# Artificial Roost Use & Emergence Phenology of Indiana Bats

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## Introduction

Artificial bat roosts are important for the conservation of at-risk bat species[1]. The loss of natural roost structures has been linked to lower reproductive success within some bat species[2]. Therefore, it is necessary, in some cases, to supplement natural roosting habitat with artificial roost structures. With the use of artificial roosts is becoming more common, it is important that these roosts are assessed so that more informed decisions can be made for bat conservation efforts.

Passive monitoring is a necessary and useful tool for monitoring at-risk species, as it permits little to no direct contact with the species. One way that passive monitoring can be performed is through fecal collection. Fecal data has been used to assess roost presence, define diet, explore phylogenetics, and relatedness[3,4,5]. Another way in which roosting bats may be monitored is through emergence counts. Using this method, it is possible to define the nightly activity patterns for a bat species. Given the relationship between foraging ecology and bat health and physiology, it's important to understand the nightly phenology of bats in a post-White-nose Syndrome landscape.

The objectives of this study were: 1) determine if guano presence can be a useful indicator of bat occupancy rates, and 2) determine if bat emergence is influenced by environmental and/or physiological factors. I hypothesized that there would be a positive correlation between the amount of guano at a roost and a corresponding emergence count at that roost, and that bats would emerge predictably in relation to weather conditions and reproductive condition.

## Methods

This study was conducted at Veteran's Memorial Wildlife Management Area in Scott County, KY. This area possesses artificial Brandenbark™ roost clusters with documented roost use from the federally-endangered Indiana bat (*Myotis sodalis*), as well as newly-installed "rocket box" style artificial roosts currently being considered as part of a master's thesis (Figure 1)[6].

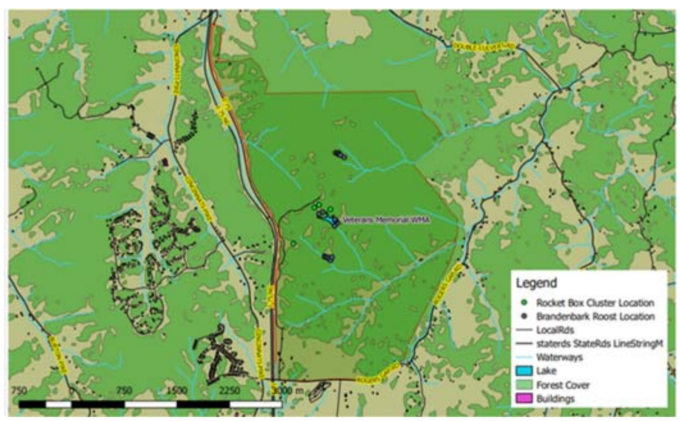

Figure 1. Map of Veteran's Memorial Wildlife Management Area.

Guano collection was conducted from May 24 to July 12 of 2019. Guano traps were deployed at each roost cluster (34 traps total). Roosts were visited 3 to 4 times weekly over the course of the study, with guano pellets counted and collected from each roost as weather permitted. Once guano was collected, it was stored at -80°C until thawed, dried (65°C for 8 hours), and weighed (g).

Emergence data was collected from April 10 to July 12 of 2019. Emergence counts were conducted 3 to 4 times weekly, with 1 to 3 counts performed on nights that weather permitted. During exit counts, time of first emergence was noted (relative to minutes after sunset), as well as time of last emergence, and total count of bats emergins from the roost.

The first objective was visualized using GG-plot via R-studio. A Shapiro-Wilk Normality Test was performed to assess the normality of emergence data, and a Spearman's Correlation Test was conducted to assess the strength of the correlation between the emergence data and the guano measurements.

For the second objective, we constructed a generalized linear model (GLM) for the time of first emergence. Predictor variables in the model included: reproductive period (pregnant or lactating), box type (Rocket or Brandenbark™), mean daily temperature (°C), and mean daily solar radiation (w/m$^2$), as measured by an on-site weather station.

## Objective 1 Results and Discussion

We surveyed across 15 nights and collected 33 paired emergence count and guano count/mass observations (Figure 2). We determined that distributions of both the guano count and mass data were non-normal via the Shapiro-Wilk Normality Test. We found that emergence data correlated with both pellet counts ($S = 215.2$, $p < 0.001$, $r_s = 0.96$) and guano mass ($S = 193.4$, $p < 0.001$, $r_s = 0.97$).

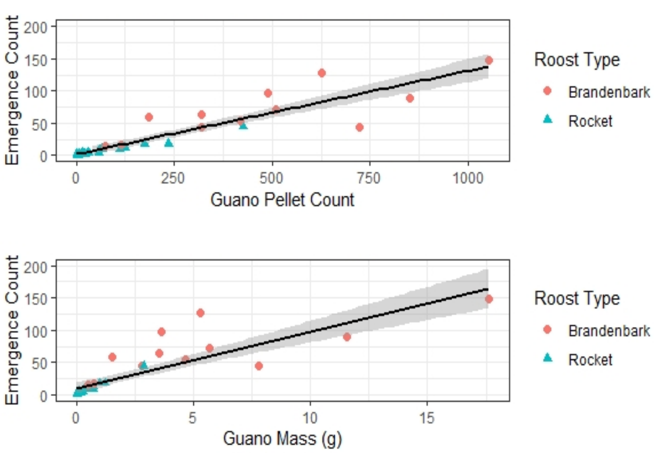


Figure 2. Relationship between guano collection and emergence.

This methodological study is important; we determined that guano quantity can allow estimation of colony size. However, it is important to note that both guano predictors lost accuracy with increasing colony size. Based on our study, we would recommend using guano pellet counts as a means to estimate roost use for smaller-sized colonies, as pellet counts require less effort than collecting, drying, and weighing guano.

## Objective 2 Results and Discussion

We surveyed across 37 nights and collected data across 67 emergence events. Based on our GLM, we found that multiple predictors impacted the timing of first emergence.

Table 1. Parameter estimates of the phenological model.

| Predictor | Parameter Estimate | Standard Error | p-value |
|---|---|---|---|
| Repro Cond. (Pregnant) | 11.32 | ±1.92 | <0.001 |
| Roost Type (Rocket) | 9.04 | ±1.58 | <0.001 |
| Mean Solar Rad. (w/m$^2$) | 0.002 | ±0.007 | 0.83 |
| Mean Temp. (°C) | 0.83 | ±.25 | 0.001 |

From our model, we found: pregnant bats emerged later than lactating bats, bats in rocket boxes emerged later vs. bats in Brandenbark™, and finally bats emerged later at high temperatures. These data demonstrate that nightly phenology is influenced by a variety of factors. It is important to understand these relationships because energetic expenditure based on reproductive condition, predator avoidance, and microclimates within the roost can influence behavior.

## References

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