2016 Indiana Mobile Acoustic Bat Survey Program Report

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INTRODUCTION

Twelve of the 13 bat species identified from Indiana are listed as endangered or special concern by the Indiana Department of Natural Resources (IDNR). Indiana's Mobile Acoustic Bat Survey Program monitors trends in species abundance and location to aid conservation efforts, increase public awareness, assist in research, and identify matters of concern. With serious threats to bats from white-nose syndrome (WNS), wind farm development, and habitat loss, and given the biologic, economic, and intrinsic value of bats, it is prudent to monitor Indiana's summer resident bat populations.

The IDNR conducted pilot mobile acoustic surveys in summer 2011. In each of the following summers, surveys have been completed in as many as 76 counties (see Figure 3). This report summarizes the results of completed surveys from 2012–2016.

METHODS

Acoustic data were collected using an Anabat SD2 bat detector connected to an Anabat car mount microphone that was attached to the roof of a vehicle (Titley Scientific, Columbia, MO). GPS coordinates for each acoustic file were obtained using a USB GPS Receiver (GlobalSat BU-353-S4, New Taipei City, Taiwan). Surveys were conducted by driving predetermined routes approximately 25 to 29 miles in length. Each route was to be surveyed two to four times from May 27 to July 7. Surveys began approximately 20 minutes after local sunset time and were driven at a target speed of 15 to 18 mph.

Collected data were first filtered in AnalookW v.4.1t to remove acoustic files identified as containing only non-bat noise. The acoustic files classified as bat calls were then analyzed using Kaleidoscope Pro v.3.1.1 automated identification software set to the "+1 More Accurate (Conservative)" setting (species classifiers: EPFU, LABO, LACI, LANO, MYLU, MYSE, MYSO, NYHU, PESU) (see Appendix I).

The duration of each survey was used to standardize the data by bat calls detected per hour of surveying, thereby accounting for variations in route length and driving speed. Species that are difficult to differentiate acoustically have been reported as groups: *Myotis* species, eastern red and evening bats, and big brown and silver-haired bats.

Data from Indiana's Mobile Acoustic Bat Survey Program are not intended for regulatory use.

RESULTS AND DISCUSSION

See pages 2–9 for survey results and discussion.

ACKNOWLEDGEMENTS

We thank our surveyors for their commitment to this work and all their late nights on the road. We also thank the local, state, and federal properties that hosted regional training sessions. Indiana's Mobile Acoustic Bat Survey Program has been supported by the State Wildlife Grant Program (T3S6 and T3S7), the WNS Grants to States Program (S1TW1 and S1TW6), the Section 6 Endangered Species Grant Program (E12R1 and E13R1), and public contributions to the Indiana Nongame Fund.

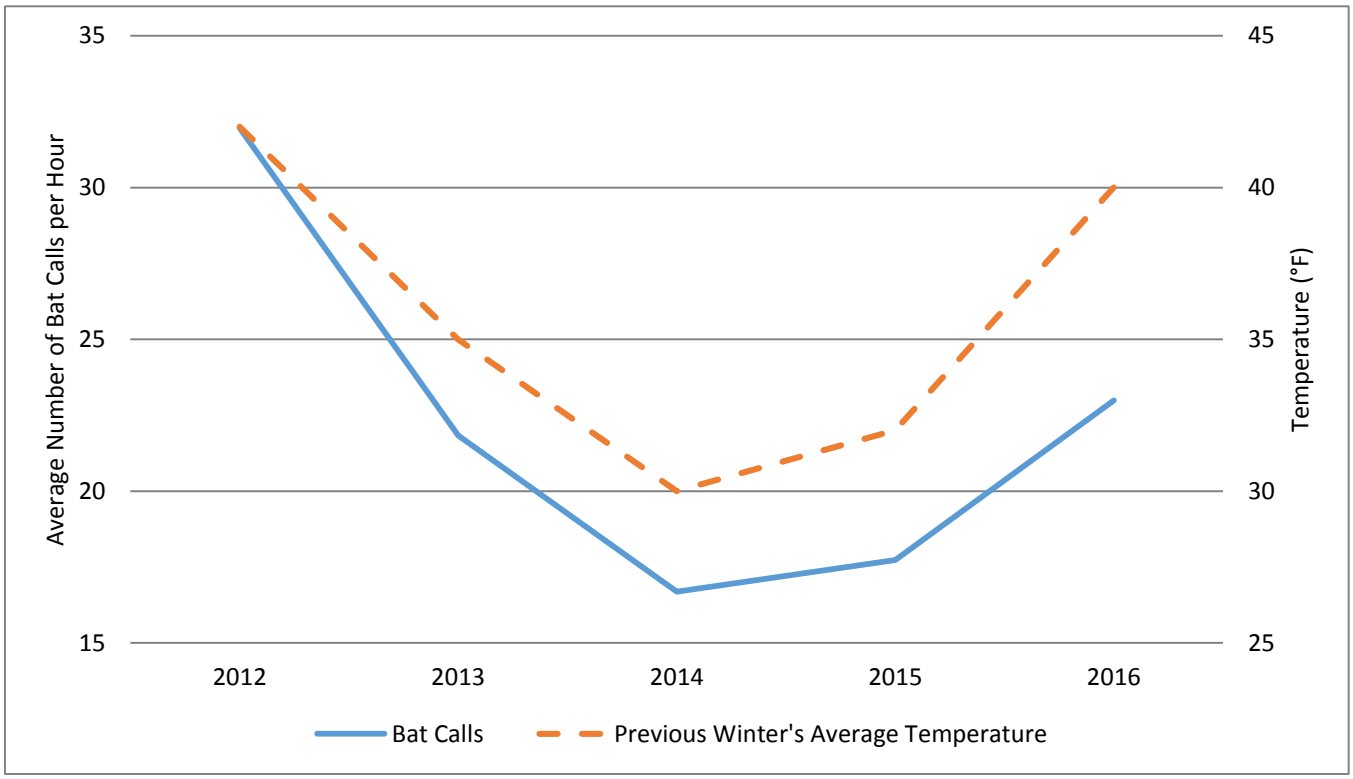

Figure 1. Average number of bat calls detected per hour from 2012–2016, plotted with the previous winter's average temperature (1 Dec–31 Mar). Bat call data from only the 49 counties surveyed a minimum of two times each year were used for analysis. Temperature data were obtained from the Bloomington, IN airport weather station (KBMG) via Weather Underground (www.wunderground.com).

WNS was first detected in Indiana in January 2011. Mobile acoustic bat surveys subsequently documented a steady decline in the number of bats detected per hour of surveying from 2012–2014. It is not a stretch to attribute this decline primarily to WNS. However, the decline in detected bats also closely mirrors drops in average winter temperatures during the same period. Longer, more severe winters would presumably lead to lower survivorship of bats during hibernation and less abundant food sources at spring emergence.

Since 2014, the number of bat calls detected per hour of surveying has increased. But again, the increase in detected bats closely mirrors rises in average winter temperatures during the same period. Ultimately, it is likely not one or the other, but rather both WNS and winter temperatures contributing to fluctuations seen in total bat numbers detected during mobile acoustic surveying.

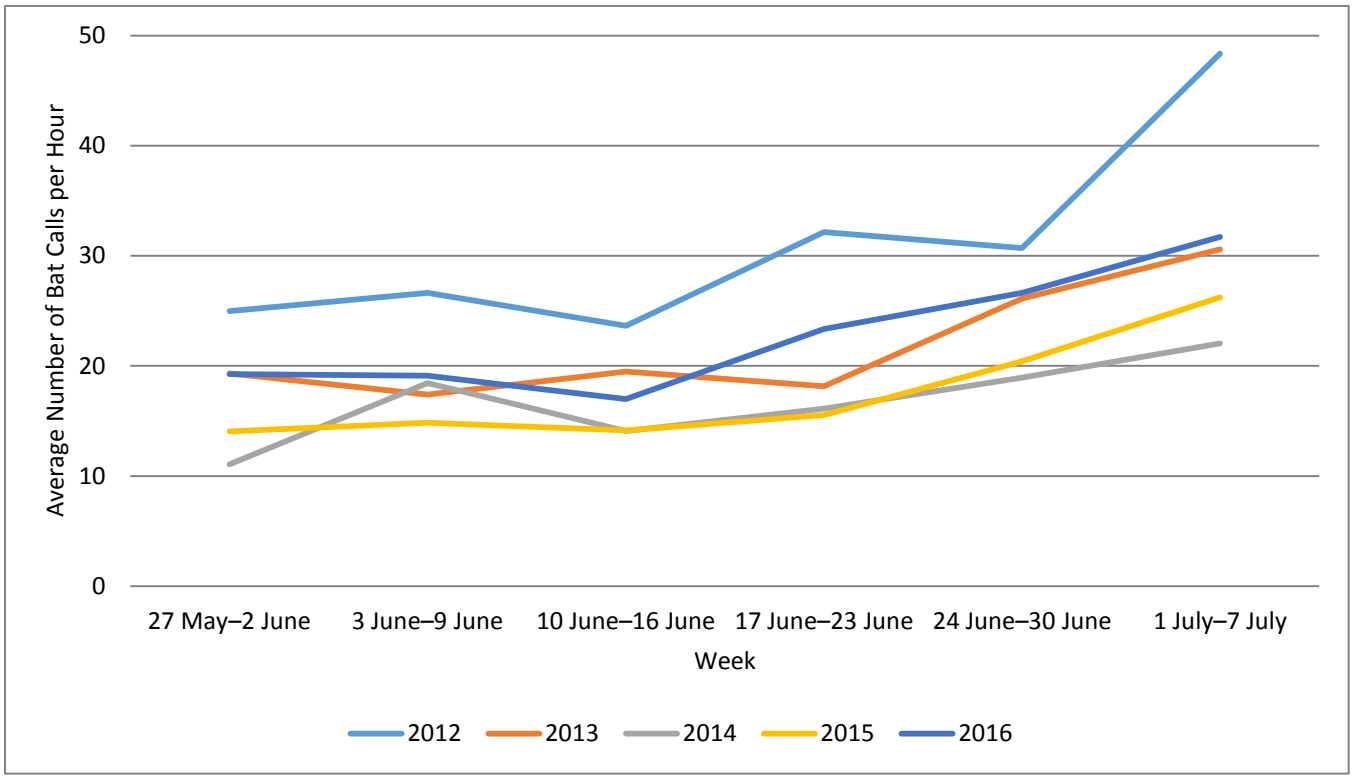

Figure 2. Average number of bat calls detected per hour during each week of the six-week surveying window from 2012–2016. Bat call data from only the 49 counties surveyed a minimum of two times each year were used for analysis.

All five years of mobile surveying generally indicate a gradual increase in bat detection rate from the beginning to the end of the surveying window. This is likely the result of the maternity season ending and pups becoming volant in late spring or summer, thus increasing the number of bats on the landscape. Other factors, such as weather or food availability, could also be involved. Annual variation in detection rate is also evident. The most bats were detected in 2012. Weekly trends of lower detection rates were similar in 2014 and 2015, with slightly higher rates in 2013 and 2016 (see Figure 1).

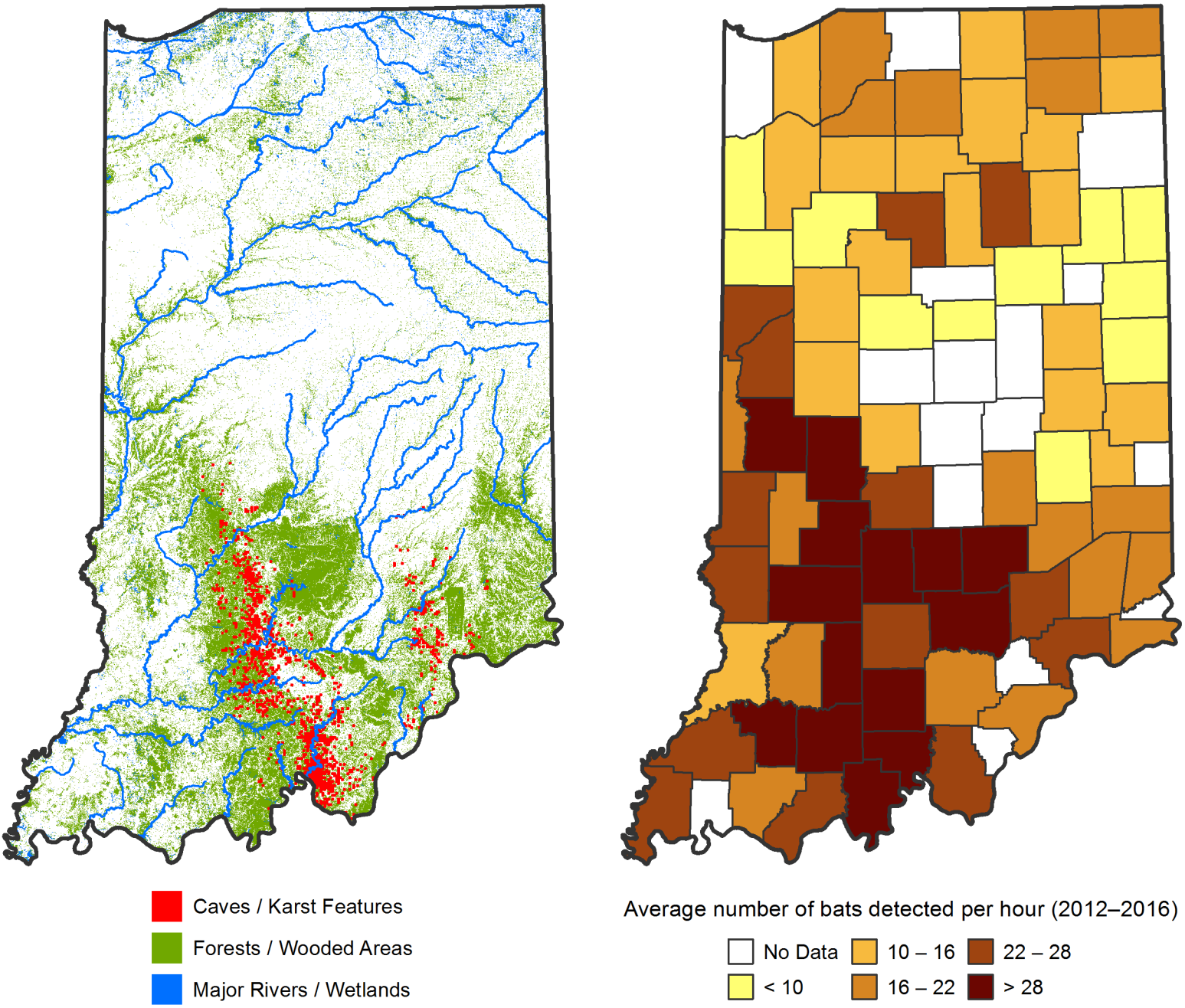

Figure 3. Locations of caves, forests, and major water features in Indiana (left), and average number of bat calls detected in each county per hour of surveying from 2012–2016 (right).

There is a clear correlation between habitat and bat abundance. The highest bat detection rates are found in the forested karst region of south-central Indiana. Moving north, detection rates drop substantially across the heavily agricultural north-central region. Detection rates then rise again in northern Indiana where wetlands and wooded areas are more abundant.

The 16 counties with no data do not have survey routes. These counties have been omitted primarily due to either the size of the county or the amount of urbanization. The remaining 76 counties have each been surveyed at least once during the surveying window for a minimum of three years.

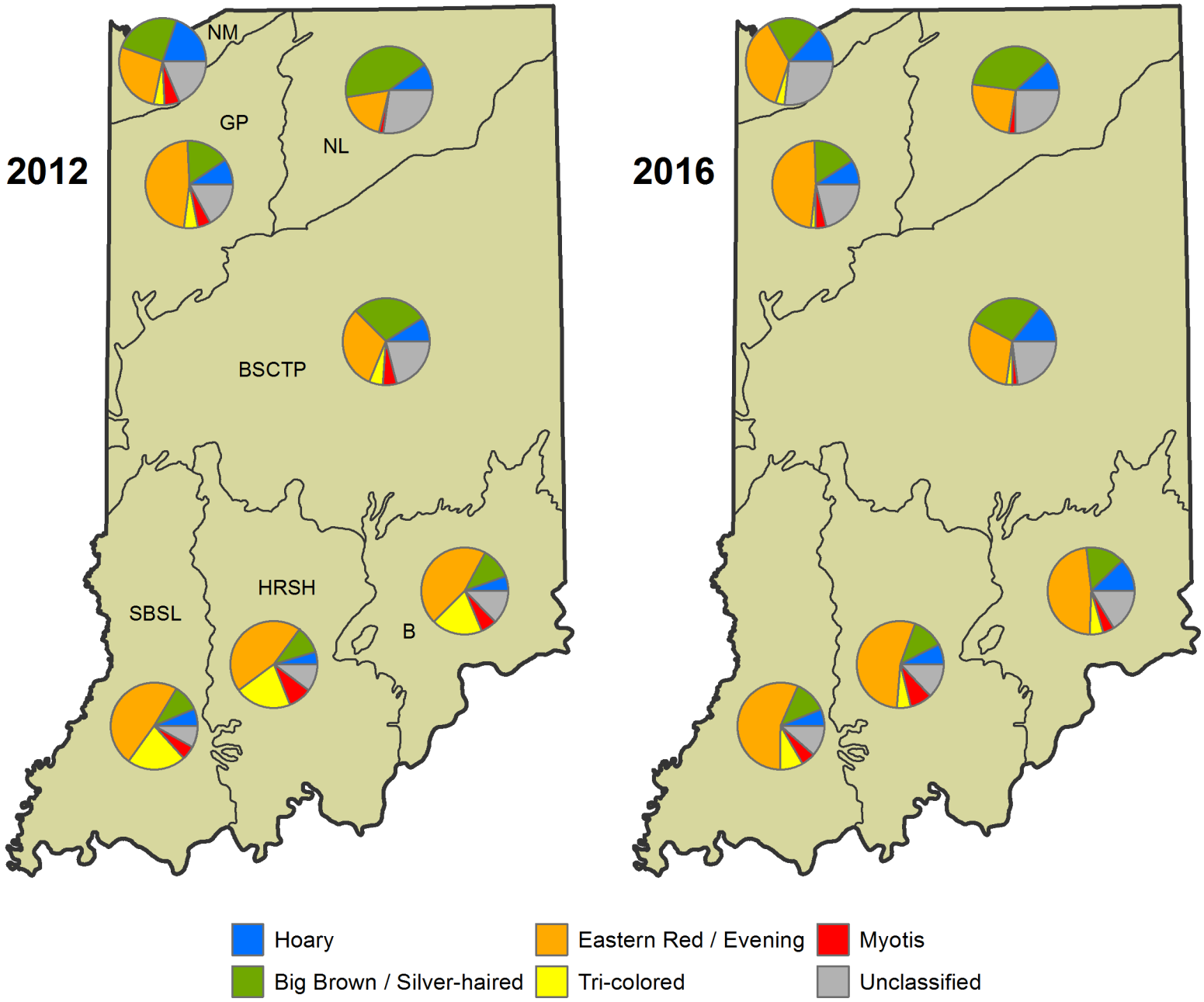

Figure 4. Proportional species representation in 2012 (left) and 2016 (right) in the seven dominant natural regions of Indiana. Bat call data from only the 49 counties surveyed a minimum of two times each year were used for analysis. SBSL = Southern Bottomlands Southern Lowlands, HRSH = Highland Rim Shawnee Hills, B = Bluegrass, BSCTP = Black Swamp Central Till Plain, GP = Grand Prairie, NL = Northern Lakes, NM = Northwestern Morainal.

The most striking change in species representation from 2012 to 2016 is the decline in proportional abundance of tri-colored bats in six of seven natural regions, but in particular the southern regions where tri-colored bats are historically more abundant. Interestingly, unclassified calls are more common in the northern regions. The more heavily wooded, and therefore cluttered, survey routes in southern Indiana would generally be expected to return a higher proportion of lower quality calls that are more difficult to differentiate acoustically. Results from the Northwestern Morainal region should be viewed skeptically due to a small sample size.

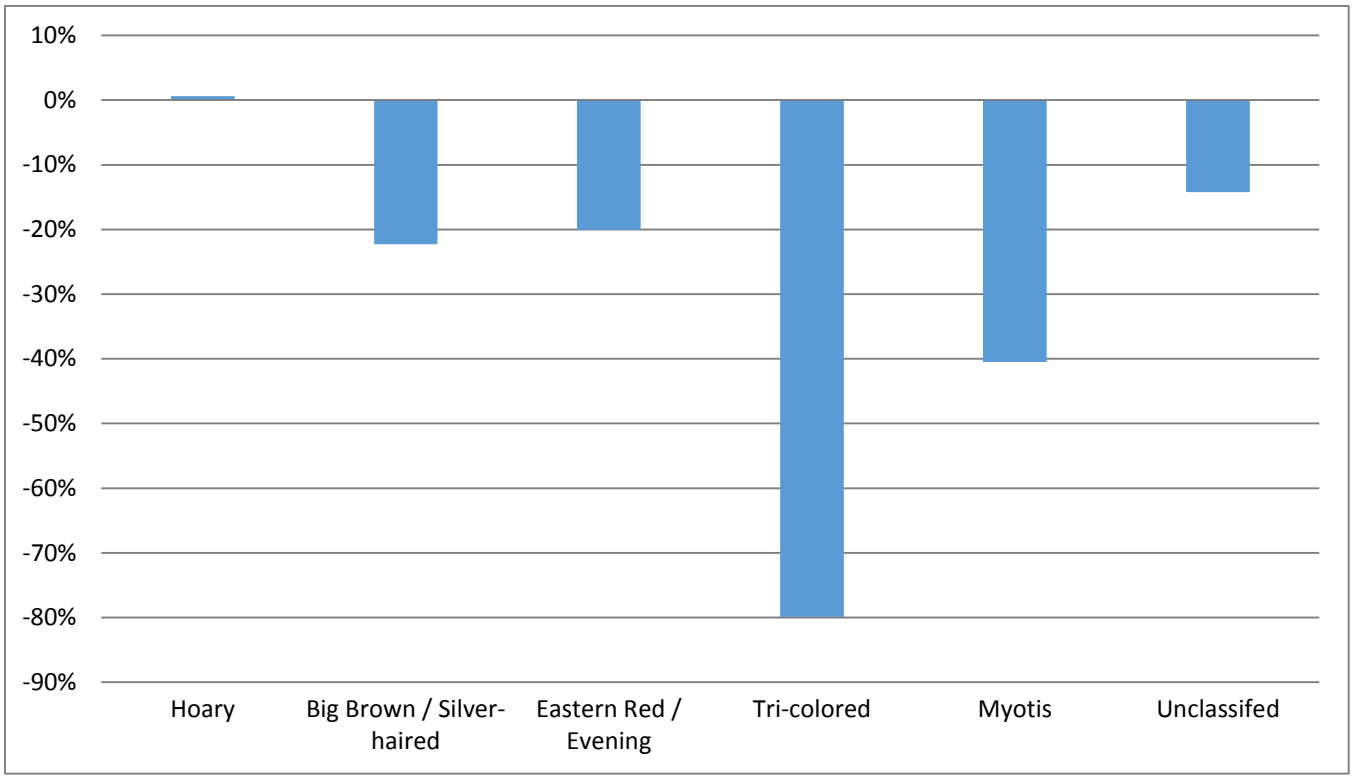

Figure 5. Percent change in the average number of bat calls detected per hour for each species or species group from 2012 to 2016. Bat call data from only the 49 counties surveyed a minimum of two times each year were used for analysis.

Detected tri-colored bat calls per hour of surveying declined approximately 80 percent from 2012 to 2016, far more than any other species or species group. Tri-colored bats and the *Myotis* group comprise the vast majority of cave-hibernating bats in Indiana. The heavy declines in these two groups indicate high rates of mortality due to WNS, which typically only affects cave-hibernating species.

Declines in other species could be the result of other factors such as fluctuations in winter temperatures (see Figure 1), habitat loss, increased mortality from wind turbines, or other natural or anthropogenic causes. Only hoary bats increased in calls detected per hour of surveying, and that only by a fraction.

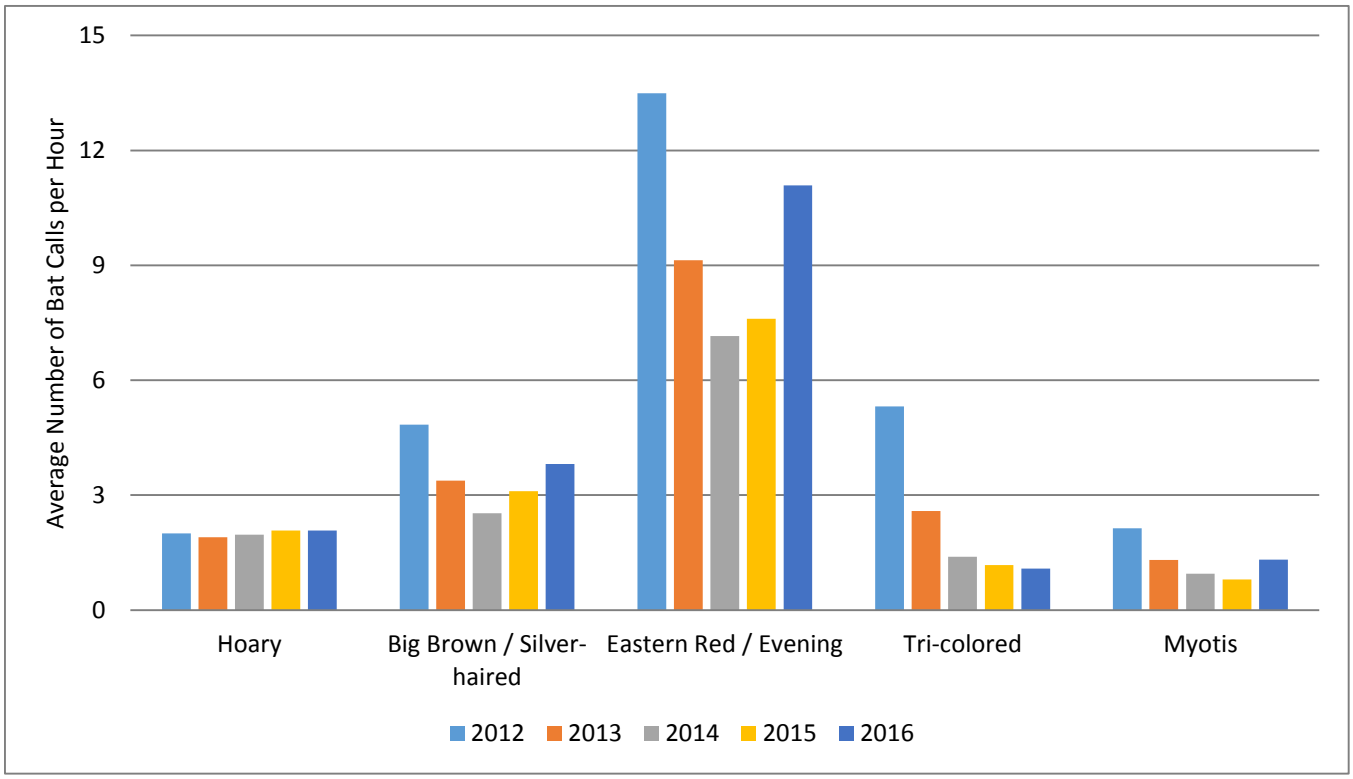

Figure 6. Average annual number of bat calls detected per hour for each species or species group from 2012–2016. Bat call data from only the 49 counties surveyed a minimum of two times each year were used for analysis.

The most common species or species group detected during mobile surveying was the eastern red/ evening group. Most of these calls are likely eastern red bats. According to Mammals of Indiana (Whitaker and Mumford 2009), the eastern red bat is "an abundant summer resident in many sections of the state", while the evening bat is "an uncommon summer resident in Indiana and is most abundant in the southern part of the state."

Apart from 2012, the big brown/silver-haired group has been the second-most common species or species group. Most of these calls are likely big brown bats. Mammals of Indiana (Whitaker and Mumford 2009) states that the big brown bat is "a common resident throughout the state", while the silver-haired bat is "an uncommon spring and fall migrant and a rare winter resident."

Only tri-colored bats have declined each year, almost certainly due to WNS. Hoary bats are the only species or species group to remain stable from year to year.

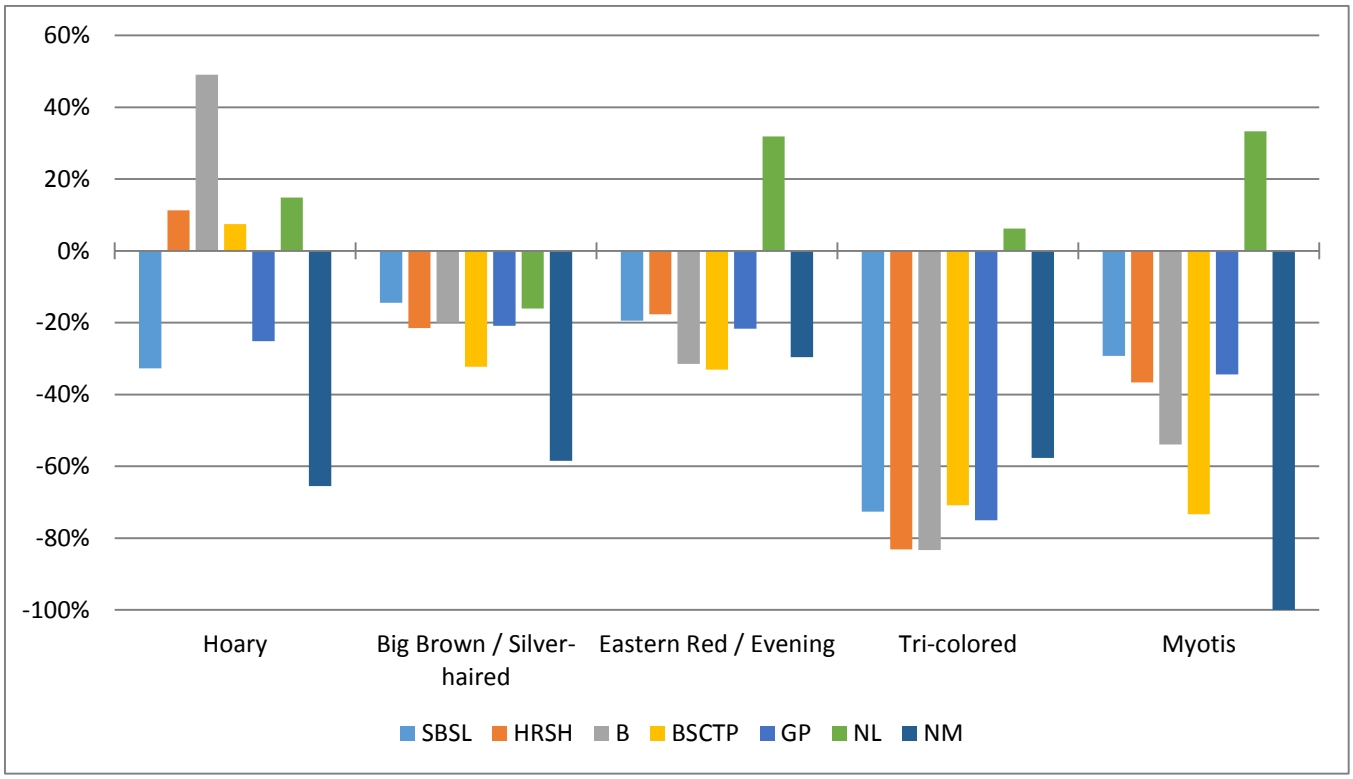

Figure 7. Percent change in the average number of bat calls detected per hour for each species or species group in each natural region from 2012–2016. Bat call data from only the 49 counties surveyed a minimum of two times each year were used for analysis. SBSL = Southern Bottomlands Southern Lowlands, HRSH = Highland Rim Shawnee Hills, B = Bluegrass, BSCTP = Black Swamp Central Till Plain, GP = Grand Prairie, NL = Northern Lakes, NM = Northwestern Morainal (see Figure 4).

Perhaps most interesting is that four out of five species or species groups increased in the Northern Lakes natural region, while every other region had declines in every species except hoary bats. It may be coincidental, but hoary bats declined in the three western-most regions, while increasing in the more easterly regions. Results from the Northwestern Morainal region should be viewed skeptically due to a small sample size.

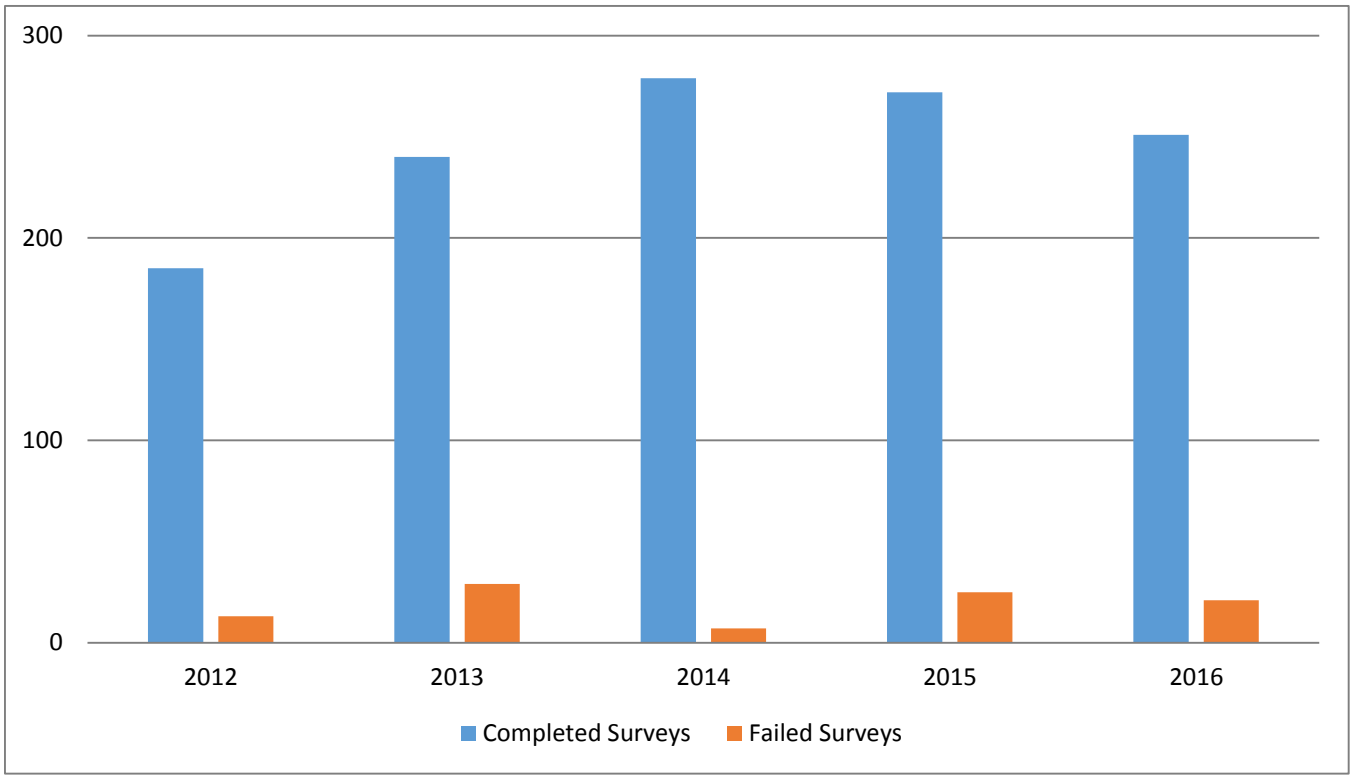

Figure 8. Survey effort from 2012–2016.

A total of 1322 surveys were attempted from 2012–2016, of which 1227 (93%) were successfully completed. Some completed surveys included minor inconsistencies that did not compromise the overall integrity of bat call data, such as: altered routes due to road closures, missing GPS coordinates for some bat calls, driving speeds slower or faster than the targeted average of 15–18 mph, and start times earlier or later than the targeted start time of 20 minutes after sunset. Failed surveys were those which were terminated prior to reaching the route endpoint or which returned incomplete acoustic data. Reasons for failed surveys included unexpected road closures, inclement weather, equipment failure, and surveyor error.

The number of surveys increased steadily from 2012 to 2014 largely due to additional survey routes added in 2013 and 2014. Small fluctuations in survey numbers since 2014 may generally be attributed to surveyor effort and weather conditions during the six-week surveying window. Indiana's mobile acoustic bat surveys are scheduled to continue in 2017.

APPENDIX I

Bat species are sometimes referred to using a four-letter abbreviation based on their scientific names, as is the case with Kaleidoscope Pro software. The common and scientific names for each abbreviation are as follows:

EPFU = big brown bat, *Eptesicus fuscus*
LABO = eastern red bat, *Lasiurus borealis*
LACI = hoary bat, *Lasiurus cinereus*
LANO = silver-haired bat, *Lasionycteris noctivagans*
MYLU = little brown bat, *Myotis lucifugus*
MYSE = northern long-eared bat, *Myotis septentrionalis*
MYSO = Indiana bat, *Myotis sodalis*
NYHU = evening bat, *Nycticeius humeralis*
PESU = tri-colored bat, *Perimyotis subflavus*

APPENDIX II

Literature Cited

Whitaker, Jr., John O., and Russell E. Mumford. *Mammals of Indiana*. Bloomington: Indiana University Press, 2009. Print.