

BATS OF THE WABASH AND OHIO RIVER BASINS OF SOUTHWESTERN INDIANA

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ABSTRACT. The purpose of this project was to sample streams, bayous, and swamps of the Wabash and Ohio River basins of southwestern Indiana for bats, particularly for the five species considered to be rare or endangered in Indiana. These are the Indiana myotis, *Myotis sodalis*, gray myotis (*M. grisescens*), southeastern myotis (*M. austroriparius*), evening bat (*Nycticeius humeralis*), and big-eared bat (*Corynorhinus rafinesquii*). Sampling occurred by mistnet from 1992 through 1999 in the lower Wabash, White, and Ohio River basins. A large and diverse bat community was found along Prairie Creek in the Wabash River bottoms in southern Vigo County, and many samplings were made there from 1994 through 1999. A total of 1811 bats of ten of the 12 species previously known to occur in Indiana was taken in 249 nettings (most often a 9 m wide, 2.6 m high mistnet run from dusk to 0100 h), 176 at Prairie Creek, 73 in the remaining area. These included the federally endangered Indiana and gray myotis, *Myotis sodalis* and *Myotis grisescens*, and the state-endangered evening bat, *Nycticeius humeralis*. The evening bat is common in the lower Wabash River basin from southern Vigo to Posey County, but was not found further east along the Ohio River. Bottomland woods as occurs in the lower Wabash basin may have been representative of original evening bat habitat, at least in the northern part of its range. Nine gray bats, mostly males, were taken in Spencer, Perry, Harrison, Floyd and Clark counties. These individuals were probably associated with colonies in Clark County, Indiana, or in Breckenridge County, Kentucky. Fifty-eight Indiana bats were netted during this study, but 49 of them were netted along Prairie Creek. Only nine were taken south of Vigo County, suggesting that few Indiana myotis form maternity colonies in the southwestern bottomland of Indiana. No southeastern myotis or big-eared bats were taken during this study, although one southeastern myotis was reported from south of Washington in Daviess County in 1998, and a big-eared bat was seen several times in Squire Boone Cave in Harrison County in 1992. We consider the big-eared bat to be of accidental occurrence and the southeastern myotis to be nearly extirpated leaving ten species as currently occurring in the state.

Keywords: Bats, Indiana, Wabash River basin, Ohio River basin

Little information is available on the bats living in the bayous, swamps and lower portions of streams near the Ohio and Wabash Rivers of southern Indiana. There are five rare or endangered species of bats in Indiana. They are the Indiana and gray myotis *Myotis sodalis* Miller & Allen 1928 and *M. grisescens* Howell 1909 (federally endangered), the evening bat *Nycticeius humeralis* (Rafinesque 1818) (state endangered), and the southeastern myotis and big-eared bat *Myotis austroriparius* (Rhoads 1897) and *Corynorhinus rafinesquii* (Lesson 1818). Any of the five could occur in the area mentioned above. No maternity colonies were known from Indiana for the southeastern myotis nor for the big-eared bat. Only one colony was known for the gray myotis and one for the evening bat at the outset of this study, and few were known for the Indiana bat. This area and these habitats are likely

places to look for any of these species, especially in view of the finding of gray, Indiana and southeastern myotis (including evidence of maternity colonies) along Yellowbank and Hardin Creeks, Breckenridge County, Kentucky in 1990 (Tyrell & Brack, 1991). The site on Yellowbank is just across the Ohio River to the east of Rome in Perry County Indiana, and Hardin Creek is about 10 miles south of Rome. Also, a big-eared bat was reported from Squire Boone Cave, Harrison County, Indiana, in 1992, and a southeastern myotis was reported from Daviess County in 1998.

THE SENSITIVE SPECIES

Myotis austroriparius. Southeastern myotis.—(probably extirpated). The southeastern myotis forms maternity colonies in buildings, caves or in hollow trees. It winters in caves (at least in northern latitudes). No maternity

colony has ever been found in the state. However, individuals were regularly found in hibernation in caves and also were netted at cave entrances as swarming individuals through the early 1970's. However, they were in decline from the 1940's through the 1970's. The main caves occupied by this species in Indiana have always been Donnehue's Cave and the caves at Spring Mill State Park. The last records in the state, other than for the 1998 record in Daviess County were by James B. Cope who has a few records at Donnehue's Cave through 1970. However, Tyrell & Brack (1991a) captured three reproductive females and one male at two sites along tributaries of Hardin's Creek and one reproductive female along Yellowbank Creek in Breckinridge County, Kentucky, in July 1990. Also, 68 individuals were taken during mistnetting by Gardner et al. (1992) from 1987–1991 at 3 of 55 sites in southern Illinois. The three sites were in Alexander, Pope and Pulaski Counties. In 1989, the Illinois workers were successful in locating a maternity colony. It was in a hollow but living tupelo gum (*Nyssa aquatica*), more than 5 miles (8 km) from the original capture site. In addition, William Hendricks (pers. commun.) reported a pregnant southeastern myotis from Daviess County along the White River southwest of Washington on 12 June 1998. This site is being further investigated.

Myotis grisescens. Gray myotis.—(federally endangered). The gray myotis is the only true cave bat of Indiana. It forms maternity colonies in caves and migrates south to hibernate in other caves. Tuttle (1976) suggested that probably 90% of the population of gray bats in the eastern United States used three caves for hibernation, one in northeastern Alabama, one in central Tennessee and one in eastern Tennessee close to the Virginia border. Two other hibernacula are now known in Tennessee, and it is assumed that the gray myotis from Indiana hibernate in these caves.

Only one maternity colony of this species was known from Indiana at the outset of this study. It was located in 1982 in a cave-like quarry at Sellersburg, Clark County (Brack et al. 1984), after Cope & Richter (1978) had netted 8 individuals about 5 miles to the north in Muddy Fork Creek. Quarrying had apparently stopped at this site by about 1900 so the colony formed after that date. It contained

about 400 bats soon after its discovery and now numbers nearly 4000 bats. The floor of the quarry is completely covered with deep water. In 1997, a second population of gray myotis was located by Scott and Lori Pruitt (pers. commun.). It is on the Charlestown military base at Charlestown (also in Clark County), and only about five miles (8 km) from Sellersburg. In nearby Breckenridge County Kentucky, Tyrell & Brack (1991a) obtained evidence of two additional nearby maternity colonies of gray myotis, one along Yellowbank Creek (5 individuals taken) and one along Hardin's Creek (10 individuals taken).

In addition, four male gray myotis were found in Wyandotte Cave on 26 July 1989. They were among a sample of 23 bats (the other 19 were male Indiana myotis) from two clusters, totalling an estimated 600 bats near a formation called the Pillar of Constitution. Also, two male gray myotis were captured in April 1991 at Wyandotte Cave during spring emergence, and one was found in hibernation in Twin Domes Cave, Crawford County in February 1989; three were there on 6 February 1995.

Myotis sodalis. Indiana myotis.—(federally endangered). The Indiana myotis forms maternity colonies under the loose bark of trees in the midwest as far north as southern Michigan (Kurta et al. 1993) and winters in large numbers in a very few caves. Two of the largest hibernacula for this species are in two caves in southern Crawford County, Indiana. The bats in these two caves numbered an estimated 91,650, 96,700, 88,175, 74,500, and 69,900 in the winters of 1991, 1993, 1995, 1997, and 1999. We think most of these bats form maternity colonies farther north, as only one individual was taken during extensive mistnetting in the southern Hoosier Forest in 1990 (Brack & Tyrell 1991b), although the same authors (Brack & Tyrell 1991a) did find evidence of a maternity colony of *Myotis sodalis* along Yellowbank and Hardin's Creek nearby in Breckinridge County, Kentucky.

Nycticeius humeralis. Evening bat.—(state endangered). The evening bat forms maternity colonies in buildings or in hollow trees. It is not known where this species hibernates, but we suspect it may be in hollow trees along larger streams to the south of Indiana. Eleven maternity colonies of this species were known from buildings in Indiana 30 years ago (Whi-

taker & Gummer 1993) and one additional colony was found in Briley Chapel, near Clay City, Clay County in July 1987. All of these sites were roughly along tributaries from major rivers (Map 1). Whitaker & Gummer (1993) checked the original maternity roosts and also mistnetted in the vicinity of each of the 11 original colonies, and found no evidence that any of these colonies was currently active. Also, the evening bats abandoned Briley Chapel by 1992. No active evening bat colonies were known in Indiana when this study was initiated.

***Corynorhinus rafinesquii*.** Rafinesque's big eared bat.—(considered as accidental in Indiana). This species most often forms maternity colonies in hollow trees or buildings and hibernates in caves, especially in the northern part of its range. However, it may live in caves year round; and there are records of maternity colonies in cisterns. This species was always rare in Indiana. There are only eight existing specimens (Mumford 1969), and there are records of only 17 individuals from Indiana as follows: (a) Eight from the caves of Spring Mill State Park, (Lawrence County), the last in 1907. (b) Three from two small caves east of Saltillo (Washington County). (c) Two from Greencastle (Putnam County) 26 November 1894. (d) one from a cave at Kossuth (Washington County), 25 October 1955. (e) one from a cave near Smedly (Washington County), 21 December 1962, (f) one from a culvert, at Lafayette (Tippecanoe County), in the winter of 1959. This is the northernmost record of this species in the United States. (g) one from Squire Boone Cave (Perry County), seen several times in the summer of 1992. All these records could be of accidental stragglers from Kentucky.

OTHER SPECIES

Other species that should occur in the southern Indiana bottomlands community (Mumford & Whitaker 1982) are the big brown bat, *Eptesicus fuscus* (Palliot de Beauvois 1796), the little brown myotis, *Myotis lucifugus* (Le Conte 1831), the northern myotis *Myotis septentrionalis* (Trouessart 1897), the red bat, *Lasiurus borealis* (Muller 1776), the eastern pipistrelle, *Pipistrellus subflavus* (F. Cuvier 1832), the hoary bat *Lasiurus cinereus* (Palliot de Beauvois 1796), and occasionally during spring and fall migration, the silver-

haired bat (*Lasionycteris noctivagans* (Le Conte 1831). Leib's bat, *Myotis leibii* (Audubon & Bachman 1842) has never been taken in Indiana, but also could occur since it has been taken in Missouri and Kentucky, and one individual (the type specimen) was collected in Ohio.

The principal objective of this project was to search for populations of any of the five rare and endangered species of bats (*Myotis austroriparius*, *M. grisescens*, *M. sodalis*, *Nycticeius humeralis*, or *Corynorhinus rafinesquii*) or of Leib's myotis, (*Myotis leibii*), in the lower Wabash, White and Ohio River basins of southern Indiana. The second objective was to provide information on the bat community composition of this area.

METHODS

Sampling was by mistnetting over bayous, swamps and streams in or near the bottomlands along the Ohio and Wabash Rivers (including the lower White River) in southern Indiana. Sampling was carried out from 1992 through 1999. Sites were over water with canopy, especially in or near areas where large hollow or dead standing trees occurred. Sampling at each site was from dusk to 2400 h or 0100 h. Data recorded were type of habitat, water depth and permanence, type of stream bottom, species and size of trees, and whether there were hollow trees or trees with loose bark present. For comparison, data are presented as number of bats per net-night (one net used for one night).

RESULTS

During these studies, a total of 249 nettings was made 176 in the Prairie Creek area, and 73 in the remaining 17 counties (Tables 1–3). The total number of bats taken during the study numbered 1811, including all ten species currently known to exist in Indiana. These included three of the five target species, the Indiana and gray myotis, federally endangered, and the evening bat, considered to be state endangered. No southeastern myotis nor Rafinesque's big-eared bats were netted. In order of decreasing abundance, 596 evening bats, 315 big brown bats, 302 northern myotis, 208 red bats, 163 little brown bats, 152 eastern pipistrelles, 58 Indiana myotis, 9 gray myotis, 5 hoary bats, and 3 silver-haired bats were netted. The evening bat predominated

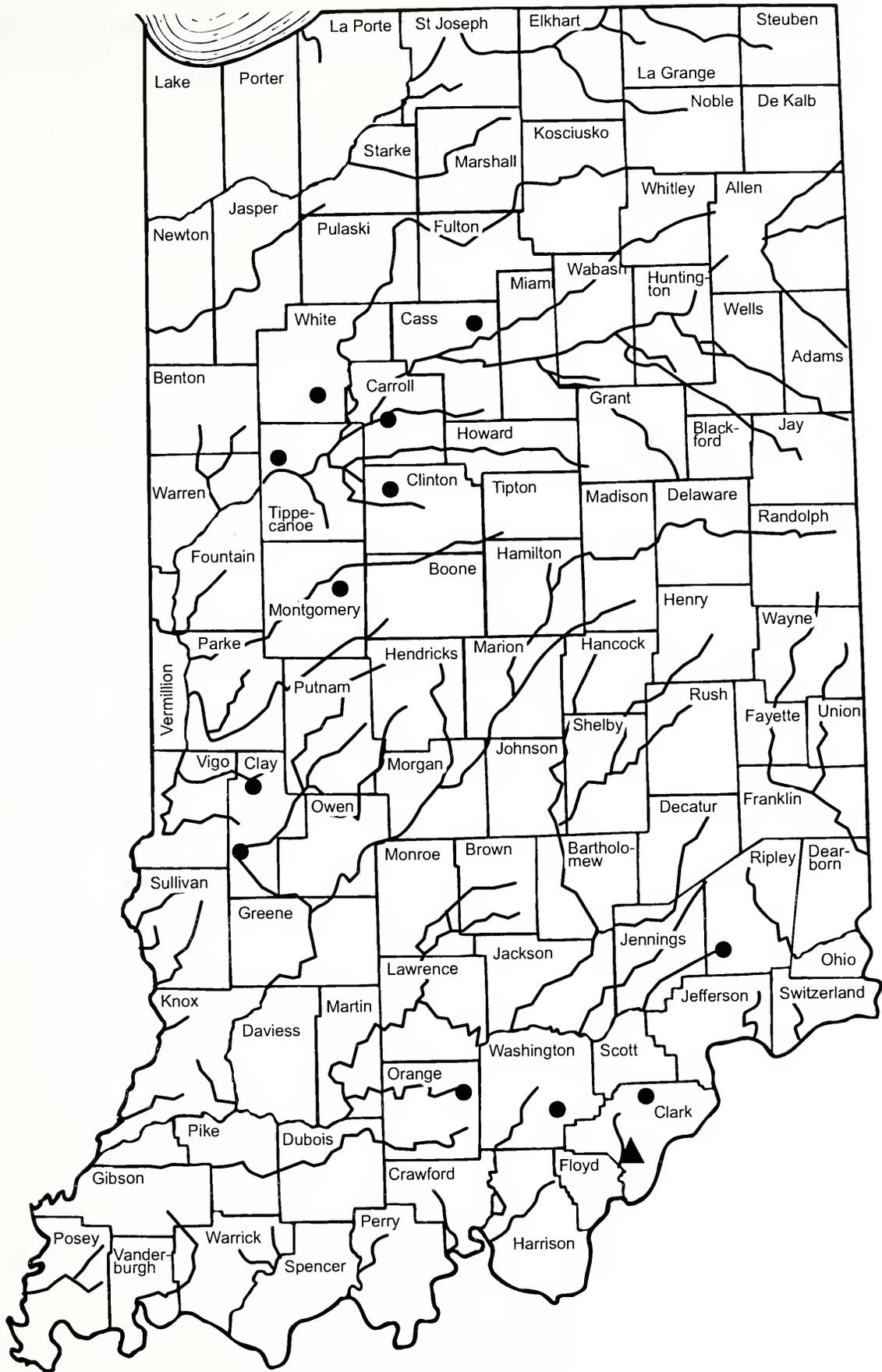


Figure 1.—Map showing location of maternity colony of the gray bat, *Myotis grisescens* (▲) and earlier locations of maternity colonies of the evening bat, *Nycticeius humeralis* (●) in Indiana.

Map 2.

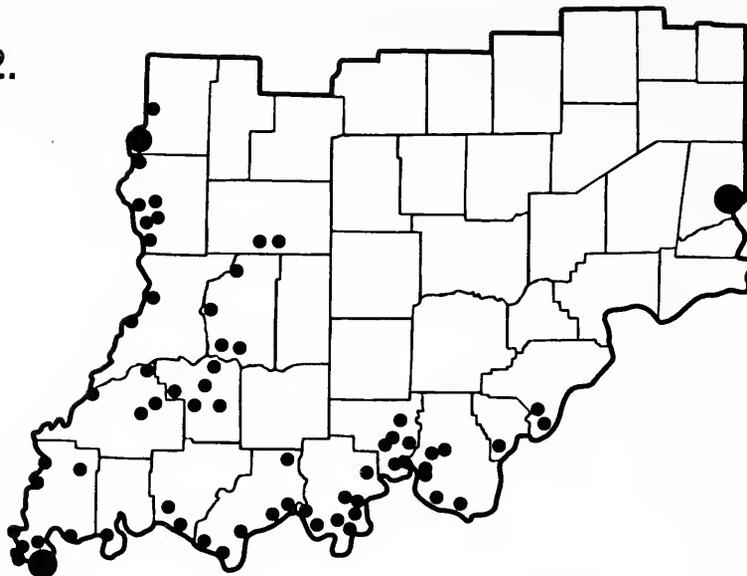


Figure 2.—Map showing netting localities for Wabash/Ohio basin study, 1992–1999. Large circles (●) represent more than one netting site, Prairie Creek in Vigo County, Hovey Lake in Posey County and the Oxbow area of Dearborn County.

(558) because of the great amount of netting at Prairie Creek in Vigo County where it was the most abundant bat species.

A map showing the general location of all the sites netted is given (Fig. 2, Map 2) and also a separate map is given showing the general locations where each of the species of bats was caught (Figs 3, 4, Maps 3–12). Specific information for each netting site along with a map pinpointing the site is given in an appendix to a report of this work to the Indiana Department of Natural Resources. Copies of this appendix can be obtained from IDNR or from the author.

BAT COMMUNITIES

Although most of the counties sampled during this study were along the Wabash or Ohio Rivers, it seemed desirable to include data from Pike, Daviess and Greene Counties on the lower White and Patoka Rivers in the Wabash lowlands. Posey County is bounded on the west by the Wabash River, and on the south by the Ohio River, but because of its biological affinities it was considered with the Wabash rather than with the Ohio basin (Tables 1–2). Since there was a great amount of information from the Prairie Creek area, and since there were important differences between the lower Wabash and the Ohio River basins, data from these three areas were considered separately.

Collectively, the Prairie Creek area had the

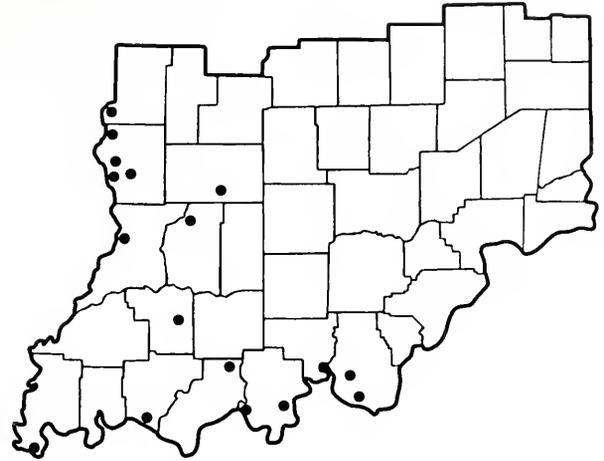
greatest concentration of bats, with a total of 1439 captures of all bat species combined, for a rate of 8.18 per net-night. In the lower Wabash basin, the rate was 5.78 per net-night and in the Ohio basin, 4.43 per net-night. Both the Prairie Creek and the Wabash basin bat community contained all species except the gray bat. However, the gray bat is rare in Indiana, with only one or two colonies being known in the state (one at Sellersburg and one at Charlestown) in Clark County in southeastern Indiana. These two areas are about 5 miles (8 km) apart and bats move between them, therefore it is not clear whether one or two colonies are actually involved. The Ohio Basin bat community contained all species except the evening bat.

Wabash River bottomlands.—Including Prairie Creek, all nine of the species of bats that one would expect in this part of the state were taken in the lower Wabash lowlands. Of the ten species which currently occur in the state, only the gray bat was missing, and it occurs only in southeastern Indiana and in nearby Kentucky. The bats of the lower Wabash basin in order of decreasing occurrence were (Tables 1, 2) *Myotis septentrionalis* (1.08), *Nycticeius humeralis* (1.06), *Myotis lucifugus* (1.00), *Lasiurus borealis* (0.89), *Eptesicus fuscus* (0.83), *Pipistrellus subflavus* (0.58), *Myotis sodalis* (0.25) and *Lasiurus cinereus* (0.08). Although *M. septentrionalis* was taken in the greatest number in the lower

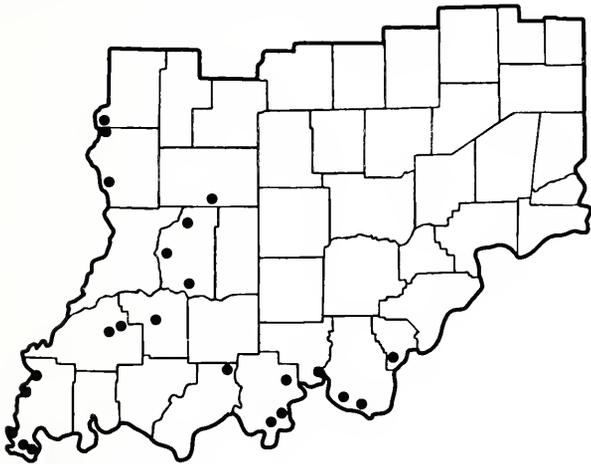
Map 3. *Myotis grisescens*



Map 4. *Myotis lucifugus*



Map 5. *Myotis septentrionalis*



Map 6. *Myotis sodalis*



Map 7. *Lasionycteris noctivagans*



Map 8. *Pipistrellus subflavus*

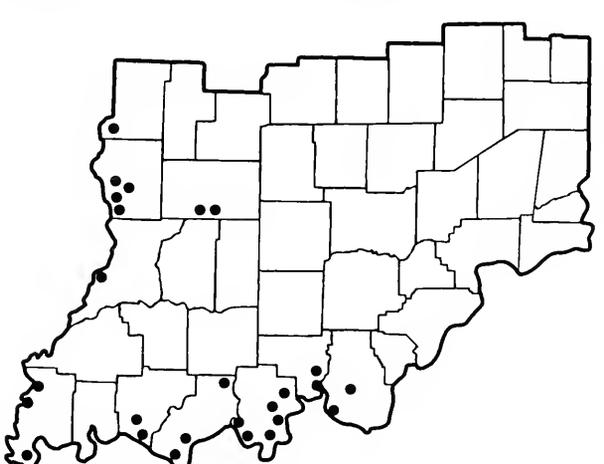


Figure 3.—Localities where various species of bats were netted during Wabash/Ohio basin studies. (Map 3) *Myotis grisescens* (stars indicate maternity colony sites); (Map 4) *Myotis lucifugus*; (Map 5) *Myotis septentrionalis*; (Map 6) *Myotis sodalis*.

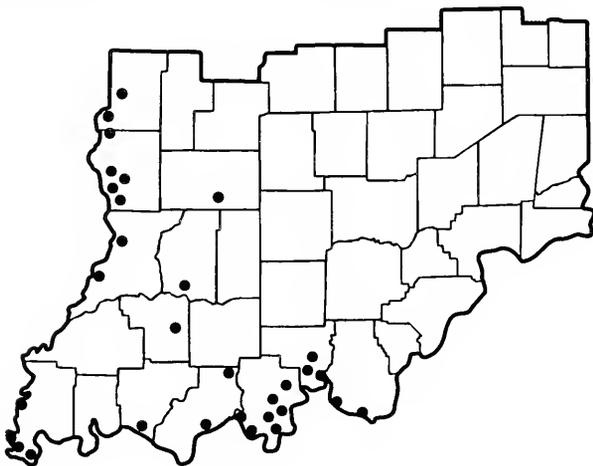
Map 9. *Nycticeius humeralis*Map 10. *Eptesicus fuscus*Map 11. *Lasiurus borealis*Map 12. *Lasiurus cinereus*

Figure 4.—Localities where various species of bats were netted during Wabash/Ohio basin studies (continued). (Map 7) *Lasionycteris noctivagans*; (Map 8) *Pipistrellus subflavus*; (Map 9) *Nycticeius humeralis*; (Map 10) *Eptesicus fuscus*; (Map 11) *Lasiurus borealis*; and (Map 12) *Lasiurus cinereus*.

Wabash basin (39 individuals, 1.08 per net night), only one less evening bat was taken. *Myotis septentrionalis* is a common species of the bottoms being the third most abundant species at Prairie Creek, and the fourth most abundant in the Ohio basin.

Myotis lucifugus, *M. septentrionalis*, *Eptesicus fuscus* and *Lasiurus borealis* were each captured in all but one of the seven counties in the Wabash basin, and *Pipistrellus subflavus* was captured in all but two. Thus these species, as would be expected, seem to be common and well distributed throughout the Wabash basin.

Ohio River basin.—Thirty-seven nights of netting were carried out and 164 bats of 7 species were captured in 9 counties in the Ohio River basin (Tables 1, 2). *Lasiurus borealis* was the most abundant (1.22 per net night),

followed by *Pipistrellus subflavus* (1.05), *Eptesicus fuscus* (0.84), *Myotis septentrionalis* (0.70), *Myotis lucifugus* (0.35), *M. grisescens* (0.24) and *L. cinereus*, with only one being netted (0.03). No Indiana myotis, silver-haired bats or evening bats were taken in the Ohio basin. Apparently Indiana myotis are increasingly uncommon in southern Indiana, but, it seemed surprising that we did not net any, especially since six were taken in Posey County. Silver-haired bats probably would have been taken if spring or fall sampling had occurred. No evening bats were taken in the Ohio basin, except in southern Posey County. Most of the earlier records of evening bats in Indiana were also up the Wabash and White River rather than in the Ohio valley (Whitaker & Gummer 1993). Even two earlier colonies in Washington and Clark Counties of southeastern Indi-

Table 1.—Bats netted along Wabash and Ohio River basins of Indiana, 1992–1999.

County	No. nets	<i>Myotis</i>										Total
		<i>Myotis lucifugus</i>	<i>Myotis septentrionalis</i>	<i>Myotis sodalis</i>	<i>Myotis grisescens</i>	<i>Lastiurus borealis</i>	<i>Lastiurus cinereus</i>	<i>Lastonycteris noctivagans</i>	<i>Pipistrellus subflavus</i>	<i>Nycticeius humeralis</i>	<i>Eptesicus fuscus</i>	
Northern Wabash River Basin—Prairie Creek												
Vigo	176	114	237	49	0	131	1	3	92	558	254	1,439
Other Wabash River Basin Counties												
Sullivan	7	8	2	1	0	14	3	0	5	9	6	48
Knox	2	3	0	0	0	5	0	0	3	0	1	12
Gibson	4	0	4	2	0	0	0	0	0	0	7	13
Pike	5	3	1	0	0	3	0	0	1	0	0	8
Daviess	4	3	5	0	0	1	0	0	0	0	2	11
Greene	2	2	1	0	0	3	0	0	6	0	12	24
Posey	12	17	26	6	0	6	0	0	6	29	2	92
Wabash total	36	36	39	9	0	32	3	0	21	38	30	208
Ohio River Basin Counties												
Vanderburgh	1	0	0	0	0	0	0	0	0	0	1	1
Warrick	2	1	0	0	0	8	0	0	10	0	0	19
Spencer	6	3	2	0	3	5	0	0	3	0	9	25
Perry	10	5	21	0	1	22	1	0	16	0	1	67
Crawford	5	0	0	0	0	2	0	0	4	0	0	6
Harrison	6	4	2	0	3	8	0	0	6	0	1	24
Floyd	1	0	1	0	1	0	0	0	0	0	0	2
Clark	2	0	0	0	1	0	0	0	0	0	2	3
Dearborn	4	0	0	0	0	0	0	0	0	0	17	17
Ohio total	37	13	26	0	9	45	1	0	39	0	31	164
Total	249	163	302	58	9	208	5	3	152	596	315	1,811

Table 2.—Bats of Prairie Creek, the Wabash basin south of Vigo County, and the Ohio Basin of southwestern Indiana. Posey County was included in the Wabash, not the Ohio basin. The number of bats and number of nettings with bats are given first, followed by the number of bats per netting and the percentages of nettings with bats (in parentheses).

Number of nettings	Prairie Creek 176		Wabash Basin 36		Ohio Basin 37		Total 249
	No. bats	No. coll. with bats	No. bats	No. coll. with bats	No. bats	No. coll. with bats	
<i>Nycticeius humeralis</i>	558 (3.17)	113 (64.2)	38 (1.06)	6 (16.7)	0	0	596 (2.39)
<i>Eptesicus fuscus</i>	254 (1.44)	94 (53.4)	30 (0.83)	10 (27.8)	31 (0.84)	8 (21.6)	315 (1.27)
<i>Myotis septentrionalis</i>	237 (1.35)	94 (53.4)	39 (1.08)	13 (36.1)	26 (0.7)	7 (18.9)	302 (1.21)
<i>Lasiurus borealis</i>	131 (0.74)	64 (36.4)	32 0.89	13 (36.1)	45 (1.22)	14 (37.8)	208 (0.84)
<i>Myotis lucifugus</i>	114 (0.65)	56 (31.8)	36 (1.0)	9 (25)	13 (0.35)	6 (16.2)	163 (0.66)
<i>Pipistrellus subflavus</i>	92 (0.52)	62 (35.2)	21 (0.58)	10 (27.8)	39 (1.05)	14 37.8	152 (0.61)
<i>Myotis sodalis</i>	49 (0.28)	34 (19.3)	9 (0.25)	5 (13.9)	0	0	58 (0.23)
<i>Lasionycteris noctivagans</i>	3 (0.02)	3 (1.7)	0	0	0	0	3 (0.01)
<i>Lasiurus cinereus</i>	1 (0.006)	1 (0.6)	3 (0.08)	2 5.6	1 (0.03)	1 2.7	5 (0.02)
<i>Myotis grisescens</i>	0	0	0	0	9 (0.24)	6 16.2	9 (0.04)
Total	1439 (8.18)		208 (5.78)		164 (4.43)		1811 (7.27)

ana could have been from a Wabash/White River origin, rather than from an Ohio River origin.

Nine gray myotis were taken in four counties in the Ohio River basin, whereas no gray myotis were taken in the Wabash River basin. This is logical as the only gray myotis colonies known in Indiana are in Clark County,

although there appear to be two in adjacent Breckenridge County (Kentucky), one just east across the Ohio River from Rome (Perry County), along Yellowbank Creek, and one about 10 miles (16 km) southeast of Rome along Hardin's Creek.

Eastern pipistrelles reached their highest levels in the Ohio River basin (1.05 per net-

Table 3.—Bats netted at Prairie Creek, 1994 through 1999.

Date	<i>Nycticeius</i>	<i>Lasiurus borealis</i>	<i>Myotis septentrionalis</i>	<i>Eptesicus fuscus</i>	<i>Pipistrellus subflavus</i>	<i>Myotis sodalis</i>	<i>Myotis lucifugus</i>	<i>Lasionycteris noctivagans</i>		Total
	<i>humeralis</i>							<i>cinereus</i>		
1994	50	23	23	63	6	12	2	2	0	181
1995	97	19	39	38	13	7	18	1	0	232
1996	36	5	12	26	4	0	16	0	0	99
1997	115	30	96	63	33	20	22	0	0	379
1998	59	12	21	18	9	5	5	0	1	130
1999	201	42	46	46	27	5	51	0	0	418
Total	558	131	237	254	92	49	114	3	1	1439

night), as opposed to 0.58 and 0.52 in the lower Wabash River basin and Prairie Creek areas. Again, this may be a reflection of the southern affinities of this species. The northern and little brown myotis occurred at their lowest rates per net-night in the Ohio River basin (0.7 and 0.35) as compared to 1.08 and 1.35 for the northern myotis in the lower Wabash basin and 1.0 and 0.65 for the little brown myotis. Big brown bats occurred at a rate of 0.84 making it the third most abundant bat by number per net-night. Many of the big brown bats originated in Dearborn and Vanderburgh Counties near the cities of Lawrenceburg and Evansville, respectively.

Prairie Creek bat community.—On 25 July 1994, a site was sampled on lower Prairie Creek in Vigo County and 15 bats of six species were captured. Included were one Indiana myotis (federally endangered) and six evening bats (state endangered). This community was located in about 650 h of contiguous bottomlands forest. From the first netting, it was obvious that this site contained an abundant and biologically diverse bat community and deserved intensive study. Consequently, weekly samplings of the area were initiated in 1994 and are still occurring. From 1994 through 1999, we made 176 mist-nettings at Prairie Creek. Except for one red bat taken at Clear Creek, all the bats from Vigo County were netted in the Prairie Creek area (Tables 1–3). The Prairie Creek data will be briefly summarized, but was presented more completely elsewhere (Whitaker 1997).

The most abundant bat in the Prairie Creek area was the Evening bat, *Nycticeius humeralis* (558 individuals taken, 3.17 per net-night), followed in order of decreasing abundance by the big brown bat, *Eptesicus fuscus* (254, 1.44), the northern myotis, *Myotis septentrionalis* (237, 1.35), the red bat, *Lasiurus borealis* (131, 0.74), the little brown myotis, *Myotis lucifugus* (114, 0.65), the eastern pipistrelle, *Pipistrellus subflavus* (92, 0.52), the Indiana myotis, *Myotis sodalis* (49, 0.28), the silver-haired bat, *Lasionycteris noctivagans* (3, 0.02) and the hoary bat, *Lasiurus cinereus* (1, 0.006). *Nycticeius humeralis*, and also *Eptesicus fuscus*, and *Myotis septentrionalis* were taken at greater rates at Prairie Creek than in the lower Ohio or lower Wabash basin.

THE BAT SPECIES

Gray myotis, *Myotis grisescens*.—Gray myotis were limited to the Ohio River Basin during this study in 6 of 37 (16.2%) net sites (0.24 per net-night) (Tables 1, 2; Map 3). This would be expected, as the only roost or roosts of this species known in the state are in Clark County, although there are apparently two roosts in nearby Breckenridge County, Kentucky. Gray myotis presumably hibernate in Tennessee and Alabama, although we have seen a few individuals among the hibernating masses of Indiana myotis in Crawford and Harrison Counties in Indiana. Gray myotis will fly great distances to feed, and we have taken three gray bats in Harrison, three in Spencer and one each in Perry, Floyd and Clark Counties. It is possible that they originated in Clark County. However, some of these bats are far from Clark County. The gray myotis in southern Spencer County was a juvenile female, and probably came from Kentucky, whereas the three in northern Spencer County, the one in Perry County, and the three in Harrison County were all males, and could have originated in Clark County or in Kentucky. The gray myotis from Floyd County, a male juvenile, and the one from Clark County, an adult female, were probably directly from the Clark County sites.

It is not known where gray myotis from Indiana spend the winter. Presumably all gray myotis in the east hibernate in five caves in Alabama and Tennessee. On 8 April 1999, Whitaker and L. Pruitt entered the Sellersburg Quarry assuming that the gray myotis would not have returned from their hibernacula. However, at least 200 gray myotis were in one cluster inside the quarry on that date. The bats were located by hearing their calls from some distance away. They were fully awake and within two minutes of the time we first shined a light on them, all had moved away from that area. Dusk counts made at intervals during that summer indicated that the colony in mid-summer included somewhat less than 2000 individuals. However, we were again surprised that, on 11 November, gray myotis were still present. We counted 54 exiting from the quarry between 1800–1830 h that night (temperature about 15° C), and wondered if gray myotis might hibernate there since it was so late in the season, and since Tuttle (1976) had stat-

ed that the summer season for this species extended from late April through late August. However, we explored the quarry on 8 March 2000 and found no bats hibernating there. Several male gray myotis were netted in streams along the Ohio River (Map 3), whereas females and juveniles were taken near Sellersburg. Perhaps the males spread out and summer in the lower part of the migratory path, rather than competing for food with the young and females. Continued increase in numbers at Sellersburg, the occurrence of males in tributaries along the Ohio River, perhaps on migratory routes, and the individuals found in hibernation in caves suggest that this species is doing rather well in summer, and perhaps could be initiating hibernation in Indiana.

Little brown myotis, *Myotis lucifugus*.—*Myotis lucifugus* was netted in 56 (31.8%) of the Prairie Creek nettings), at 9 of 36 (25%) sites in the lower Wabash basin and at 6 of the 13 (16.2%) of the sites in the Ohio River basin (Tables 1–3; Map 4). It was the fifth most abundant species at Prairie Creek (0.65 per net-night), but did not produce young there. It was taken in lower numbers in the Ohio basin (0.35), but was fifth in abundance there also. It was taken in higher numbers in the lower Wabash basin (1.00, fifth in abundance). Although not shown by these data, we generally consider this species to be the third most abundant species of bat in the state after the red and big brown bats, although we suspect it may be declining both in absolute numbers and in relation to big brown bats. If such a decline is real, it may be due to adverse competition with big brown bats for suitable roosting sites in buildings. However, its relative low abundance in this study is probably related to lack of human habitations in the bottoms, as this species almost always forms maternity roosts in buildings. Many of the little brown myotis were netted during migration or late in the season after the young were volant.

Northern myotis, *Myotis septentrionalis*.—*Myotis septentrionalis* (Tables 1–3, Map 5) was the third most abundant species at Prairie Creek (1.35 per net-night), the most abundant species in the lower Wabash River basin (1.08), and the fourth most abundant species in the Ohio River basin (0.70). It was taken in 13 of the 36 (36.1%) sites in the low-

er Wabash and 7 of the 37 (18.9%) sites in the lower Ohio basin. It apparently forms maternity colonies at Prairie Creek, although little radio-tracking of this species has been done there to date. We consider this to be about the fourth most abundant species of bat in Indiana. It is a woodland species, thus the results in this study are not surprising. Although it is a common species and hibernates in caves, it was seen in small numbers in caves, because it hibernates in small cracks and crevices in caves and mines (Whitaker & Rissler 1992).

Indiana bat, *Myotis sodalis*.—There were 58 captures of Indiana myotis during this study, 49 in the Prairie Creek area of Vigo County, one in Sullivan County, two in Gibson County and six of them in Posey County (Tables 1, 2, Map 6). Indiana myotis were taken at similar rates at Prairie Creek (0.28 per net-night) and in the Wabash River basin (0.25), but none were taken in the Ohio River basin, probably indicating its greater abundance during summer in northern, rather than in southern Indiana.

Two Indiana myotis, both lactating females, were netted in Gibson County on 10 June 1993. They were taken along a ditch near the Patoka River just west of the Sugar Creek State Fish and Wildlife Area and of the newly developed Patoka National Wildlife Refuge. No other Indiana myotis were taken that night. These two bats probably indicated the presence of a maternity colony of this species near the capture site.

The Indiana myotis was the seventh most abundant species at Prairie Creek. There was no evidence of a maternity colony of this species earlier; but in 1997, 19 Indiana myotis were taken, seven of them pregnant or lactating females. It appeared that a maternity colony had been established in or near the study area in 1997, but unfortunately none were radio-tracked there. Unfortunately, in September 1997 the entire 4.0 km north/south section of the study area was bulldozed. All trees were removed in a 30 m wide swath extending westward from the eastern bank of Prairie Creek, and the southern half km of the stream was channeled as well. The trees were stacked up at the western edge of the swath. This was a major US waterways violation. The Army corps of engineers issued a cease work order, and all work was stopped. However, all four

of our main study sites on the north/south portion of the stream had been destroyed, but the east/west section of Prairie Creek was little affected. In 1998, logging commenced in summer which further damaged the site. There was no evidence of a maternity colony in 1998 or 1999, although we were unable to determine if this resulted from the violation.

Silver-haired bat, *Lasionycteris noctivagans*.—*Lasionycteris noctivagans* was taken at Prairie Creek (Tables 1–3, Map 7) but not elsewhere undoubtedly because it is a spring and fall migrant. This species does not occur in Indiana during summer, but migrates through the state in spring and fall. Prairie Creek was netted in spring and fall, the other areas mainly in summer. It is surprising that more silver-haired bats were not netted at Prairie Creek.

Eastern pipistrelle, *Pipistrellus subflavus*.—The Eastern pipistrelle was the sixth most abundant species at Prairie Creek (0.52), and was taken at a similar rate in the lower Wabash River basin (0.58), but at a higher rate in the Ohio River basin (1.05). It was netted at 10 (27.8%) of the sites in the lower Wabash River basin, and in 14 (37.8%) of the sites in the Ohio River basin (Tables 1–3, Map 8). The eastern pipistrelle is a southern species pretty much reaching its northern limits in Indiana, which probably explains its greater abundance in the Ohio River basin. We expected to find pipistrelles in tree hollows, since pipistrelles will roost in buildings (Whitaker 1998). However, radios attached to pipistrelles in late 1997 through 1999 by Jacques Veilleux (unpubl. data) enabled him to locate 21 roosts. To our surprise, the pipistrelles, without exception, were roosting in clumps of leaves (one in a squirrel nest), rather than in hollows in trees. Most clumps were of brown dead leaves, but two were in green leaves. Pups were seen in some of the clusters.

Evening bats, *Nycticeius humeralis*.—The evening bat is listed as endangered in Indiana. At the outset of this study, no active evening bat maternity colonies were known to remain in the state. Thirteen colonies had been previously known from buildings in Indiana (Whitaker & Gummer 1993; Clem 1992; Whitaker & Clem 1992), but all were now inactive. It had appeared that this was a species that formed maternity colonies in buildings in Indiana. However, a total of 596 of the 1811

bats netted (33.0%) during this study were evening bats (Tables 1–3, Map 9). Most of them, 558 individuals, were taken in the Prairie Creek study area of Vigo County, amounting to 38.7% of the 1439 bats taken there. Besides those taken in Vigo County, 38 of the 372 bats netted in other counties (10.2%) were evening bats. Nine of the other 38 evening bats taken to date during this study were from Sullivan County and 29 were from Posey County. Two from Sullivan County were females from Busseron Creek, thus there is probably a maternity colony near there. The other seven were from just south of the Sullivan County line, therefore were undoubtedly from the Prairie Creek population. In Posey County, males were taken near Cypress Slough near Goose Pond, at Hovey Lake and at Slim Pond. Six of the 12 Posey County sites yielded a total of 29 evening bats. At one site an evening bat was radio-tagged and tracked to a silver maple tree across the Wabash River to the south in Illinois. Another site where evening bats were netted was west of the Wabash River on the southern edge of Great-house Island in an old bed of the Wabash River. It was on the Indiana/Illinois state line. Eighteen evening bats were netted there on 17 July 1996, including at least 13 females indicating that the maternity colony was very close to this site. It is clear that the evening bat is relatively common in the floodplain of the lower Wabash River in southwestern Indiana. We suspect that this species occurs commonly in the extensive bottomland woods in Gibson County, but this area has not been adequately netted.

Several evening bats were radio-tracked in late summer, 1994 at Prairie Creek (T10N R10W, Section 13, Hutton Quadrangle), but none of the radioed bats roosted in buildings. Two were tracked to four separate hollow silver maple trees in the large bottomlands woods (Whitaker 1997). On 17 June 1995, a transmitter was placed on an adult female evening bat and she was tracked to a silver maple tree. That night at least 350 bats emerged from what appeared to be a pileated woodpecker hole about 12 m up in that tree. More recently, Sherry Beland has tracked many more evening bats to a number of trees in these same woods.

It is not known where evening bats hibernate. We have surmised that it could be in

hollow trees near larger rivers to the south of Indiana or at least far enough south so that the temperature inside of the trees does not fall below freezing. All of the adult evening bats taken at Prairie Creek in 1999 ($n = 145$) and 2000 ($n = 107$) were females (total = 252), whereas twelve of 28 (42.9%) of the adult evening bats from Posey County were males. Males are seldom associated with maternity colonies at least in numbers. Why then, did we get so many males in Posey County? Might the males remain to the south of the female range during the maternity season, then both sexes migrate south together? Or perhaps southern Indiana is the northern edge of the hibernating range, and the males stay there all year. Additional data are needed on sex, age and temporal distribution of evening bats in Posey counties to determine if the northern edge of the hibernating range for this species might be in southwestern Indiana.

Big brown bat, *Eptesicus fuscus*.—We consider the big brown bat to be the most abundant bat in the state. We think it has attained its abundance because of its ability to use the structures built by humans as their primary roost sites both for maternity colonies and for hibernation. The big brown bat (Tables 1–3, Map 10), was the second most abundant species (1.44 individuals per net night) at Prairie Creek, the fifth most abundant in the lower Wabash Riverbasin (0.83), and the third most abundant in the Ohio River basin (0.84). Big brown bats were found at 10 of the 36 (27.8%) sites in the lower River Wabash basin and at 8 of the 37 sites (21.6%) in the Ohio River basin. We were somewhat surprised that it was this abundant at Prairie Creek, since they roost almost entirely in buildings in Indiana, and there are very few buildings in the bottoms, and few within a mile of the study site. Interestingly, big brown bats were not found at Prairie Creek during the maternity season at least during the early years of the study. However, they appeared there from August–October, after the young became volant. Two were radio-tracked to a dead cottonwood tree in the main portion of the woods just east of Prairie Creek. Totals of 15 and 16 big brown bats were observed to emerge from a crack in this tree about 12 m above the ground on 2 and 12 October, respectively, 1995. Since this was after the maternity season, we referred to this tree as a post-maternity roost. It

may have served the bats as a roost close to foraging grounds in late summer and fall. Big brown bats were also present in that or nearby trees in late 1996 and 1997.

Red bat, *Lasiurus borealis*.—We consider the red bat to be the second most abundant bat in Indiana, followed by the little brown myotis. It was the most abundant bat in the Ohio River basin (1.22 per net night), but second at Prairie Creek (1.44 per net-night), and fourth (0.89) in the Wabash River basin (Tables 1–3, Map 11). It occurred at 13 of the 36 (36.1%) sites in the Wabash River basin and at 14 of the 37 (37.8%) sites in the Ohio River basin. Perhaps the red bat is less abundant at Prairie Creek because that species is more associated with upland or oak-hickory forest, whereas most of the trees at Prairie Creek are silver maples and sycamores, although much sycamore and silver maple occurred in the Ohio and Wabash River basins as well.

Hoary bat, *Lasiurus cinereus*.—Hoary bats produce young in Indiana, but the species is relatively rare here, and only five individuals were taken during this study, one at Prairie Creek, three in the lower Wabash Basin and one in the Ohio basin (Tables 1–3, Map 12).

DISCUSSION

Three of the bat species targeted in this study were found in southwestern Indiana, the gray myotis, the Indiana myotis and the evening bat. Rafinesque's big eared bat and the southeastern myotis were not captured. We consider the big-eared bat to be of accidental occurrence in the state and the southeastern myotis to be nearly extirpated. Leib's myotis was watched for, but was not found during this study, and has never been taken in the state.

Neither *Myotis austroriparius* nor *Corynorhinus rafinesquii* was taken during this study, although there was one report of each of these species as the study was occurring, *M. austroriparius* in 1998 along the White River just southwest of Washington (Daviness County), and *Corynorhinus rafinesquii* in 1992 at Squire Boone Caverns (Harrison County). Nettings were carried out at and just below Squire Boone Caverns during the present study, but no big-eared bats were captured.

Additional netting for *M. austroriparius* is needed southwest of Washington.

The other species expected in the bottomland forest areas were present: *Myotis lucifugus*, *M. septentrionalis*, *Pipistrellus subflavus*, *Eptesicus fuscus*, *Lasiurus borealis* and *L. cinereus*. There were some notable differences between the Wabash and Ohio River basins. In the lower Wabash River basin, the northern myotis and evening bat were the most abundant and widespread species, whereas in the Ohio River basin, the red bat and eastern pipistrelle were the most abundant and widespread. Probably the two most abundant bat species in Indiana are the big brown bat, followed by the red bat, thus it is not hard to understand the red bats' abundance. However, the big brown bat is closely associated with humans, living in various artificial structures. That our sampling was mostly in remote bottoms undoubtedly explains the relatively low number of big brown bats taken during this study.

The occurrence in the bottomlands of relatively large numbers of evening bats was of great interest, as we had been searching for this species in buildings for some years. All of the previously known *Nycticeius* maternity colonies were associated with buildings in Indiana (Mumford & Whitaker 1982). However, present data indicate an association of this species with large river bottom woods. Whitaker & Gummer (1993) had previously noted a general relationship between the colonies in buildings to the Wabash and White rivers (Map 1), which is consistent with this idea. Numerous evening bats were netted in the Wabash River bottoms from Vigo to Posey Counties, and a number of individuals have been radio-tracked to hollow trees. Prairie Creek and the Posey County sites, and to some extent the Busseron site are large flat wooded bottomland, the sorts of areas that are not developed or inhabited because they often flood. These data lead us to conclude that the southern Wabash River bottomland woods are similar to the typical ancestral habitat of this species in Indiana. Roosts previously known from buildings were probably either spillover from times when there were good populations in bottomland woods, or else show that this species was adapting well to humans and their structures the same as big brown bats and little brown myotis have done. However, the fact

that the previously known populations in buildings are all gone seems to indicate that this adaptation was not very successful, and perhaps that *Nycticeius* does not very successfully compete with big brown bats for roosts in buildings.

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