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# A SURVEY OF BATS IN WAYNE NATIONAL FOREST, OHIO[1]

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ABSTRACT. Distribution, abundance, habitat selection, and activity of bats in Wayne National Forest, Ohio, were studied during the winters and summers of 1979 and 1980. Methods included winter surveys of abandoned mines and mist netting of riparian sites in summer. Four species of bats were found hibernating in 23 of 65 coal mine shafts examined, and big brown bats, *Eptesicus fuscus,* were most abundant. Mines with long tunnel systems had significantly higher temperatures than those with shorter systems, but humidity did not differ between mine types. Big brown bats chose the cooler mines and in general showed the greatest tolerance of climatic extremes. Eight species of bats totaling 261 individuals were captured by mist netting at 163 riparian locations in 5 watersheds. Little brown bats, *Myotis lucifugus,* comprised 56% of all bats captured. Big brown bats (14%), eastern pipistrels, *Pipistrellus subflavus* (13%), and red bats, *Lasiurus borealis* (13%), were the next most abundant species in mist net samples. No Indiana bats, *Myotis sodalis,* were captured. Big brown bats preferred to forage in forested habitats. Activity for most species was highest soon after sunset, but activity in big brown bats peaked 0.5 hr later than in the other species.

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## INTRODUCTION

Information on the distribution and abundance of bats in Ohio is scarce. Much of the information consists chiefly of individual sightings or records (Smith and Goodpaster 1960, Maly 1962, Gottschang 1966, and others). Investigations have been carried out in western (Rausch 1946, Mills 1971, Mills et al. 1975) and northeastern (Smith 1954) Ohio, but most of these studies have involved only selected species.

The objective of this study was to survey bats in Wayne National Forest (WNF), with special reference to the endangered Indiana bat so that, if present, management plans for its protection could be prepared.

## STUDY AREA

Wayne National Forest, located in the southeastern quarter of Ohio, is separated into 3 geographically distinct units: Athens, Ironton, and Marietta (fig. 1). Many sections of WNF are underlain with rich deposits of coal and have been intensively shaft or strip mined during past decades. The extensive system of shafts left behind now provides potential bat hibernacula in an area lacking the preferred limestone caverns. Most of WNF is composed of rolling hills, and prior to establishment of WNF much of the land within its boundaries was privately owned. Therefore, considerable abandoned farmland is interwoven between the patches of forested area resulting in a diversity of habitat types. For further information on the area consult King (1979).

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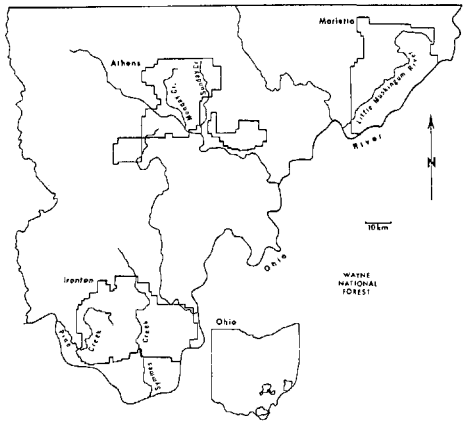


FIGURE 1. The 3 units constituting Wayne National Forest, Ohio.

## METHODS AND MATERIALS

Field work was done during the winters and summers of 1979 and 1980. Methods included examining abandoned coal mines for winter roosts and erecting mist nets over streams during summers. Most mines located are indicated on the 1975 edition of U.S. Forest Service maps. Others were found while searching for marked sites. Many shafts had already collapsed, been overrun by strip mine operations, or been sealed by the Forest Service. All tunnels were examined both years except those not found until 1980. Deeper passages were explored more extensively in 1980. Mine shafts were grouped into 2 size types based on length; type 1 shafts, the more abundant, were greater than 30 m in length and contained extensive tunnel systems, and type 2 mines were 30 m or less in length.

Temperature and humidity were recorded 30 m into the shafts of 54 mines. A pocket thermometer was used to measure temperature; humidity was measured with a Model SAC wet bulb-dry bulb sling psychrometer in 1979 and with a battery powered wet bulb Psychron Hygrometer in 1980.

Sites within 5 watersheds of WNF were mist netted during spring and summer months (19 Jun-7 Sep 1979, 28 Apr-25 Aug 1980): Monday and Sunday creeks in the Athens unit, Pine and Symmes creeks in the Ironton unit, and the Little Muskingum River in the Marietta unit (fig. 1); the numbers of nights nets were set in each unit were 96, 96, and 68, respectively. Streams were initially surveyed at crepuscular hours from bridges with a SON TECTOR 11 OM ultrasonic sound detector to determine areas of highest bat abundance. One- and two-tiered mist nets of 3.2-cm nylon mesh, 2-ply denier, and either 5.4 or 12 m in width were set over the water at selected sites. We maintained a distance between sites of not more than 2 km, the maximum foraging distance measured for Indiana bats in Missouri (LaVal et al. 1977). Nets were raised by 2100 hr and checked at 30- to 45-min intervals until 0030 hr. Nets remained up until they were examined at dawn. Each site was netted for no more than 2 consecutive nights.

Habitat at netting sites was classified into 3 types. Type A contained forest on one side of the stream and open area (old-field, cropland, or pasture) on the other. The uniform habitats were Type B, with open areas on both sides, and Type C, with forest on both sides. Numbers of nights nets were set were 76, 82, and 102 for Types A, B, and C, respectively.

## RESULTS

ROOST SURVEYS. Of the 118 known coal mine sites, 100 (85%) were examined. Sixty-five of the 100 were open, and 23 were used as hibernacula. Most shafts opened horizontally into the substrate, and entrances ranged from 1 to 2 m in height and from 2 to 6 m in width. The floors of most shafts were covered with a thick layer of mud, and many contained standing water.

Temperatures in the 2 mine types differed significantly ($P < 0.02$, two-tailed t-test); those in Type 1 (with tunnel systems) averaged 6.30 C (range −5.56 to 14.46), and those in Type 2 averaged 3.30 C (range −6.67 to 11.68). Humidity in Type 1 and Type 2 mines averaged 85.1% (range 57-100) and 84.5% (range 67-100); the difference was not significant ($P > 0.05$, two-tailed t-test).

Only 4 species of bats were found in the mines of WNF: big brown bats, *Eptesicus fuscus* (n = 54), little brown bats, *Myotis lucifugus* (33), eastern pipistrels, *Pipistrellus subflavus* (22), and Keen's bat, *Myotis keenii* (1). The largest roost contained 42 bats.

We found big brown bats rare in deeper passages but common near shaft entrances where air currents were almost always more noticeable. Temperatures in mines used by big brown bats were significantly lower than temperatures in mines without bats (table 1), and the range of temperatures at which this species was recorded suggested a tolerance to temperature extremes. Big brown bats were recorded in a wider range of humidities than those of the other 3 species (table 1).

TABLE 1

*Comparison of microclimate conditions found in mines used and not used as hibernacula, Wayne National Forest, Ohio, winters of 1979-80.*

| Species | Temperature (°C) | | | Humidity (%) | | |
|---|---|---|---|---|---|---|
| | No. readings | Mean ± SE | Range | No. readings* | Mean ± SE | Range |
| None present | 58 | 5.94 ± 0.61 | −7.78 − 14.46 | 52 | 86.2 ± 1.46 | 58 − 100 |
| *E. fuscus* | 21 | 2.67 ± 0.94** | −6.67 − 8.90 | 16 | 81.4 ± 2.55*** | 57 − 93 |
| *P. subflavus* | 6 | 8.62 ± 1.24 | 2.78 − 11.68 | 5 | 89.6 ± 2.48 | 81 − 94 |
| *M. lucifugus* | 3 | 6.12 ± 1.61 | 3.34 − 8.90 | 3 | 92.7 ± 0.33 | 92 − 93 |

*Humidity not always measured
**Two sample t-test, significant ($P < 0.01$)
***Two sample t-test, not significant ($P > 0.05$)

Other bat species using the mines of WNF appeared to choose shafts with higher temperatures. Several bats, including a species not recorded in 1979, the eastern pipistrel, were found farther back from the entrance in the deeper explorations of 1980.

MIST NETTING. Eight species of bats, comprising 261 individuals, were captured at 163 riparian sites. The little brown bat was the most abundant species netted along all 5 streams (table 2), making up 56% of bats caught. Three other species were captured relatively frequently: big brown bats, eastern pipistrels, and red bats, *Lasiurus borealis*. Big brown bats and red bats were found along all 5 streams, whereas pipistrels were never captured along Monday Creek.

Of the rarely captured species, only Keen's bat was found in all 3 units of WNF (table 2). The 3 adult hoary bats, *Lasiurus cinereus,* were netted in the Athens unit; 2 were females, suggesting the presence of a summer resident population in this unit. An adult female evening bat, *Nycticieus humeralis,* was netted 21 May 1980 on Symmes Creek, Ironton unit, and an adult silver-haired bat, *Lasionycteris noc-*

TABLE 2

*Species and numbers of bats captured along streams mist netted in Wayne National Forest, Ohio, 1979-80.*

| | Athens Unit | | | | Ironton Unit | | | | Marietta Unit | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Monday Cr. | | Sunday Cr. | | Pine Cr. | | Symmes Cr. | | L. Muskingum | | |
| Species | 1979 (14)* | 1980 (36) | 1979 (21) | 1980 (25) | 1979 (28) | 1980 (35) | 1979 (14) | 1980 (19) | 1979 (29) | 1980 (39) | Totals |
| *E. fuscus* | | 14 | 8 | 4 | 1 | 2 | | 3 | 3 | 2 | 37 |
| *L. borealis* | 1 | 8 | 3 | 5 | | 3 | 5 | 1 | 3 | 4 | 33 |
| *L. cinereus* | | 1 | 2 | | | | | | | | 3 |
| *L. noctivagans* | | 1 | | | | | | | | | 1 |
| *M. keenii* | 1 | 1 | | | | 1 | | | 1 | 3 | 6 |
| *M. lucifugus* | 16 | 21 | 13 | 9 | 7 | 16 | 35 | 4 | 15 | 10 | 146 |
| *N. humeralis* | | | | | | | | 1 | | | 1 |
| *P. subflavus* | | | 3 | 9 | 2 | 6 | | 4 | 7 | 3 | 34 |

*Number of evenings mist nets were set on stream

*tivagans,* was caught on Monday Creek, Athens unit.

Only 1 association of species with a habitat type was found. Big brown bats strongly favored Type C habitat ($X^2 = 28.8$, 2 df, $P < 0.05$), demonstrating a preference for foraging in wooded areas. Conversely, no apparent preference by red bats for any habitat was indicated (Lacki 1980).

Most species showed early evening and pre-dawn peaks in activity (fig. 2). With the exception of big brown bats, most species we captured were most active in the first hour after sunset.

## DISCUSSION

Our data suggest big brown bats do not hibernate in large concentrations in southeast Ohio. In Minnesota, Davis and Hitchcock (1964) reported this species hibernating in mines with conditions similar to those reported here. Most of the wintering populations observed in southwest Ohio were small in numbers, leading Mills et al. (1975) to conclude that most winter roosts of big brown bats remained unknown.

We found big brown bats rare in deeper passages but common near shaft entrances where air currents were almost always more noticeable. Previous investigators also indicated the big brown bat chooses winter roosts exposed to strong air currents (Davis and Hitchcock 1964, Phillips 1966). Temperatures in mines in which we found big brown bats were significantly lower than temperatures in mines without bats. The range of humidity percentages we found for hibernacula of big brown bats was similar to findings of Goehring (1972). Other studies demonstrated that big brown bats are more common in sites with low humidities (Rysgaard 1942, Hitchcock 1949, Phillips 1966). Our results suggest big brown bats avoid saturated conditions, because none was found in mines with a relative humidity greater than 93%.

The pipistrels, located in 6 different mines, usually were found deeper within the tunnels than other bats, suggesting a preference for more stable conditions. Swanson and Evans (1936) reported a population of pipistrels hibernated in a sandstone cave in Minnesota that had tem-

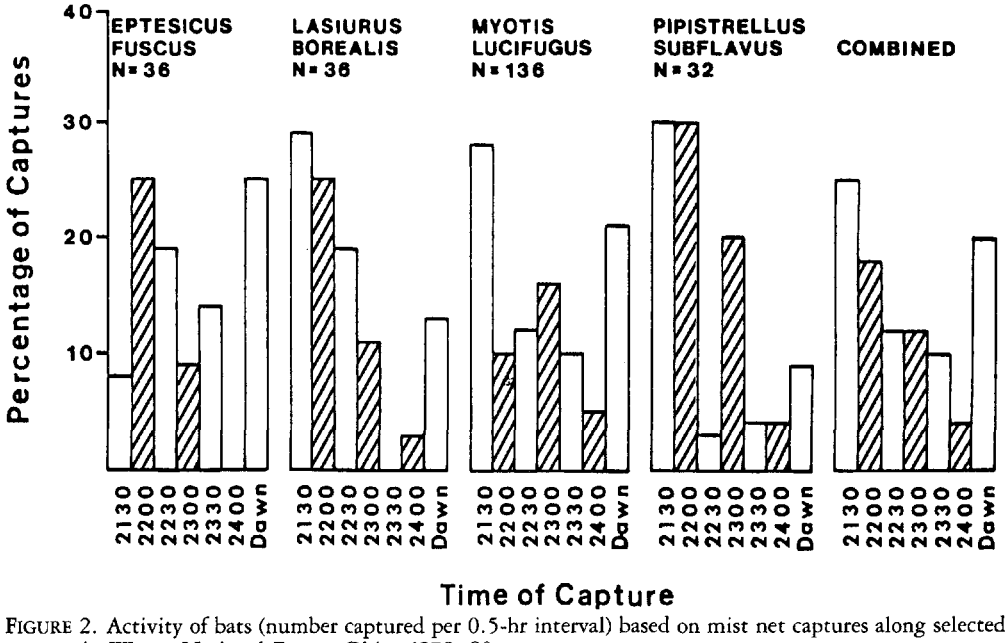


FIGURE 2. Activity of bats (number captured per 0.5-hr interval) based on mist net captures along selected streams in Wayne National Forest, Ohio, 1979–80.

peratures that varied only from 7.2 to 8.9 C throughout the winter.

McNab (1974) stated that hibernation temperatures selected by species in cold climates should be inversely related to their body weight; thus big brown bats, the heaviest species we found, should occur at the lowest temperatures and eastern pipistrels, the smallest species we observed, should choose the warmest conditions. Our findings (table 1) are in complete agreement with those of McNab (1974).

We netted more little brown bats than any other species, and Smith (1954) also found this bat the most abundant species in northeast Ohio. Humphrey and Cope (1976) suggested the eastern species of little brown bats are grouped into demes, but southeast Ohio was not included within the range of any of the demes they presented. The preponderance of this species in the eastern half of Ohio suggests the presence of a new deme or an extension of the deme located in southwest Ohio.

The evening bat was considered to range only as far east in Ohio as the Scioto River Valley (Rausch 1946, Barbour and Davis 1969). Our capture of a single individual confirms the presence of this species about 40 km farther to the east.

Segregation of sexes within summer range has been suggested for hoary bats and red bats (Barbour and Davis 1969). We caught both sexes of hoary bats in the Athens unit (male 14 July 1979, and 1 female 13 July 1979), and both male (n = 17) and female (n = 16) red bats were common on our samples.

Davis and Mumford (1962) seldom found eastern pipistrels foraging in the same area as little brown bats and proposed mutually exclusive summer feeding territories for these species. Our findings were contrary to their conclusion because we caught both species in the same net on the same night, on 11 different nights at 11 different locations.

At least 5 different species were captured at each of the streams sampled (table 2). The capture of 3 hoary bats, the silver-haired bat, and a Keen's bat in the Athens unit suggests this area contains the most diverse bat fauna.

The presence of 8 species of bats in mist net samples indicates WNF has a diverse bat fauna during summer months. Data from examination of mines suggests most of the bats winter elsewhere. The lack of natural caves in this region of the state probably has always made the area less desirable for hibernating bats. Although we failed to capture Indiana bats, they nevertheless might occur in WNF. Formulating guidelines for managing WNF habitats for this species is unnecessary presently.

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