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DISTRIBUTION AND STATUS OF *MYOTIS AUSTRORIPARIUS* (SOUTHEASTERN BAT) IN ILLINOIS

FINAL REPORT MARCH 19, 1992

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Endangered Species Coordinator, Region 3, U.S. Fish and Wildlife Service,
Illinois Department of Transportation
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ABSTRACT

Myotis austroriparius is a very secretive species in Illinois, second only to *Plecotus rafinesquii* (Rafinesque's big-eared bat) in its rarity of occurrence. *Myotis austroriparius* is listed as an endangered species by the Illinois Endangered Species Protection Board; it is a Category 2 candidate species being considered for federally threatened or endangered species status by the United States Fish and Wildlife Service. The consensus of more than 40 authorities from states included in the range of the species is that it deserves at least a federally threatened status.

Previous to this study, incidental records of *M. austroriparius* were known from only nine caves or abandoned mines in Illinois; no maternity colonies or evidence of reproductively active populations had been reported in Illinois. Investigations of more than 52 caves and abandoned mines, of which many were historical locations, resulted in the determination that only one winter site is still inhabited.

Mist netting was conducted (1984 through 1991) at 55 sites scattered throughout the eleven southernmost Illinois counties in attempts to capture *Myotis austroriparius*. Sixty-eight *M. austroriparius* were captured at three of the 55 netting sites; one site each in Alexander, Pope, and Pulaski counties. The Cache River (Karnak) site in Pulaski County accounted for 93% of the captures of *M. austroriparius*.

Data for the 68 *M. austroriparius* captured in Illinois from 1987 through 1991 indicate parturition during early to mid-May. Lactating adults were captured from mid-May through mid-July; post lactating adult females and volant juveniles were first captured in mid-July over the Cache River. Males captured during 4 and 5 May and 5 July had enlarged epididymides.

Radiotransmitters were attached to 22 *M. austroriparius* in attempts to discover their maternity roosts and identify foraging ranges: one as a pioneering attempt in 1987, ten during 1989, and 11 during 1991. Lactating adults were tracked to a 105 cm dbh *Nyssa aquatica* (tupelo gum) in a forested palustrine wetland during 1989. Approximately 101 *M. austroriparius* were observed leaving this roost on 15 June 1989. One year later (25 July 1990) the roost was examined again and more than 75 *M. austroriparius* were observed. This roost was the first maternity colony of *M. austroriparius* discovered north of Louisiana and Florida, and is also the only summer maternity colony ever reported from a natural, non-cave structure.

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INTRODUCTION

Myotis austroriparius (Miller and Allen 1928), whose accepted vernacular is the southeastern myotis (Jones et al. 1986), is considered to be monotypic; *Myotis austroriparius gatesi* Lowery (1943) and *M. a. mumfordi* Rice (1955) are synonyms (LaVal 1970). Translated from the Greek origin, the specific name *austro* means southern, and *riparius* means frequenting edges of streams (Jones and Manning 1989). The species is considered to be a medium-sized myotis; in Louisiana, weights of males ranged from 5.1 to 6.8 g while that of females ranged from 5.2 to 8.1 g (Lowery 1974).

Myotis austroriparius is somewhat woolly in appearance with little or no contrast between the base and the tip of the hairs (Barbour and Davis, 1969; LaVal 1970; Hall 1981). The dorsal pelage varies from gray to bright orange-brown with the ventral pelage usually cream-colored or pinkish. Particularly in the case of females, the more grayish-colored specimens have been taken in autumn and winter and the more yellowish-colored in spring and summer (LaVal 1970). In the Jackson Purchase area of western Kentucky the females are generally more brightly colored than males (W. D. Hendricks, pers. comm.), but LaVal (1970) noted very little color difference between sexes in the specimens he examined from Illinois . Both males and females with bright orangish pelage have been captured in summer in Illinois during this study.

In *M. austroriparius*, the wing membrane is attached to the ankle, a characteristic shared only with *Myotis grisescens*. The baculum of *M. austroriparius* is small and differs from other species (e.g., *Myotis lucifugus*) with whom it may be confused (Davis and Rippey 1968). This characteristic can be used to identify specimens in alcohol (Rippy 1965) that would otherwise be indistinguishable on the basis of pelage alone. Although this species was first described by Miller and Allen (1928) as "having a low but perfectly definite and sharp-edged sagittal crest," this characteristic is no longer regarded as diagnostic in all cases (LaVal 1970).

Considered a species of the deep south (Barbour and Davis 1969), the range of *M. austroriparius* extends up the Mississippi River valley, reaching its northern limits in southern Illinois and Indiana and western Kentucky and Tennessee (Figure 1). The remainder of the geographic range of this species extends from southeastern Oklahoma and eastern Texas east through Arkansas and Louisiana to the northern half of Florida, then north along the Atlantic coastline to the southern portion of North Carolina (Hall 1981; Jones and Manning 1989). Previously, the species had been divided into three subspecies because the Louisiana, Florida, and southern Indiana and Illinois populations were thought to have been disjunct (Lowery 1943; Rice 1955; LaVal 1970). To date, the species is perhaps best known from Florida, in terms of large populations, colony sites, and natural

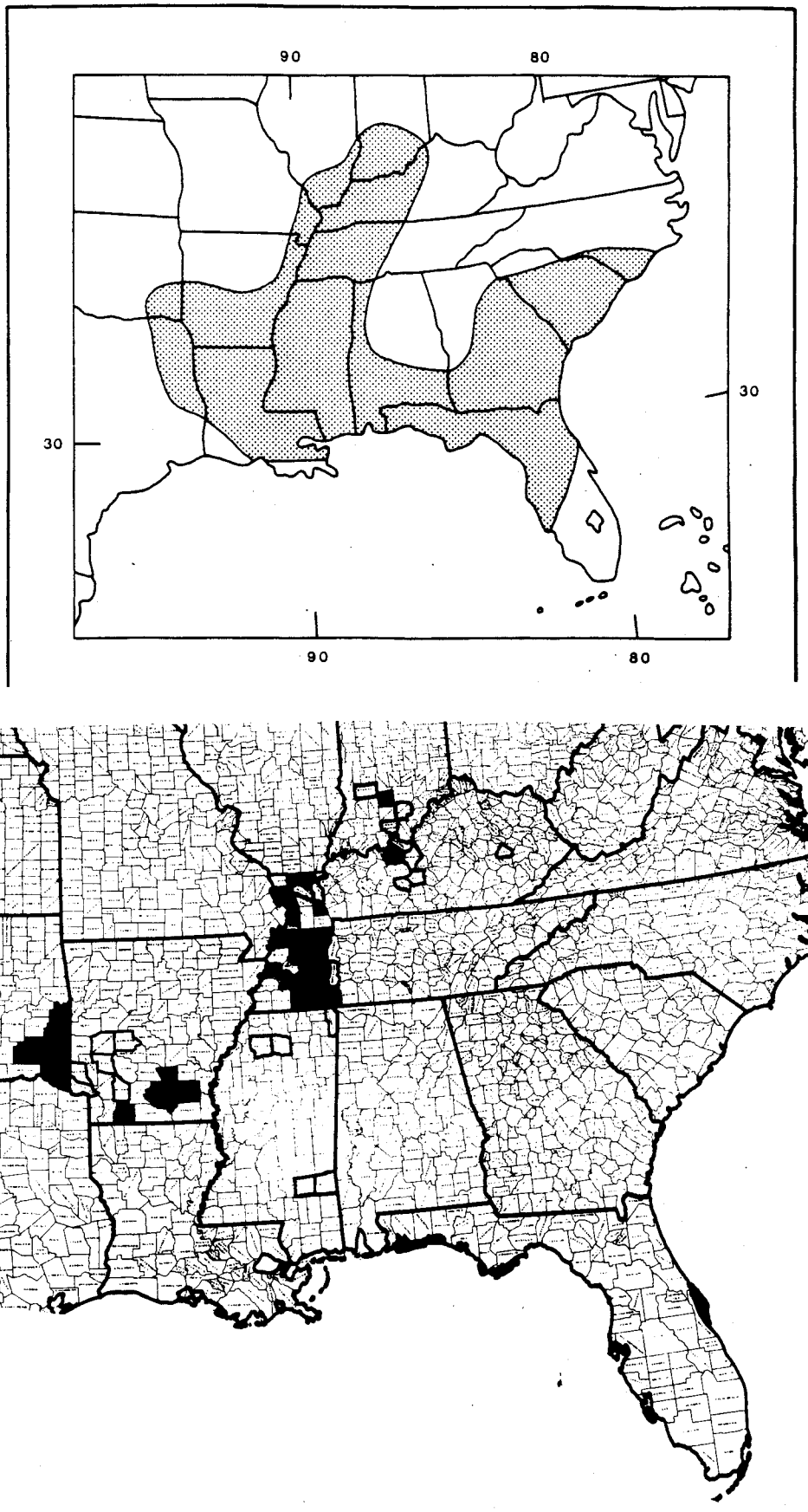

Figure 1. Distribution of *Myotis austroriparius* (southeastern bat) in the southeastern United States (upper map adapted from Jones and Manning 1989). Lower map indicates actual summer (filled) county records and winter (outlined) county records for selected states within the range of the species.

history (Rice 1957). Specific information on the distribution and status of this species in states other than Illinois was of great concern; therefore, comments and information were solicited from authorities in other states and were incorporated into this report.

In the upper Mississippi and Ohio rivers region, *M. austroriparius* hibernates (or at least enters torpor) for shorter periods than other cave-associated species of bats (late October through March). Rice (1957) thought that bats in the western Florida panhandle hibernate for about four or five months (late October until early March); however, individuals in the panhandle respond similarly to temperatures as do the bats in the peninsula, remaining active throughout much of the winter and feeding most of the time (Humphrey and Gore 1992). Bats were found to be semitorpid at temperatures below 40 degrees F in Louisiana, but they resumed their nightly foraging activities during warmer (presumed >40 degrees F) temperatures (Lowery 1974).

In Kentucky, greater numbers of bats are encountered hibernating in caves and mines during lower than average winter temperatures, but many are often fully awake when encountered (John MacGregor, pers. comm.). During hibernation, compact clusters may be found on the ceiling or walls of caves or beneath buildings (Jones and Pagels 1968; Lowery 1974; Mumford and Whitaker 1982). In Arkansas, this species has most frequently been found hibernating in abandoned mines (Davis et al. 1955; Heath et al. 1986; Saugey et al. 1989), and in concrete-lined abandoned water wells (D. A. Saugey, pers. comm.). With the exception of a single female, all records from Indiana were from winter caves (Mumford and Whitaker 1982).

In central Florida, maternity colonies began forming in caves during late March; all bats had arrived by early April. They gathered in large dense clusters of about 150 bats per square foot. Colonies, ranging in size from 2,000 to 90,000, were found most often over pools of water in caves (Rice 1957). Foster et al. (1978) thought that water was an important deterrent to predation, as well as the major factor responsible for maintenance of high humidity so necessary for the clusters of bats; however, roosting over water resulted in a higher rate of mortality for young bats that became dislodged and fell from the roost.

Most of the information concerning reproduction in this species comes from the work of Rice (1957) in Florida; details of its reproduction throughout the remainder of its range remain poorly known. In Florida, parturition occurred from late April to the end of May, with the peak of births in the second week of May; young bats were found as early as 30 April. Pregnant females were not detected after 17 May in the peninsular Florida colonies that were studied (Rice 1957); however, Foster *et al.* (1978) reported a 22 May parturition date for the northern (non-peninsular) Florida maternity colony they studied. Ninety percent of the pregnant females gave birth to twins; the remainder of the females produced one young.

Myotis austroriparius is unique among other members of its genus in the United States in that all other species normally produce one young. Young bats were capable of flight about 5 to 6 weeks after birth; the earliest date volant young were encountered was 9 June (Rice 1957). In peninsular Florida, some young were still non-volant by 3 July (Rice 1957), but by 4 July in the northern Florida colony most young were volant and had dispersed from the nursery (Foster *et al.* 1978).

During the Florida studies, Rice (1957) found that only 42% of the population was male; because sex ratios at birth were 1:1, he suspected higher mortality among males. Tabulation of sex ratios in several winter colonies in Indiana (Mumford and Whitaker 1982) revealed a predominance of males (56.3 to 77.4%).

In Florida, Rice (1957) found that nearly all males had enlarged epididymides from about 12 February to 16 April. Mumford and Whitaker (1982) reported males from Indiana with scrotal testes in March, April, and August, but noted that those with the largest testes were taken in August. R. E. Mumford reportedly found a copulating pair in Indiana on 23 November (Rice 1957). Rice (1957) examined males collected in Illinois on 29 November and 2 December which had enlarged epididymides. Smith and Parmalee (1954) reported males from the three compact clusters they found in Layoff Cave, Hardin County, Illinois on 21 December had enlarged testes. Few males are found in nursery colonies; however, many adult males joined the colonies after maturation of the young. The colonies dispersed during October, with males departing for winter quarters earlier than females (Rice 1957).

In winter, most bats leave their summer caves roosts and are usually found roosting over water in such places as crevices between bridge timbers, storm sewers, road culverts, the vertical drain pipes of concrete railroad bridges, and in boat houses and various other houses and buildings (Rice 1957; Barbour and Davis 1969; Lowery 1974). Fargo's (1929) report of a winter roost of *M. austroriparius* in a dead, hollow *Avicennia nitida nitida* (black mangrove tree) is the only documentation of this species use of "natural," non-cave structure. Even in Louisiana, where this species is somewhat commonly encountered, Lowery (1974) only speculated that they used hollow trees. Foster *et al.* (1978) discovered a nursery population roosting in a house chimney in Florida. One colony (>300 bats) was found during February hibernating in a fertilizer plant in Thomasville, Thomas County, Georgia. The plant building was a large shelter open on all sides; torpid bats were tightly packed into a long narrow crevice between two of the rafters supporting the roof.

According to Barbour and Davis (1969), in Illinois, Florida, Kentucky, Tennessee, and Mississippi, caves were the most frequently selected roosting sites, although other shelters were occasionally used. Except for one female found in a breeding colony of *M. lucifugus* in the attic of a building, all Indiana records of the southeastern myotis were from caves (Mumford and Whitaker 1982).

Conversely, only one of the many captures in Tennessee was from a cave; *M. austroriparius* is commonly taken in western Tennessee in mist nets placed over tree-lined streams or woodland ponds (Graves and Harvey 1974; Mic Harvey, pers. comm.). This species was discovered in roosts in buildings in "caveless" Louisiana, but Lowery (1974) believed that they also used hollow trees, although no tree roosts were discovered. Sealander (1979) speculated that since the range of *M. austroriparius* was mostly outside of the cave regions of Arkansas (e.g., Mississippi River embayment), it must reside mainly in old mine shafts, buildings, and hollow trees (although no colonies were actually found in Arkansas in either of the latter two). This species was not found in the Delta Region of northeast Arkansas despite some extensive mist netting efforts there (Gardner and McDaniel 1978). David A. Saugey (pers. comm.) has found this species winter roosting in an abandoned water wells in the Gulf Coastal Plain and in abandoned mines in the Ouachita Mountains of southern Arkansas, demonstrating that these types of roosts are important to this species.

Occasionally *M. austroriparius* has been found roosting in association with groups of *M. lucifugus* (Mumford and Whitaker 1982), and colonies of *Tadarida brasiliensis* (Brazilian free-tailed bat) in Florida (Sherman (1937); Hermanson and Wilkins (1986); Humphrey and Gore 1992). *Myotis austroriparius* has been found using the same caves as *Pipistrellus subflavus* during the winter in Florida (Rice 1957; J. A. Gore, pers. comm.) and hibernating with *P. subflavus* and *E. fuscus* in abandoned mines in Arkansas (Saugey *et al.* 1989) and Illinois (this study). Also in Florida, this species has roosted with *E. fuscus*, *Myotis grisescens* (gray bat), and *Nycticeius humeralis* (evening bat) (Bain 1981; Humphrey and Gore 1992). In Louisiana, *M. austroriparius* shared roost sites with *P. subflavus* and *Plecotus rafinesquii* during most months of the year (Jones and Suttkus 1973, 1975). In Arkansas (D. A. Saugey, pers. comm.), *M. austroriparius* has been found sharing winter roosting sites with *P. rafinesquii* and in Illinois they were found sharing summer roost sites as well, although not at the same time.

Inextricably associated with ecological communities near water, *M. austroriparius* emerge from roosting places and fly to nearby ponds and streams to feed (Barbour and Davis 1969). Individuals have been netted over rivers and stock ponds in Arkansas (Baker and Ward 1967), tree-lined streams and woodland ponds in Tennessee (Graves and Harvey 1974; Barbour and Davis 1974), and were most often captured over streams flowing through floodplain forests associated with extensive wetland complexes in the Jackson Purchase Region of western Kentucky (Bill Hendricks, pers. comm.) While feeding, *M. austroriparius* flies very close to the surface of the water (Barbour and Davis 1969; Lowery 1974).

In Florida, bats occupied different roosts during summer and winter, but the patterns of movements between sites were unknown. Seasonal movements of banded animals were recorded for distances of 28.9 to 72.4 km (Rice 1957). Mumford and Whitaker (1982) found no

evidence of migration of this species in Indiana, but animals move into and out of hibernating sites periodically.

Rice (1957) stated that in parts of Florida this species was extremely abundant. He estimated the population density for a large area of central Florida as 77 bats per square mile during May. This high density estimate contrasts sharply with estimates of 26 bats per square mile for *M. lucifugus* in some of its most favorable habitat in New England (Davis and Hitchcock 1965).

The highly gregarious nature of *M. austroriparius* has contributed to its vulnerability. Flooding, ceiling collapses in caves and mines, and freezing are all natural disasters responsible for large-scale mortality. However, the single most serious cause of decline in southeastern bat populations has been human destruction of roosts and the bats themselves. Other factors that have undoubtedly contributed to the decline of the species include habitat reduction and pesticide poisoning (Geluso *et al.* 1976; Clark *et al.* 1983).

Myotis austroriparius is a very secretive species in Illinois, second only to *Plecotus rafinesquii* (Rafinesque's big-eared bat) in its rarity of occurrence. This rarity, combined with its apparently long nightly flights from its roost to forage, and its infrequent capture in mist nets, makes it a very difficult species to study. The Illinois Natural History Survey and the Illinois Department of Conservation, with support from the Illinois Department of Transportation and Shawnee National Forest studied this species from 1987 through 1991 in Illinois. The objectives of these studies were to determine the distribution and status of *M. austroriparius* in Illinois. Previous to the findings presented in this report, nothing was known concerning extant summer populations, particularly maternity colonies, and only scattered information was available on winter distribution through the reporting of incidental records from abandoned mines and caves.

Myotis austroriparius is listed as an endangered species by the Illinois Endangered Species Protection Board (Illinois Administrative Code, Title 17, Chapter I, subchapter c, part 1010.30, as amended March 17, 1989) with legal protection enforced by the Illinois Department of Conservation. Further, *M. austroriparius* is a Category 2 candidate species being considered for federally threatened or endangered species status by the United States Fish and Wildlife Service (U.S. Federal Register, 1989). Early evidence of this species' declining population was documented by Barbour and Davis (1969); they said, "It (other than the Florida or Louisiana populations) is known only from a few caves in Indiana, Illinois and Kentucky, where its numbers have been steadily declining. Apparently, this race is nearing extinction." Recent studies in Florida indicate that their populations in that state have seriously declined also (Humphrey and Gore 1992; Jeff Gore, pers. comm.).

DESCRIPTION OF STUDY AREA

The area of Illinois studied during this investigation was limited to the eleven southern-most counties of the state, hereafter referred to as "southern Illinois." Riparian habitats, considered among the most essential habitats for *Myotis austroriparius*, exist throughout southern Illinois either as narrow strips in more agriculturalized floodplain areas or riparian zones contained within forested uplands. The upland slopes of southern Illinois are covered by highly fragmented forested tracts that are often grazed by livestock if privately owned. Some of the largest, most contiguous forested uplands and floodplains in southern Illinois are found on Shawnee National Forest lands in the counties between and bordering the Mississippi and Ohio rivers. This relatively small region of southern Illinois is ecologically diverse, encompassing four (Ozark, Lower Mississippi River Bottomlands, Shawnee Hills, and Coastal Plain) of the 14 Natural Divisions of the state (Schwegman 1973).

Southern Illinois is a hilly, often rugged region that is characterized by limestone karst topography which possesses many bluffs, natural caves, and rock overhangs. Countless abandoned mines and quarries occur throughout the area. Abandoned buildings (e.g., barns, human dwellings) and other man-made structures, some of which are known to provide roost sites for certain species of bats, are common, although disappearing rapidly. Much of the state's remaining high quality floodplain forests and their associated wetland sites (e.g., marshes, sloughs, oxbow lakes and other naturally-formed lakes) are found in the southern Illinois landscape. Many small streams dissect the southern Illinois area, flowing into the Mississippi and Ohio rivers which converge to form the extreme southern tip of the state.

METHODS

Bat Capture

Bats were captured with black, monofilament Japanese mist nets (38-mm mesh) ranging in length from 5.5 m to 18.3 m. Mist nets of equal length were stacked vertically (6.1 m to 9.1 m in height) with the end loops secured to a rope and pulley system suspended on pairs of interlocking metal masts (Gardner *et al.* 1989). Mist nets were positioned adjacent to roosts, over stream corridors and other types of flyways, and beneath forest canopies. Data recorded for each bat captured included location, date, time of capture, height (m) in net above water (or ground), sex, age (adult or juvenile), weight (g), and reproductive condition (females = nonreproductive, pregnant, lactating, post-lactating; males = scrotal or nonreproductive). Juveniles were distinguished from adults by smaller overall size and incomplete ossification of the epiphyses. Males were considered reproductively active (scrotal = functional testes) when enlarged and fully distended epididymides were visible in

pigmented sheaths in the uropatagium. Females were determined to be either lactating or post-lactating by teat examination. Pregnancy was diagnosed by abdominal palpation with care taken not to mistake a food-distended stomach for a fetus. All *Myotis austroriparius* were banded (males on right wing, females on left wing) with sequentially numbered, red or white size XCL plastic bands (A. C. Hughes, London, England) and immediately released at the site of capture.

Radiotelemetry Equipment and Tracking

Radio-tracking was conducted on a limited number of individuals (1-1987; 10-1989; 11-1991). When *M. austroriparius* were radio-tagged, series BD2A radio transmitters with frequencies ranging from 172.0 to 173.0 MHz were used (Holohil Systems Ltd., Ontario, Canada). These rectangular transmitters measured 12 mm X 8 mm X 4 mm with an 11-cm whip antenna. Pre-attachment transmitter weights ranged from 0.68 to 0.80 g. Transmitters were attached with non-toxic skin-bond cement (Pfizer Hospital Products Group Inc., Largo, Florida) to the mid-sagittal dorsal surface midway between the scapulae and the external origin of the tail. At this position, hair was clipped from an area of skin large enough to accommodate the transmitter.

Model TRX-1000S tracking receivers (Wildlife Materials Inc., Carbondale, Illinois) were used to locate bats in conjunction with collapsible series F172-3FB three-element Yagi antennas (AF Antronics, Inc., White Heath, Illinois). Under optimal conditions (clear nights with dry vegetation), line-of-sight signals were received from distances up to 3 km over flat to gently-rolling, partially forested terrain; however, a diurnal receiving range of $\leq$1 km was more common.

It became evident from the beginning of our studies in 1989 that fixed-station tracking would be unfeasible due to the large foraging range flights of this species. Only infrequently were signals monitored with a null/peak antenna configuration from stations positioned on hilltops within the study area. Sparse information on foraging ranges of radio-tagged bats was gathered; most of the foraging locations of bats were determined by teams of "bat chasers" that changed their monitoring locations frequently in order to maintain signal reception.

Roost Analysis and Habitat Evaluation

All roosts reported here were diurnal roosts of *M. austroriparius*; roosts were defined as the entire tree occupied. No artificial structures (e.g., barns, human dwellings, bridges) were discovered being used as roosts by *M. austroriparius* during this study. Data recorded for each roost included location in Universal Transverse Mercator (UTM) coordinates, date discovered, tree species and condition (dead or alive), relative elevation (upland or floodplain), diameter of tree at breast height (cm dbh), tree height (m), height of roost site above ground (m), type of roost site (bark

or cavity), and total number of bats present. The sex, age, reproductive condition, and numerical identity of radio-tagged bat(s) within the roost were recorded. Where foraging range data for radio-tagged bats were collected, the distance of their roost to the foraging locality was measured.

RESULTS

Previous to this study, *M. austroriparius* was known from only nine caves or abandoned mines in Illinois (Figure 2). Smith and Parmalee (1954) were among the first investigators to discover this species in Illinois: in 1953 in a cave 0.5 mi NE Rosiclare (determined to be Layoff Cave) and a fluorspar mine 2.5 mi NW Cave in Rock, both in Hardin County (Table 1). They reported Layoff Cave as having three compact clusters of 30-40 bats each on 21 December 1954; 17 of these bats were collected. Bats in these clusters were described as being "in a state of semi-hibernation and flew when disturbed." Heavy human disturbance and vandalism to Layoff Cave since the late 1960's has practically prevented bats of any species from roosting there.

A second large past population of *M. austroriparius* recorded in Illinois was that of 120 hibernating bats in Cave Spring Cave, Hardin County, on 29 November 1953; Wayne H. Davis banded three *M. austroriparius* from this cluster (Whitaker and Winter 1977). Once (1958-1961) a maternity site for $\geq$10,000 *Myotis grisescens* (Hall and Wilson 1966), Cave Spring Cave has been visited periodically since 1950 with none to only a few individual *M. austroriparius* encountered (Layne 1958; Whitaker and Winter 1977; Hoffmeister 1989; this study). Due to permanent surface disturbance (rock quarrying) above the cave, the microclimate of Cave Spring Cave is now considered completely unsuitable for either summer or winter use by more than a few bats of any species. May and August records for Illinois were all males (Hoffmeister 1989); no maternity colonies or evidence of reproductively active populations had been reported prior to this study. The remaining historical records for the state were all winter records, primarily of individuals encountered in caves and abandoned mines (including a single rock quarry) in Alexander, Hardin, Johnson, and Union counties.

Distribution and Status of Illinois' Winter Population

In extreme southern Illinois, it is possible to encounter a few individual torpid or hibernating *Myotis austroriparius* in a cave or abandoned mine; however, such a discovery would be considered rare. From 1982 through 1991, more than 52 caves, abandoned mines, and quarries throughout southern Illinois were trapped or searched in attempts to discover *M. austroriparius* (Figure 3: see Appendix A for site listings). Although bats were discovered and identified at almost every site, *M. austroriparius* were found at only one site (087804; Whitehill Quarry). Further, this was the only historical site that had not collapsed or still exhibited a microclimate suitable for winter roosting.

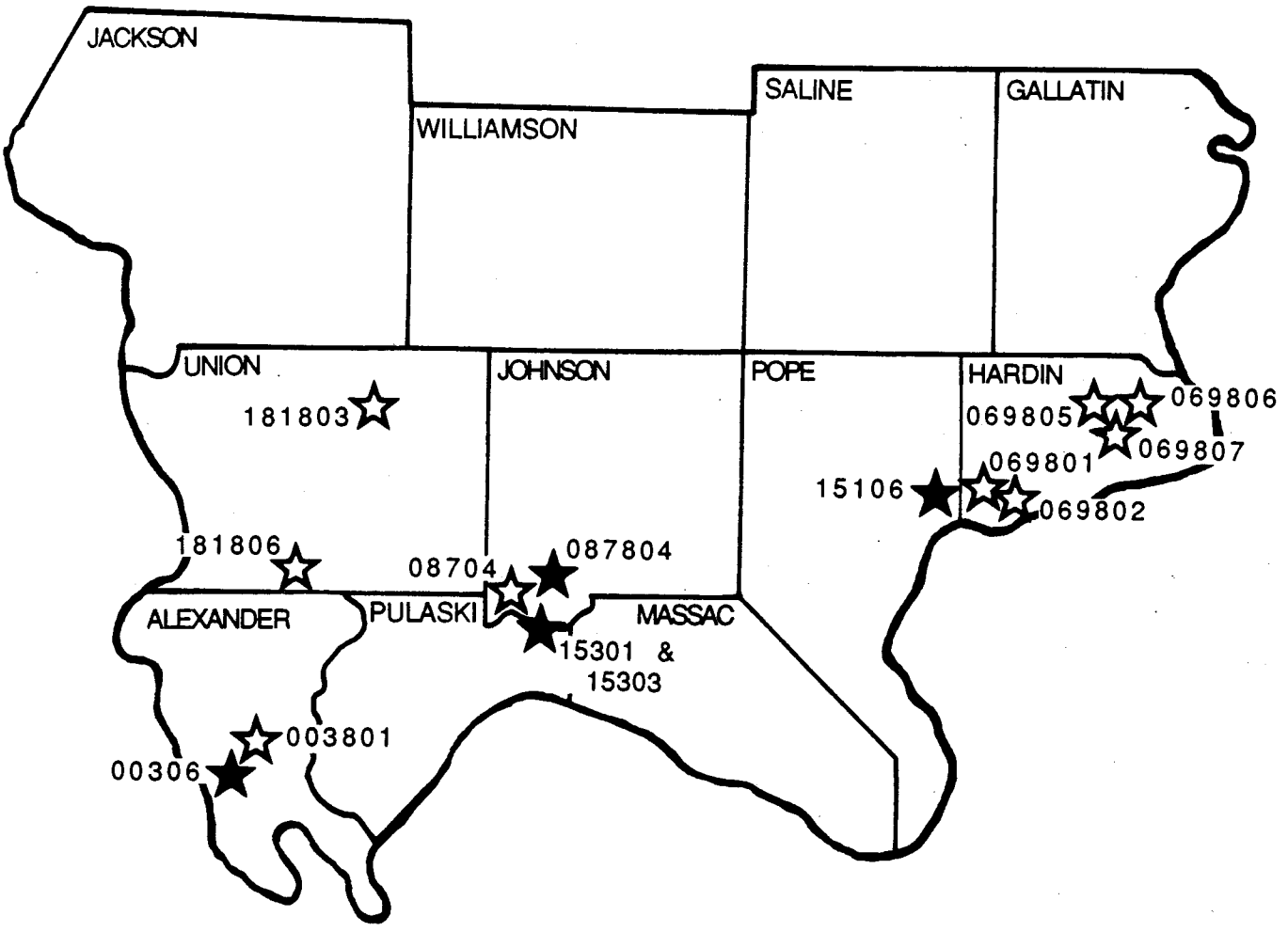

Figure 2. Distribution of *Myotis austroriparius* in Illinois. Stars indicate the location of historical (nonsolid) records and new (solid) occurrence records (see Table 1 for site number identification data).

Table 1. Distribution records for *Myotis austroriparius* in Illinois.

*Record No.	County	Site	^Ref.	UTM Coordinates
033801	Alexander	Silica Mine 0.5 mi N Olive Branch	13	291820,4116760
00306	Alexander	Black Creek/Horseshoe Lake	SEB91'	290370,4113960
069802	Hardin	Natural Cave 0.5 mi NE Rosiclare (prob. Layoff Cave)	2,3,7,13	381060,4143700
069805	Hardin	Fluorspar Mine 2.5 mi NW Cave In Rock	2,7,13	394000,4150500
069801	Hardin	Cave Spring Cave (=Watter's Cave)	2,3,7,11	367160,4146150
069806	Hardin	Fluorite Mine No. 66 (prob. Crystal Mine)	11	394200,4152480
069807	Hardin	Crystal Mine No. 67	11	394700,4152500
087804	Johnson	Whitehill Quarry	1,7	321340,4131880
08704	Johnson	Roost Tree No. 940/ Little Black Slough	SEB89',1	326145,4135740
15301	Pulaski	Cache River (org Karnak Site)	1	325660,4130000
15303	Pulaski	Cache River (Flood Site)	SEB91'	325700,4130000
15106	Pope	Big Grand Pierre Creek (Route 146)	1	373520,4146480
181803	Union	Rich's Cave	3,11	304620,4156670
181806	Union	Silica Mine No. 40	11	295280,4138270

*=record numbers correspond to numbered symbols on GIS ARC/INFO generated maps accompanying this document

^=SEB89'=1989 Southeastern Bat Preliminary Studies; SEB91'=1991 Southeastern Bat Status and Distribution study; 1=Illinois Natural History Survey/Illinois Department of Conservation statewide endangered bat studies 1985-1990; 2=Smith and Parmalee 1954; 3=Layne 1958; 7=Hoffmeister 1989; 11=Whitaker and Winter 1977; 13=University of Illinois mammal collection

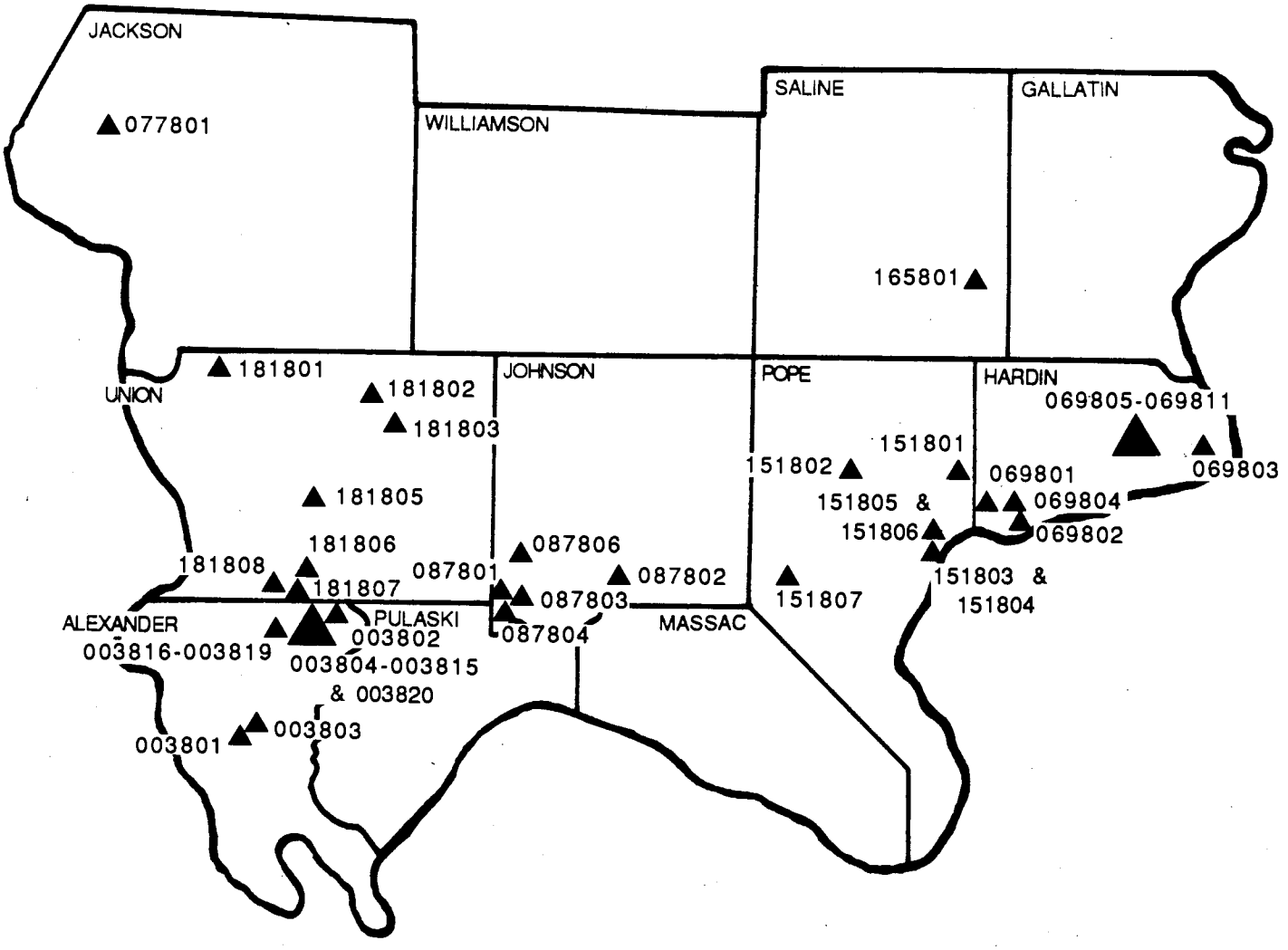

Figure 3. Distribution of 52 natural caves, mines, and quarries in southern Illinois trapped or visited from 1982 through 1991 in attempts to find *Myotis austroriparius*.

Table 2. Censuses of the winter population of *Myotis austroriparius* in Whitehill Quarry, Johnson County, Illinois from 1960 through 1991.

DATE	NUMBER	DESCRIPTION
2/21/1960	2	Collected by D. A. Hoffmeister
1/04/1988	40	Observed by J. D. Garner
1/05/1989	220	Observed by J. E. Gardner/J. E. Hofmann; several small clusters (some 50-60 bats), very easily awakened, some active, 10 bats examined were all male
1/24/1990	205	Observed by K. A. West, some bats active and were easily disturbed
12/10/1991	2	Observed by J. D. Garner/G. Kruse

The number of individuals roosting/hibernating in the abandoned portion of the active limestone quarry near Whitehill, Illinois (Columbia Quarry Company, Cypress, Illinois) has varied greatly over the years (Table 2). Hoffmeister (1989) collected two specimens from Whitehill Quarry on 21 February 1960, but made no mention of any additional numbers there. Apparently, Southern Illinois University has 20 specimens from there, but there is no indication of the date(s) they were collected or total numbers. Forty *M. austroriparius* were observed by J. D. Garner (IDOC) on 4 January 1988; however, 220 were censused on 5 January 1989. All ten bats sexed in 1989 were males. Just over 200 were counted during 24 January 1990 by K. A. West (IDOC), but only two individuals were found at the site on 10 December 1991. These fluctuating numbers are undoubtedly a result of the physiological adaptation that this species has for dealing with colder temperatures. Bats were found to be semitorpid at temperatures below 40 degrees F in Louisiana, but they resumed their nightly foraging activities during warmer temperatures (Lowery 1974). In Kentucky, greater numbers of hibernating bats are encountered in caves and mines during lower than average (harsh) winter temperatures and are often fully awake when encountered (John MacGregor, pers. comm.). The bats using Whitehill Quarry undoubtedly roost in other quarters during the frequently milder periods of winter in southern Illinois; however, the locations of those other quarters remain unknown.

Distribution and Status of Illinois' Summer Population

Mist netting was conducted (1984 through 1991) at fifty-five sites scattered throughout the eleven southernmost Illinois counties to capture *Myotis austroriparius* and other species of threatened and endangered bats (Figure 4; see Appendix B for site listing). In the majority of cases, nets were positioned over such forested floodplain stream corridors as the Cache River, and such upland streams as Lusk and Big Grand Pierre creeks. Other netting sites included forested

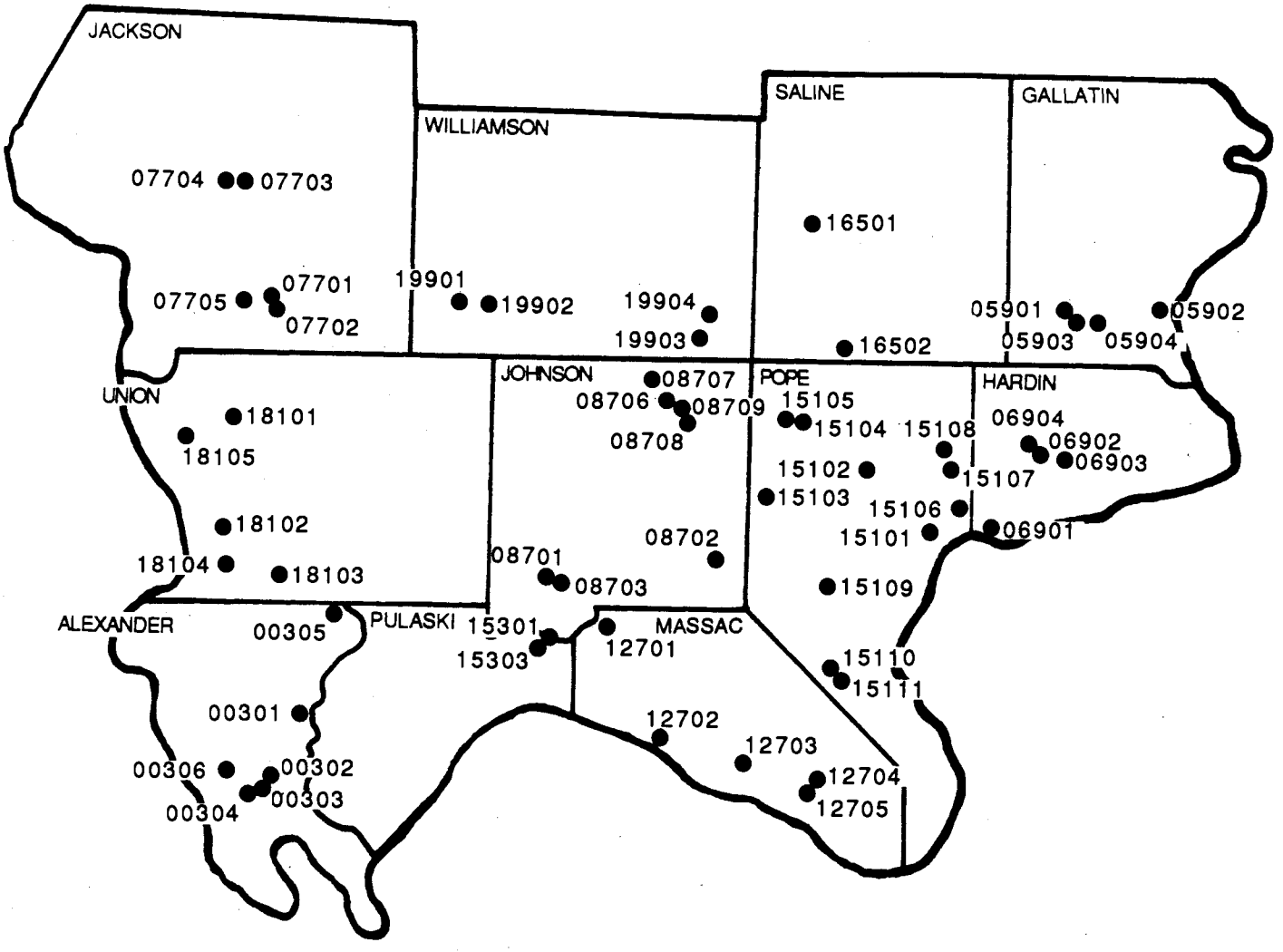

Figure 4. Distribution of 55 netting sites in southern Illinois sampled from 1984 through 1991.

wetlands (e.g., Little Black Slough), a pond (near Millstone Bluff), wooded upland ravines (07704 and 12702), deeply channelized streambeds with no forested canopies (12701 and 16502), and the forested margins of Crab Orchard Lake (19901 and 19902) and Horseshoe Lake (00301, 00303, 00304, and 00306). These efforts resulted in the captures of 474 bats representing all twelve species commonly known from Illinois.

Sixty-eight *M. austroriparius* were captured at three of the 55 netting sites (Table 3) in Illinois sampled from 1987 through 1991. A single lactating adult female was captured on 1 July 1991 at the Black Creek/Horseshoe Lake site in Alexander County. Four females (three post-lactating adults and one juvenile) were captured on 5 July 1988 over Big Grand Pierre Creek in Pope County. *Myotis austroriparius* were captured at the Cache River site (Karnak Site; 15301) every year but one from July 1987 through July 1991; no *M. austroriparius* were captured during 1990. At this site, two stacked nets, 5.5 m in length were position over the water beneath the same individual trees. Captures of *M. austroriparius* at the Karnak site (Pulaski County) accounted for 30% (n=63) of the total captures of bats of all species in Pulaski County, Illinois and represented 93% of the total *M. austroriparius* captures (Table 4). *Myotis austroriparius* obviously dominated the insect-rich Cache River foraging habitat at the Karnak site.

Based solely on percent total mist net captures of bats for all eleven counties (Table 4), *M. austroriparius* was captured more frequently (12%) in mist nets than the federally endangered *Myotis sodalis* (4%). This statistic is misleading because *M. sodalis*, although fewer in total numbers, are known from 16 surface sites in seven of these eleven counties, while *M. austroriparius* was captured at only one site in each of only three counties. Capture success at the Karnak site were tremendously influenced since the nets were repeatedly positioned in a constricted corridor commonly shared for foraging by a maternity colony. Of the 63 *M. austroriparius* captured at Karnak, 39 were lactating adult females and 14 were juveniles.

Foraging Range of a *Myotis austroriparius* Maternity Colony

Radiotransmitters were attached to 21 *M. austroriparius* in attempts to identify their foraging ranges (Table 3); one as a pioneering attempt in 1987, ten during 1989, and 11 during 1991. Radiotransmitters were attached to eleven lactating adult females (eight during 1989), four post-lactating adult females, five juveniles (all during 1991), and two adult males.

The most significant results from radio-tracking foraging bats came from the 1989 efforts. On 30 May 1989, radiotransmitters were attached to three lactating adult females (058, 258, and 540) captured over the Cache River at the Karnak Site. Three mobile tracking vehicles monitored their movements beginning within one hour of their release (2230 hrs). These bats continued to forage in the vicinity of the Cache River west and east of the netting site until approximately 0055 hrs. From then until 0200 hrs all three bats foraged as far as 2 km south of the Illinois Rt. 169 bridge over the Post Creek Cutoff

(Figure 5). Although weaker than before, the steady characteristic of the transmitter signals from the bats at 0200 hrs indicated that they had night roosted somewhere along the Post Creek Cutoff; however, their night roost was never discovered.

Table 3. Capture data (arranged chronologically) for *Myotis austroriparius* netted in Illinois from 1987 through 1991.

DATE	*COUNTY	SITE	AGE	SEX	REPCOND	BANDINFO	TRX
07/14/87	153	Cache R (Karnak Site)	A	F	NR		
07/14/87	153	Cache R (Karnak Site)	A	F	NR		
07/14/87	153	Cache R (Karnak Site)	J	F	NR		
07/13/87	153	Cache R (Karnak Site)	A	F	L	W 3	TRX .045
05/04/88	153	Cache R (Karnak Site)	A	F	PG	R 2	
05/04/88	153	Cache R (Karnak Site)	A	F	PG	R 3	
05/04/88	153	Cache R (Karnak Site)	A	F	PG	R 4	
05/04/88	153	Cache R (Karnak Site)	A	M	SC	R 5	
05/04/88	153	Cache R (Karnak Site)	A	F	PG	R 7	
05/05/88	153	Cache R (Karnak Site)	A	F	PG	R 8	
05/05/88	153	Cache R (Karnak Site)	A	F	PG	R 10	
05/05/88	153	Cache R (Karnak Site)	A	F	PG	R 11	
05/05/88	153	Cache R (Karnak Site)	A	M	NR	R 12	
05/05/88	153	Cache R (Karnak Site)	A	F	PG	R 13	
05/05/88	153	Cache R (Karnak Site)	A	F	PG	R 14	
05/05/88	153	Cache R (Karnak Site)	A	F	PG	R 15	
05/05/88	153	Cache R (Karnak Site)	A	F	PG	R 16	
05/05/88	153	Cache R (Karnak Site)	A	M	NR	R 17	
05/05/88	153	Cache R (Karnak Site)	A	M	SC	R 18	
07/05/88	151	Big Grand Pierre Ck	A	M	NR	na	
07/05/88	151	Big Grand Pierre Ck	A	M	NR	na	
07/05/88	151	Big Grand Pierre Ck	A	M	NR	na	
07/05/88	151	Big Grand Pierre Ck	A	F	L	na	
05/30/89	153	Cache R (Karnak Site)	A	F	L	W 4	TRX .258
05/30/89	153	Cache R (Karnak Site)	A	F	L	W 5	TRX .540
05/30/89	153	Cache R (Karnak Site)	A	F	L	W 7	TRX .058
06/26/89	153	Cache R (Karnak Site)	A	F	L	W 11	TRX .096
06/26/89	153	Cache R (Karnak Site)	A	F	L	W 8	TRX .339
06/28/89	153	Cache R (Karnak Site)	A	F	L	W 39	
06/28/89	153	Cache R (Karnak Site)	A	M	NR	W 40	
06/28/89	153	Cache R (Karnak Site)	A	M	NR	W 42	
06/28/89	153	Cache R (Karnak Site)	A	F	L	W 43	
06/28/89	153	Cache R (Karnak Site)	A	F	L	W 44	
07/06/89	153	Cache R (Karnak Site)	A	M	NR		
07/06/89	153	Cache R (Karnak Site)	A	F	L	W 12	TRX .221
07/06/89	153	Cache R (Karnak Site)	A	F	L	W 13	
07/06/89	153	Cache R (Karnak Site)	A	M	NR	W 14	TRX .418
07/06/89	153	Cache R (Karnak Site)	A	F	L	W 15	
07/06/89	153	Cache R (Karnak Site)	A	F	L	W 16	
07/14/89	153	Cache R (Karnak Site)	A	M	NR	W 45	
07/14/89	153	Cache R (Karnak Site)	A	F	NR	W 46	
07/14/89	153	Cache R (Karnak Site)	A	F	L	W 47	TRX .499

Table 3. concluded.

DATE	COUNTY	SITE	AGE	SEX	REPCOND	BANDINFO	TRX
07/15/89	153	Cache R (Karnak Site)	A	M	NR	W 48	TRX .381
07/15/89	153	Cache R (Karnak Site)	A	F	L	W 49	TRX .167
07/24/89	153	Cache R (Karnak Site)	A	F	PL		
07/24/89	153	Cache R (Karnak Site)	A	F	PL		
05/15/91	153	Cache R (flood Site)	A	F	L	R220	TRX .339
07/01/91	003	Black Ck/Horseshoe Lake	A	F	L	Y115	TRX .781
07/15/91	153	Cache R (Karnak Site)	A	F	PL	W 21	
07/15/91	153	Cache R (Karnak Site)	J	M	NR	W 19	
07/15/91	153	Cache R (Karnak Site)	J	M	NR	W 20	
07/15/91	153	Cache R (Karnak Site)	J	F	NR	W269	TRX .897
07/15/91	153	Cache R (Karnak Site)	J	M	NR	W 22	TRX .419
07/15/91	153	Cache R (Karnak Site)	A	F	PL	W270	TRX .736
07/15/91	153	Cache R (Karnak Site)	J	M	NR	W271	
07/15/91	153	Cache R (Karnak Site)	J	F	NR	W278	TRX .336
07/15/91	153	Cache R (Karnak Site)	J	F	NR	W272	TRX .262
07/15/91	153	Cache R (Karnak Site)	J	F	NR	W273	TRX .679
07/15/91	153	Cache R (Karnak Site)	A	F	PL	W274	TRX .536
07/16/91	153	Cache R (Karnak Site)	J	F	NR	W 97	
07/16/91	153	Cache R (Karnak Site)	J	M	NR	W 56	
07/16/91	153	Cache R (Karnak Site)	J	M	NR	W 96	
07/16/91	153	Cache R (Karnak Site)	A	F	PL	W 57	TRX .981
07/16/91	153	Cache R (Karnak Site)	A	F	PL	W 58	TRX .719
07/16/91	153	Cache R (Karnak Site)	A	F	PL	W 59	
07/16/91	153	Cache R (Karnak Site)	J	F	NR	W 60	
07/16/91	153	Cache R (Karnak Site)	J	F	NR	W 61	
07/16/91	153	Cache R (Karnak Site)	A	F	PL	W 23	

003=Alexander; 151=Pope; 153=Pulaski
A=adult; J=juvenile; F=female; M=male; NR=nonreproductive; L=lactating;
PL=post-lactating; PG=pregnant; SC=scrotal;
R=red; Y=yellow; W=white
TRX=radiotransmitter number

Table 4. Relative abundance of *Myotis austroriparius* in Illinois based on percent total mist net captures of all bat species captured in eleven counties in southern Illinois.

County	TOTAL NUMBER BATS CAPTURED (%TOTAL CAPTURE)				
	Total Bats Captured (all species)	*Myotis sodalis*	% total (all sp.)	*M. austro-riparius*	% total (all sp.)
Alexander	74	3	4%	1	1%
Gallatin	21	0		0	
Hardin	12	0		0	
Jackson	22	8	36%	0	
Johnson	31	1	3%	0	
Massac	22	0		0	
Pope	88	1	1%	4	6%
Pulaski	213	6	3%	63	30%
Saline	12	2	17%	0	
Union	61	1	2%	0	
Williamson	8	0		0	
	564	22	4%	68	12%

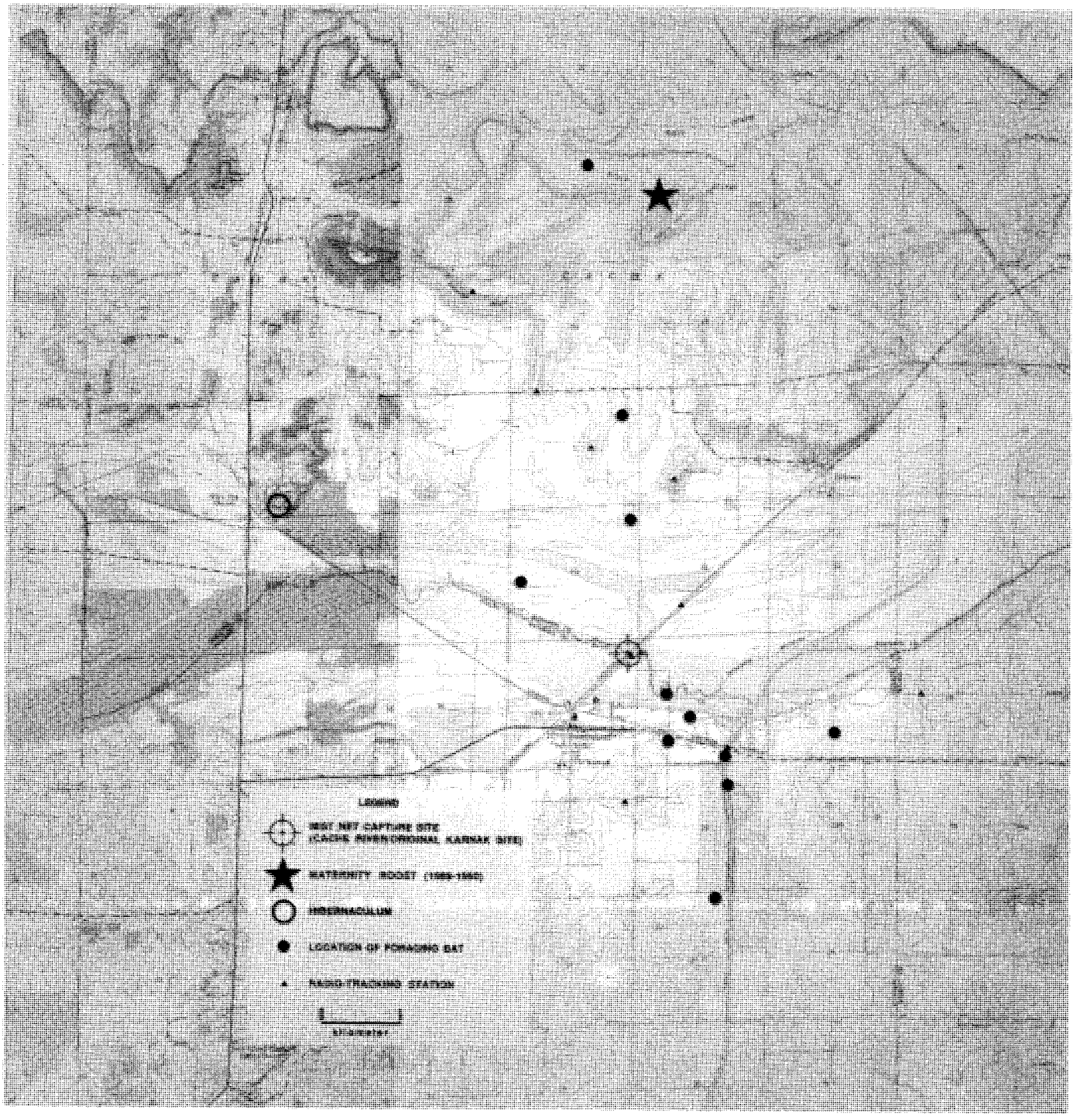

Figure 5. Foraging locations of radio-tagged *Myotis austroriparius* captured at the Cache River (Karnak) site, Pulaski and Johnson counties, Illinois. Bat 258 was tracked on 5/31; bat 540 on 5/31, 6/5, and 6/6; bat 339 on 6/27; and bat 058 on 5/31 from several tracking stations (triangles). The Little Black Slough maternity roost tree (star) and the only known hibernaculum for this species (circle) is shown.

Of the three lactating adult females (058, 258, and 540) radio-tagged on 30 May 1989, we were able to determine foraging locations only for bat 540 on 5 and 6 June. Shortly after dusk (2055 to 2206 hrs) on each of these nights, female 540 foraged in the floodplain forest surrounding the Cache River at points southeast of the netting site and along the Post Creek Cutoff. We were unable to receive even faint signals from bat 540 after 2220 hrs. On 5 June, faint signals from bat 058 were received from 2121 through 2132 hrs in the direction of the Post Creek Cutoff south of the Illinois Rt. 169 bridge. June 5 and 6 were the last dates that signals were received from 540 and 058.

On 26 May 1989, transmitters were attached to two more lactating adult females (bat 096 and 339). In fact, a single foraging location for bat 339 on 27 May was the only information gained. We know that bat 096 continued to forage in the vicinity of the netting site, because her transmitter was recovered on the ground <100 m from the netting site on 15 July.

On 6 July 1989, two radiotransmitters were attached to *M. austroriparius* (female 221 and male 418). On 14 and 15 July, three radiotransmitters were attached to *M. austroriparius* (female 167, male 381, and female 499) . The transmitter from bat 381 became detached on 16 July because an insufficient amount of skin glue had been applied. Although these transmitters were emitting good signals upon release of the bats, their signals were never received again. Exhaustive searches by three tracking vehicles crisscrossing the tri-county area surrounding the Karnak study site were conducted daily through 16 July with no positive results.

A lactating adult female *M. austroriparius* was captured over Black Creek, an inundated tributary to Horseshoe Lake, in Alexander County on 1 July 1991. She (bat 781) was radio-tagged that night (2318 hrs), and her movements monitored until approximately 0300 hrs. Her direction of movement was south-southeast toward Horseshoe Lake. This female foraged in and around the mature forested wetlands of Horseshoe Lake and the its surrounding habitat.

A Tree-Roosting Maternity Colony of *Myotis austroriparius*

While documenting foraging areas was a major thrust of radio-tracking, a great deal of time was spent searching for the diurnal roosts of *M. austroriparius*. Efforts to locate the diurnal roost of bats 058, 285, and 540, radio-tagged on 30 May 1989, were unsuccessful at first. Because these bats returned on consecutive nights to forage in the vicinity of their capture site, efforts to pinpoint the general direction of their emergence from their roost were conducted at dusk on 31 May from three fixed stations. Beginning at 2052 hrs, strong signals were received from bat 258 from the direction of Little Black Slough, north of the netting site. By 2101 hrs, bat 258 had flown to the forested floodplain near the netting site and perhaps beyond. Bat 540 exhibited flight direction and behavior similar to bat 258 and had apparently come from the same roost; however, this bat did not reach the foraging area until 2124 hrs. Unlike bats 258 and 540, signals from bat 058 were not received at dusk, but she was located in the

vicinity of the Cache River west and east of the net site and along the Post Creek Cutoff later that night.

Efforts to find the roost of bats 258 and 540 resumed on the morning of 1 June. Aware of the general direction of the roost, tracking efforts began from high points on the southwest side of Little Black Slough. More than three hours later, the roost tree was located in Little Black Slough approximately 85 m from the bank of the slough on the northwest side of Hairy Hill (Figure 5). The roost tree (roost 940) was a 105 cm dbh *Nyssa aquatica* (tupelo gum) which was completely surrounded by water and other *N. aquatica* and *Taxodium distichum* (bald cypress) in the forested palustrine wetland known as Little Black Slough. This tree, although alive, had a triangular-shaped opening (60 cm high by 25 cm wide) on the south side of its base that opened into a large cavity (1.6 m diameter at water level) that extended upward into the main trunk for at least 6 m (Figure 6). Another opening, more circular in shape and smaller (16 cm high by 30 cm wide), occurred on the west side of the tree near the water level (not visible in Figure 6). Bats used the larger triangular opening for exiting. One-Hundred one *M. austroriparius* were observed leaving roost 940 during an exit count conducted on 15 June 1989. Unfortunately, unseasonably high water levels in Little Black Slough forced the bats to abandon roost 940 by 18 July.

During the 18 July 1989 examination of roost 940, four *Plecotus rafinesquii* (Rafinesque's big-eared bat) were discovered in a similarly hollow *N. aquatica* (roost 941) <50 m east of roost 940 (Figure 7). This roost tree had an identically-shaped triangular opening (78 cm high and 45.5 cm wide) near its base. The hollow bole of the main trunk was 1.4 m inside diameter at water level and extended approximately 7 m above the water surface. Although only four *P. rafinesquii* were observed inside the tree, a large (0.5 square m) stained area near the top of the hollow trunk indicated use by larger numbers of bats. Our findings were not conclusive, but it was possible that the *M. austroriparius* from roost 940 used this roost also.

In an attempt to ascertain roost fidelity in *M. austroriparius*, roost 940 was examined on 25 July 1990. More than 75 *M. austroriparius* were observed in this roost on this date. The colony was very active, vocal and easily disturbed. They immediately began trying to exit the tree through the triangular opening near the water's surface. One bat, a post lactating adult female, was captured as she tried to escape. Although roost 941 was examined also, no bats were discovered there.

On 15 May, flood conditions prevented positioning the mist nets in the usual place at the Karnak site; however, one lactating adult female *M. austroriparius* was captured in nets positioned over the flooded roadside ditch very near the usual net site. This bat was radio-tagged (339), and remained within the floodplain forests west and southeast of the netting site for the remainder of the evening. Roosts 940 and 941 were examined on 16 May 1991 with the hope that bat 339 was roosting there, but no bats were found in either roost.

Figure 6. *Nyssa aquatica* (tupelo gum) maternity roost (940) of *Myotis austroriparius* in Little Black Slough, Johnson County, Illinois. A second, smaller opening (indicated by arrow) is not visible. Line indicates high water mark during higher-than-normal water levels that result from heavy rains.

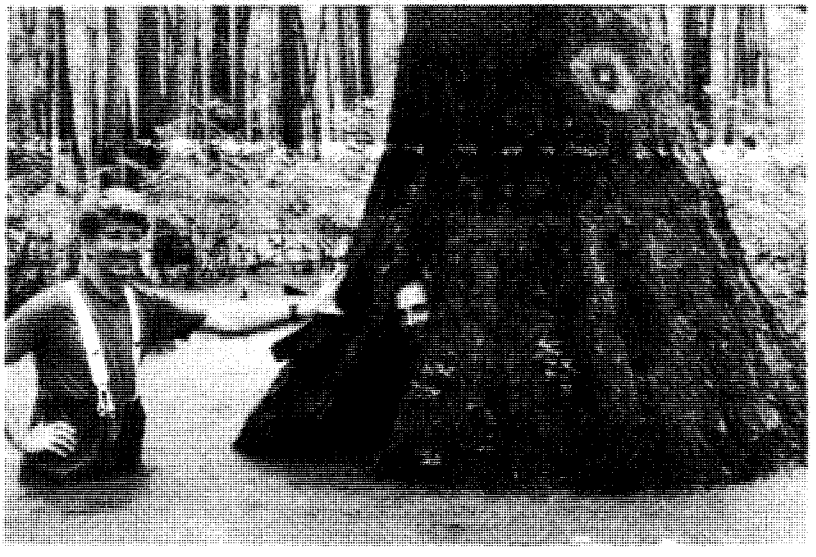

Figure 7. *Nyssa aquatica* (tupelo gum) roost (941) used by *Plecotus rafinesquii* on 18 July 1989. Investigators in picture are James E. Gardner (inside tree) and Randall Collins.

Unseasonably heavy rains had resulted in abnormally high water levels in Little Black Slough; the openings remaining on both trees appeared to be too small to be used by bats. More than one-half the original 60 cm high opening size (water level on 1 June 1989) was covered by the high water level. The colony using roost 940 during 1989 was known to have abandoned roost 940 because of equally high water levels subsequent to its discovery on 1 June 1989. Unfortunately, exhaustive searches to locate bat 339 within the tri-county area during the next two days were unproductive.

Efforts (2-3 and 5-9 July) to locate the diurnal roost of the lactating adult female *M. austroriparius* (781) captured over Black Creek, the inundated tributary to Horseshoe Lake, in Alexander County failed. On these dates, a large area surrounding the capture site was systematically searched; a powerboat was used on 5 July to search the more inaccessible reaches of Horseshoe Lake, but her roost was not found.

Additional Attempts (Unsuccessful) to Locate Diurnal Roosts of M. austroriparius

By 15 July, water levels of the Cache River at the Karnak site had fallen sufficiently to allow placement of mist nets in the usual position. During 15-16 July, 20 *M. austroriparius* were captured and radiotransmitters were attached to nine (Table 3) as the last attempt of the project to locate their roost sites. Adequately strong signals were received immediately upon release of the bats and later that night; however, despite exhaustive searches by several teams throughout the study area during daylight hours, no signals could be received. By 18 July, useable signals were received from bats 897 and 536 (Table 5). Although one vector was recorded for bat 336 at 2130 hrs and three consecutive vectors were recorded for bat 736 (2228 through 2239 hrs), these data were of little value in determining the direction of their roost.

Single vector bearings on bat 897 were recorded on 18 July as the bat presumably emerged from its roost at 2103 hrs (Table 5). The first signal received from the railroad embankment station northeast of its capture site (Station A, Figure 8) was suddenly very strong (indicating emergence from a roost in close proximity). This juvenile flew in a southerly direction toward the Cache River and was tracked until the signal grew very weak and finally faded after 2124 hrs. Bat 897 foraged within the floodplain forest along the Cache River the majority of that evening. This was the last time that signals were received from bat 897.

Another bat (bat 536) radio-tagged with bat 897 on 15 July provided valuable insight to the general location of their roost. During the early morning hours (0347 through 0434 hrs) of 22 July, post lactating female 536 flew northward from her foraging area near the Cache River netting site (Figure 8), coming continuously closer to the trackers at station A. Suddenly, at 0434 hrs the signal, which had been received stronger and stronger, was lost (Table 5). Believing that they were close to the roost of these two bats,

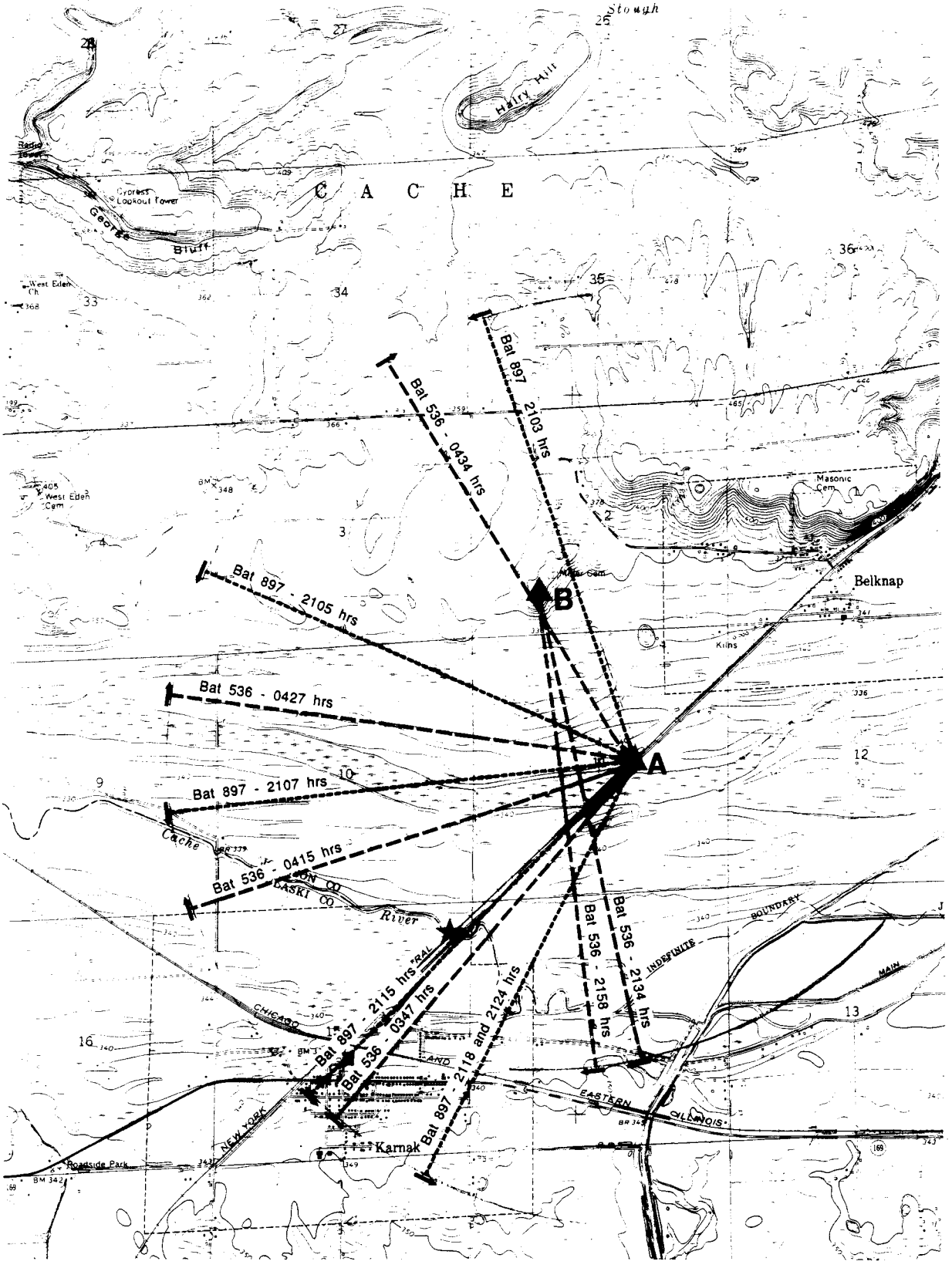

Figure 8. Directional vectors (azimuth) and times for bat 897 (short dashes) on 18 July 1991 and bat 536 (long dashes) on 22 July 1991 from an abandoned railroad embankment (station A) and the hilltop southwest of Millers Cemetery (station B); arrows indicate the general direction of movement. The Cache River (Karnak) site is indicated by a star. Vector lengths represent the maximum possible receiving distance of the transmitters.

Table 5. Summary of radio-tracking data for bat 897 and bat 536 from 18 July 1991 through 22 July 1991.

BAT #	TIME (2400 hrs)	DATE	BEARING (azimuth)	NOTES
897	2103	7/18/91	345	first signal rcvd. (strong)
"	2105	"	292	
"	2107	"	265	
"	2115	"	225	
"	2118	"	206	
"	2124	"	207	signal weak and fading
536	0347	7/22/91	221	first signal rcvd. (good)
"	0415	"	252	
"	0420	"	254	
"	0427	"	277	
"	0434	"	330	closer, stronger, then suddenly no signal rcvd.
536	2134	7/22/91	168	first signal rcvd. (strong)
"	2158	"	172	signal weakening, then no signal rcvd.

the research team monitored the signals from bat 536 from another location (station B, Figure 8) at dusk on 22 July. The first signal was received at 2134 hrs from somewhere south of the tracking station; the signal was tracked from this direction until it weakened and finally disappeared by 2158 hrs.

Subsequent to the tracking of bats 897 and 536 on 18 and 22 July, intense searches were conducted between stations A and B and southwest of these points toward the Cache River (primarily sections 10 and 11, Figure 8). Several potential man-made sites (an abandoned cement truck with the large mixing tank attached, the chimney of an abandoned house, and an abandoned house) were investigated during these searches with no roosts discovered. The investigators carried a receiver and tracking antenna with them, listening for signals at all times, but no signals were received even though many natural potential roost sites (including large dead, hollow trees) were observed.

Ontogeny and Reproduction

Although more than 100 *Myotis austroriparius* were censused in maternity roost 940 and 68 more were captured in mist nets during the summer, specific details concerning their reproductive success remain a mystery. We do know that Rice's (1957) statement that "the time during which birth [in *M. austroriparius*] occurs in Indiana and Illinois is unknown, but it doubtless occurs in late June, as with other species of *Myotis* in those latitudes," is incorrect. Data for 68 *M. austroriparius* captured in Illinois from 1987 through 1991

indicate parturition during early to mid-May (Figure 9). In Florida, Rice (1957) reported that young bats were found as early as 30 April, but no pregnant females were found after May 17. It appears that the northern populations (particularly Illinois) have a similar parturition date to the Florida populations. Lactating adults were captured from mid-May through mid-July; post lactating adult females and volant juveniles were first captured in mid-July over the Cache River. The earliest date volant young were encountered in Florida was 9 June (Rice 1957).

Fourteen adult male *M. austroriparius* were captured in Illinois from 1987 through 1991 (Table 3) and ten additional males were examined on 5 January 1989 in Whitehill Quarry (Table 2). Males captured during 4 and 5 May and 5 July had enlarged epididymides (Figure 10). None of the epididymides examined in the ten males in Whitehill Quarry showed signs of activity. These data are not conclusive and can be used only to speculate on the date when males become reproductively active. We expect that Illinois males will be similar to males in Florida; Rice (1957) found males in Florida with enlarged testes from mid-February through mid-April. Rice (1957) examined males from Illinois with enlarged epididymides on 29 November and 2 December and Smith and Parmalee (1954) reported that males from Layoff Cave on 21 December had enlarged testes. Mumford and Whitaker (1982) found males in Indiana with scrotal testes in March, April, and August with the largest testes observed in August.

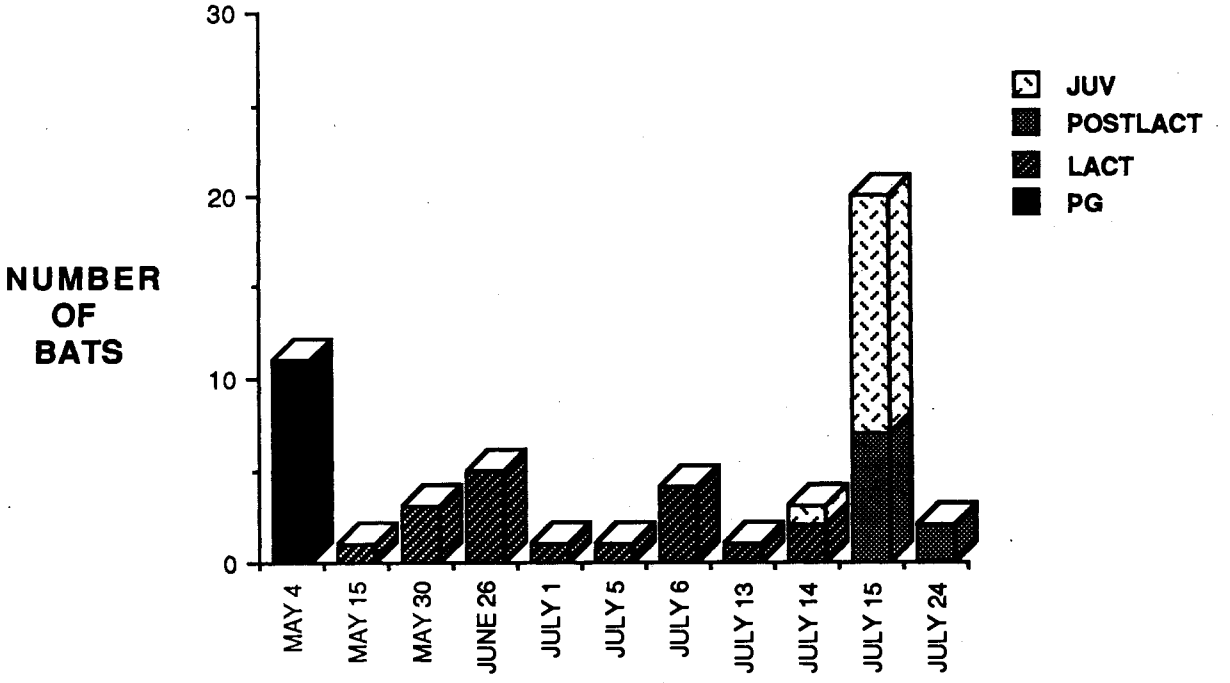

Figure 9. Captures of pregnant, lactating, postlactating, and juvenile *Myotis austroriparius* in Illinois in relation to time of year.

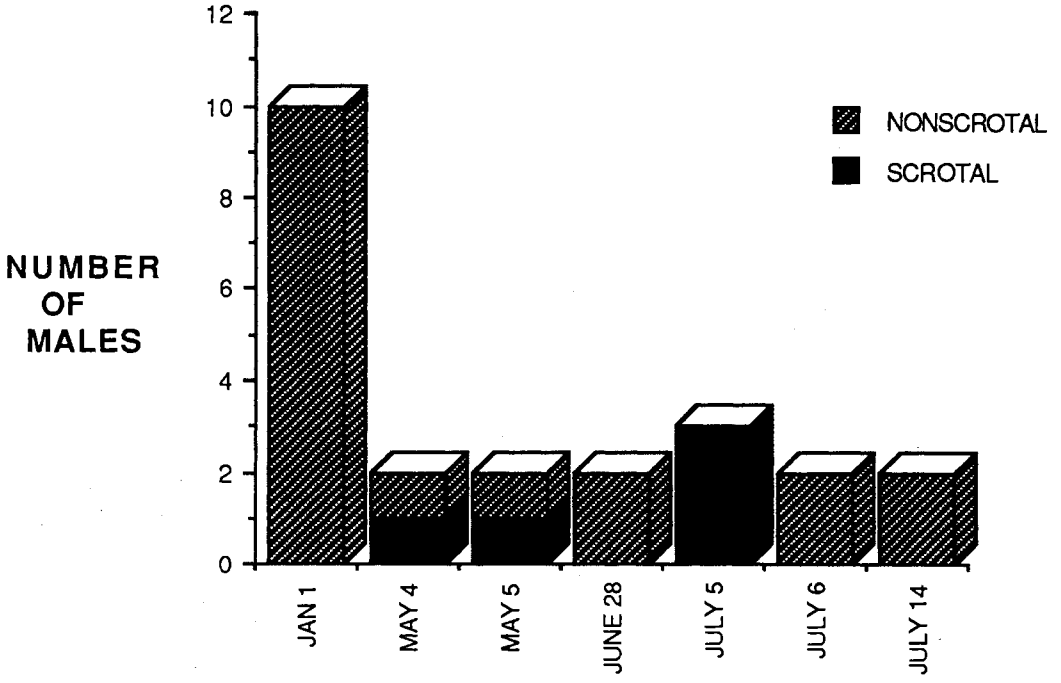

Figure 10. Captures of male *Myotis austroriparius* in Illinois in relation to time of year.

CONCLUSIONS

Listing *Myotis austroriparius* as an endangered species in Illinois (Illinois Administrative Code, Title 17, Chapter I, subchapter c, part 1010.30, as amended March 17, 1989) is fully justified. Investigations of more than 52 caves and abandoned mines, of which many were historical locations, resulted in the determination that only one site (Whitehill Quarry) is still inhabited (Figure 5). Many of the subterranean sites, especially abandoned mines, are no longer suitable for use by this species due to habitat (microclimate) alteration, destruction, or disturbance. Mist netting efforts at more than 55 sites scattered throughout the southern tier of eleven counties resulted in captures of 68 *M. austroriparius* at only three sites, one site in each of three counties. One site, the Cache River (Karnak) site, accounted for 92% (n=63) of the southeastern bats captured, simply because the nets were located within an area used by a colony for foraging. Conversely, federally endangered *Myotis sodalis* (Indiana bat), although fewer in total numbers, are known from 16 surface sites in seven of the same eleven southern Illinois counties.

Previously known as a riparian species, *M. austroriparius* in Illinois has been most frequently associated with such mature, high quality forested wetland habitats as the Cache River, Little Black Slough, Heron Pond, Horseshoe Lake, and Big Grand Pierre Creek. Many such wetland habitats in Illinois have already been lost to agricultural clearing, timber harvest, and urban and recreational development. Indirect threats to populations in highly agriculturalized regions include potential poisoning through pesticide contamination. Pesticide-induced mortality of insectivorous bats has been documented for species in other states (Mohr 1972; Geluso *et al.* 1976; Clark *et al.* 1983) and has undoubtedly contributed to the decline of *M. austroriparius* populations in Illinois.

Myotis austroriparius is a Category 2 candidate species being considered for federally threatened or endangered species status by the United States Fish and Wildlife Service (U.S. Federal Register, 1989). Apparently, this species has suffered drastic declines throughout its range; authorities in Florida indicate that populations in their state, historically high numbers at many cave sites, have declined by as much as 51% (Jeff Gore, pers. comm.). Range-wide efforts are being undertaken to ascertain the current status of *M. austroriparius* populations and their habitats in order to make recommendations to the U.S. Fish and Wildlife Service concerning federal listing. The consensus of more than 40 authorities from states included in the range of the species is that *M. austroriparius* deserves at least a federally threatened status.

Several highly significant discoveries resulted from investigations prior to and during the 1991 *M. austroriparius* project. Some of those accomplishments were:

1. Reproductively active (summer) populations of *M. austroriparius* were discovered in three counties in southern Illinois. These populations had not been discovered or studied previous to the cooperative investigations spearheaded by the Illinois Natural History Survey, Illinois Department of Conservation, Illinois Department of Transportation, and the Shawnee National Forest.

2. The first maternity colony of *M. austroriparius* north of Louisiana and Florida was discovered in a hollow *Nyssa aquatica* (tupelo gum). This was also the first summer maternity colony ever reported from a natural, non-cave structure. Although this roost is indirectly protected as part of the Little Black Slough Nature Preserve, Johnson County, it should be a high priority for special protection.

3. A hibernaculum containing a winter population of *M. austroriparius* was confirmed and its status frequently assessed. The hibernaculum, Whitehill Quarry, should be a very high priority for protection efforts, either through the Illinois Department of Conservation Natural Heritage Landmark program, purchase, management easement, or some other type of incentive.

4. Precedent-setting radio-tracking efforts were successful, although not to the degree expected (e.g., previous radiotracking studies of *Myotis sodalis* in Illinois); however, it was only through radiotelemetry that:
   (A) the maternity roost tree was discovered;
   (B) foraging habitat was identified;
   (C) maximum foraging distance from the diurnal roost was roughly ascertained;
   (D) evidence was collected that other roosts were used, although their exact locations remain unknown.

5. The efforts put forth during the Illinois investigations and its accomplishments resulted in the principal investigator of the project becoming a co-organizer of a range-wide effort to provide the U.S. Fish and Wildlife Service with adequate information to warrant the listing of *M. austroriparius* as a federal threatened or endangered species.

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APPENDIX A

Table A-1. Natural caves, mines and quarries in southern Illinois trapped or visited from 1982 through 1991 in attempts to find *Myotis austroriparius*.

RECORD No.	UTM	COUNTY	SITE
003801	291820,4116760	Alexander	Silica Mine .5 mi N Olive Br
003802	298480,4133640	Alexander	Silica Mine No. 37
003803	292230,4117050	Alexander	Silica Mine 1 mi NNE Olive Br
003804	296680,4133260	Alexander	Mine No. 83
003805	295260,4131600	Alexander	Mine No. 31a
003806	295260,4131600	Alexander	Mine No. 31b
003807	295260,4131600	Alexander	Mine No. 31c
003808	296920,4132310	Alexander	Mine No. 38
003809	296920,4132310	Alexander	Magazine Hollow Mine No. 1
003810	296920,4132310	Alexander	Magazine Hollow Mine No. 3
003811	296920,4132310	Alexander	Silica Mine No. 42
003812	296920,4132310	Alexander	Magazine Hollow Mine No. 5
003813	296920,4132310	Alexander	Magazine Hollow Mine No. 6
003814	296920,4132310	Alexander	Magazine Hollow Mine No. 7
003815	296920,4132310	Alexander	Silica Mine No. 41
003816	293000,4130230	Alexander	Silica Mine No. 32
003817	293350,4130450	Alexander	Silica Mine No. 33
003818	293300,4130250	Alexander	Silica Mine No. 34
003819	293300,4130250	Alexander	Silica Mine No. 35
003820	296050,4132910	Alexander	Silica Mine No. 82
069801	376160,4146150	Hardin	Cave Spring Cave
069802	381140,4144440	Hardin	Layoff Cave
069803	401550,4152380	Hardin	Brown's Hole Cave
069804	381320,4145880	Hardin	Griffith Cave
069805	394000,4150500	Hardin	Fluorspar Mine 2.5 mi NW
069806	394200,4152480	Hardin	Fluorite Mine No. 66
069807	394700,4152500	Hardin	Crystal Mine No. 67
069808	394670,4153450	Hardin	Crystal Mine
069809	394650,4153300	Hardin	Crystal Cave
069810	393820,4152000	Hardin	Flourspar Mine No. 55
069811	394780,4153000	Hardin	Mine No. 69
077801	275440,4192430	Jackson	Ava Cave
087801	319340,4133150	Johnson	Mason Cave
087802	332900,4137270	Johnson	Teal Cave
087803	321780,4132860	Johnson	Unnamed Cave (Whitehill)
087804	321340,4131880	Johnson	Whitehill Quarry
087806	322130,4141300	Johnson	Archimedes Cave

Table A-1. concluded.

RECORD No.	UTM	COUNTY	SITE
151801	372920,4147780	Pope	Big Grand Pierre Ck Cave
151802	359260,4149300	Pope	Frieze Cave
151803	370050,4142250	Pope	Hurricane Hol. An. No. 1
151804	370070,4142130	Pope	Hurricane Hol. An. No. 2
151805	369830,4143500	Pope	Simmons Ck Cave No. 1
151806	370320,4143400	Pope	Simmons Ck Cave No. 2
151807	352830,4137435	Pope	Tube Cave
165801	375340,4171990	Saline	Equality (Cave Hill) Cave
181801	288550,4163290	Union	Cave Spring Cave
181802	303790,4160560	Union	Ephgrave (Guthrie) Cave
181803	304620,4156670	Union	Rich's Cave (main ent)
181804	304520,4156500	Union	Rich's Cave (upper ent)
181805	298940,4146320	Union	Whiting Cave
181806	295280,4138270	Union	Silica Mine No. 40
181807	295540,4134500	Union	Silica Mine No. 39
181808	295000,4135160	Union	Silica Mine No. 85
[additional sites in literature not found]			
181809	287000,4154700	Union	Unnamed Site (cave or mine?)

APPENDIX B

Table B-1. Mist netting sites in southern Illinois sampled from 1984 through 1991.

Record No.	Site	County	UTM Coordinates
00301	Lake Ck (spillway rd)	Alexander	295055,4110180
00302	Sandy Ck	Alexander	298400,4120580
00303	Lake Ck No. 1	Alexander	294800,4110140
00304	Lake Ck No. 2	Alexander	293580,4109340
00305	Cooper Ck No. 5	Alexander	299240,4134160
00306	Black Ck/Horseshoe Lake	Alexander	290370,4113960
05901	Eagle Ck	Gallatin	384800,4168760
05902	Ohio R Trib	Gallatin	395930,4168000
05903	Robinette Ck	Gallatin	385720,4167950
05904	Eagle Ck No. 2	Gallatin	388620,4167300
06901	Wallace Branch	Hardin	376200,4143160
06902	Big Ck	Hardin	382640,4150740
06903	Hogthief Ck	Hardin	385100,4151200
06904	Big Ck	Hardin	382600,4150760
07701	Cave Ck (conf. Cedar Ck)	Jackson	293940,4170740
07702	Cedar Ck (conf. Cave Ck)	Jackson	293920,4170800
07703	Lake Murphysboro Overflow	Jackson	290030,4182930
07704	Sandstone Ravine	Jackson	288860,4182950
07705	Cedar Ck	Jackson	290710,4170370
08701	Cache R (Boss Island)	Johnson	327980,4137250
08702	Bay Ck	Johnson	345380,4140600
08704	Little Blk Sl (RR Track)	Johnson	328420,4136910
08706	Sugar Ck No. 1	Johnson	340600,4159475
08707	Sugar Ck No. 2	Johnson	339460,4161560
08708	Sugar Ck No. 3	Johnson	341520,4157620
08709	Sugar Ck No. 4	Johnson	341340,4158810
12701	Main Ditch	Massac	332720,4130910
12702	Ravine II	Massac	338200,4118600
12703	Massac Ck	Massac	348340,4117230
12704	Sevenmile Ck (north 45)	Massac	355680,4115270
12705	Sevenmile Ck (south 45)	Massac	354575,4113530
15101	Simmons Ck	Pope	369800,4143280
15102	Lusk Ck (Eddyville Rd Br)	Pope	363150,4148200
15103	Pond (s Millstone Bluff)	Pope	350720,4147120
15104	Bay Ck	Pope	353780,4153500
15105	Hunting Branch Ck	Pope	353200,4154000
15106	Big Grande Pierre Ck (IL 146)	Pope	373520,4146480
15107	Big Grand Pierre Ck (2)	Pope	372650,4149210
15108	Big Grand Pierre Ck (org)	Pope	372800,4150030

Table B-1. Concluded.

Record No.	Site	County	UTM Coordinate
15109	Flat Lick Br	Pope	357460,4136150
15110	Robnette Ck (Rosebud 1)	Pope	359620,4124700
15111	Robnette Ck (Rosebud 2)	Pope	359025,4124130
15301	Cache R (org Karnak Site)	Pulaski	325660,4130000
15303	Cache R (Flood Site)	Pulaski	325700,4130000
16501	Rock Branch	Saline	359670,4163220
16502	Bankston Fk	Saline	357260,4179220
18101	Clear Ck	Union	292220,4155540
18102	Clear Ck Ditch	Union	291600,4144245
18103	Lingle Ck No. 2	Union	297260,4137050
18104	Line C Ditch	Union	291225,4139580
18105	Trib to Wolf Lake	Union	285750,4153940
19901	Crab Orchard (1)	Williamson	316660,4171920
19902	Crab Orchard (2)	Williamson	322240,4170540
19903	Sugar Ck (Creal Springs)	Williamson	340105,4165265
19904	Sugar Ck (Palzo)	Williamson	342320,4168660