CURRENT STATUS
Second year of a two-year project

FUNDING SOURCES AND PARTNERS
Endangered Species Grant Program (E18R1)
Purdue University

PROJECT PERSONNEL
Dr. Patrick Zollner, Principal Investigator, Purdue University
Dr. Laura D’Acunto, Co-Principal Investigator, Purdue University
Cheyenne Gerdes, Graduate Student, Purdue University

BACKGROUND AND OBJECTIVES
The fungal disease white nose syndrome (WNS) has caused the death of millions of bats in North America with local extirpation of some species expected as a result. Such dramatic losses have made it increasingly important to understand factors that inform effective bat conservation strategies. Research on WNS is ongoing, and protection of critical hibernation caves has been enhanced in many areas. However, addressing the resource needs of bats during the summer reproductive season remains a crucial element in preserving these species. In particular, the threatened northern long-eared bat (Myotis septentrionalis), is of conservation concern.

Our study is developing insights into the resource needs of northern long-eared bats in landscapes in which forest habitats are less abundant and often fragmented. Several studies have shown that landscape-scale effects have a strong influence on northern long-eared bats and this species is associated
with forested landscapes. Most of the current research on northern long-eared bats in Indiana occurs in the southern part of the state. Given the dramatic differences between the forested landscapes in southern Indiana and the agriculturally dominated region of northern Indiana, there is a clear need to evaluate the relevance of established insights and models to northern Indiana. Models created with data from only agricultural landscapes may suggest different management strategies for northern long-eared bats in fragmented landscapes.

The objective of this project is to use information from mist-netting and acoustic monitoring to build predictive models of habitat suitability for the northern long-eared bat in environments with limited or fragmented forest habitats.

**METHODS**

Mist-netting was conducted using standard federally accepted protocols. Nets were set before sunset, opened near sunset, and remained open for at least five hours. Nets were checked at a minimum of 10-minute intervals, and any captured bats were immediately removed for processing. The location, net, and time of capture were recorded for each bat. Additional data were recorded, including species, sex, age class, reproductive status, body weight, forearm length, and a wing score to determine if bats had been infected with WNS.

Additional information was obtained using detectors that record the ultrasonic echolocation calls emitted by bats. Detectors were set before sunset, and bat calls were recorded from 6 p.m. until 6 a.m. each day detectors were in the field. Echolocation calls were classified to species level using the program EchoClass (Version 3.1). Due to similarities between the calls of some species, some bat passes were unable to be identified and were classified as unknown.

To develop models that predict where northern long-eared bats may be found, we analyzed historical data with cutting-edge statistical techniques. The historic records of northern long-eared bat detections and roost locations were provided by the U.S. Fish & Wildlife Service for Illinois, Indiana, and Ohio. Three modeling
tools (MaxEnt, MaxLike, RandomForest) were integrated to predict northern long-eared bat habitat suitability areas where forest is common as well as areas where forest is rare. Predictor variables for these models are percent forest cover within 90 meters and within 1 kilometer, distance to the nearest road, distance to the nearest major road, distance to the nearest annual stream, and distance to the nearest perennial stream.

**PROGRESS TO DATE**

From May 15 to August 15, 2017, 59 sites on 14 properties were surveyed for northern long-eared bats, resulting in 132 total net-nights. From May 15 to August 15, 2018, 14 sites on eight properties were surveyed, resulting in 35 total net-nights. Collectively, during both field seasons, sampling occurred over 167 net-nights. Net sites included forest patches, riparian areas, forest edges, and other locations likely used by bats as flyways. Over the two study seasons, a total of 233 bats of seven species were captured, including 140 big brown bats (*Eptesicus fuscus*), 58 eastern red bats (*Lasiurus borealis*), 23 Indiana bats (*M. sodalis*), three evening bats (*Nycticeius humeralis*), three little brown bats (*M. lucifugus*), two silver-haired bats (*Lasionyctereis noctivagans*), and three hoary bats (*L. cinereus*). No northern long-eared bats were captured.

Throughout the two-summer study period, we sampled 35 acoustic sites on 10 properties for northern long-eared bats. These acoustic detections served as a scouting tool for our mist-netting and provided additional sampling effort to detect northern long-eared bats. A total of 143 detector nights were recorded, and 11 species were identified from 6,649 echolocation calls. Northern long-eared bats were detected acoustically at three sites: Martell Forest, Prophetstown State Park, and Purdue Wildlife Area.

Two MaxEnt models of northern-long eared bat roosting habitat suitability have been developed and compared. One model used data from the entire region, and the second model only used data from the portion of the study area where forest is uncommon, which is defined as an area with less than 22% forest cover in a 25-km radius around each 30-m pixel. Preliminary results based on the entire study area suggest the percentage of forest cover within 90 m of roost trees was the largest contributor to the model (34%).
with distance to perennial streams (19%) and percentage of forest within 1 km (19%) being the next highest contributors. The model AUC, a measurement of the model’s predictive power, was 0.980. An AUC value of 0.70 or greater represents a model with sufficient predictive power. Values closer to 1.0 are more ideal. This model generated an output with 619,020 hectares of habitat with a habitat suitability of at least 0.025. The model based on data from areas where forest is rare suggested that the amount of forest, both within 90 m of roost trees (50% model contribution) and within 1 km of the roost tree (35% model contribution), were even more important in predicting habitat suitability in less-forested regions. This model had an AUC of 0.984 and generated an output with 673,008 hectares of habitat with a habitat suitability of at least 0.025.

These results imply that in forest-rare regions, the percentage of forest cover at local and landscape levels is an increasingly important predictor of roosting habitat suitability for northern long-eared bats. Models that specifically address habitat suitability in forest-rare regions provide different predictions than models made for the more generalized three-state area. This suggests that the habitat needs of northern long-eared bats may differ in areas where forest is relatively rare.

**COST: $95,017 FOR THE COMPLETE TWO-YEAR PROJECT**