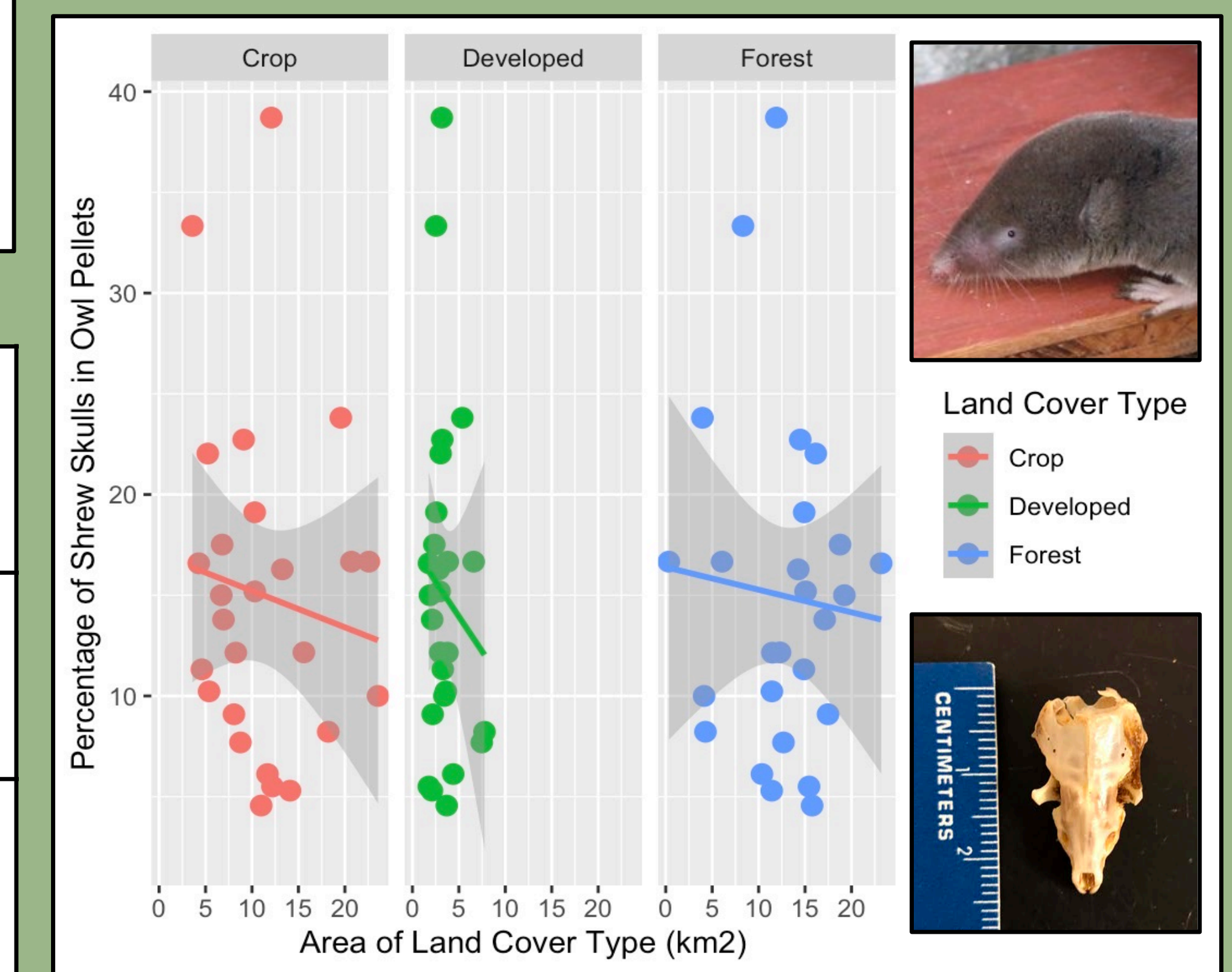


Figure 5. As area of cropland, developed, and forest increased, the percentage of shrew skulls found in Barn owl pellets decreased.

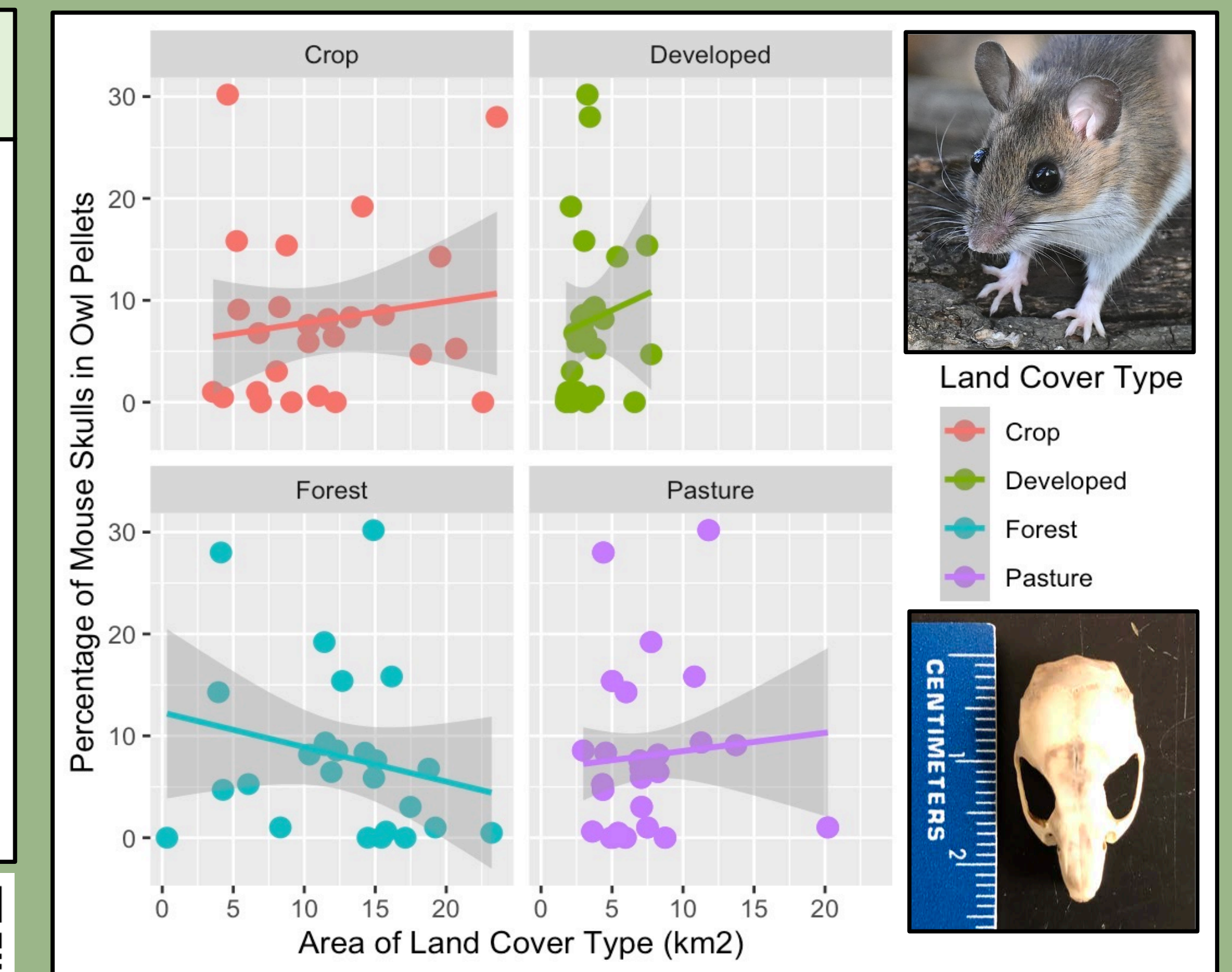


Figure 6. As area of cropland, developed, and pasture increased, percentage of mouse skulls found in Barn owl pellets increased. As area of forest increased, percentage of mouse skulls decreased.