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1985 PROGRESS REPORT:  
ECOLOGICAL INVESTIGATIONS OF *MYOTIS SODALIS* (INDIANA BAT)  
DISTRIBUTION, ABUNDANCE, HABITAT UTILIZATION, AND STATUS  
IN ILLINOIS

Submitted To:

Bureau of Locations and Environment,  
Illinois Department of Transportation

Division of Forest Resources and Natural Heritage,  
Illinois Department of Conservation

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Illinois Natural History Survey

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## ABSTRACT

This project involves a five-year ecological investigation into the distribution, abundance, habitat utilization, and status of *Myotis sodalis* in Illinois. During the first year of field work, extending from 18 March through 3 October 1985, mist netting and bat trapping efforts were conducted at 24 surface sites and seven cave and/or mine entrances. These efforts resulted in the captures of 1513 bats representing eleven species. Thirty-five *Myotis sodalis* were mist netted over surface creeks and rivers and 197 were trapped at cave and/or mine entrances. Data strongly suggested the occurrence of Indiana bat maternity colonies at four study sites.

A total of 219 *Myotis sodalis* were banded during the first year of field work. Bands were placed on an additional 63 bats of six species as part of long-term studies at particular sites.

Suggested guidelines for evaluating the suitability of riparian habitats as maternity sites for *Myotis sodalis* were field tested at 12 mist netting sites. Definite problems emerged concerning the evaluation criteria used to measure life requisite values. Further studies and field testing are needed to determine maternity site requirements of *Myotis sodalis* before potential habitat values can be accurately evaluated.

## INTRODUCTION

*Myotis sodalis* (Indiana bat) has been known from Illinois since it was first described as a new species (Miller and Allen 1928). Until recently, information on Illinois populations were limited to studies of one cave in the extreme southeastern portion of the state (Hardin County) and one abandoned mine in north-central (LaSalle County) Illinois (Layne 1958; Hall 1962; Walley 1971; Humphrey 1978). *Myotis sodalis* have been reported from a cave in Madison County and winter records from a lead mine in JoDaviess County are over 30 years old. Until recently, only one hibernaculum for Indiana bats was known to occur in Illinois.

There is a definite lack of accurate data concerning *Myotis sodalis* summer distribution in Illinois. Previous records range throughout the state, but they probably more closely illustrate individual records and areas that have been sampled selectively rather than meaningful population structures (Figure 1). Recent studies have documented the occurrence of juvenile and reproductively active adult female *Myotis sodalis* in Jackson, Perry, Pike, Union and Wabash/Edwards counties in Illinois [Brack 1979; Sparling *et al.* 1979; Gardner and Gardner 1980; Kessler and Turner 1980; Kirkpatrick 1980; Dunstan and Warnock 1981; Gardner and Taft 1984; unpubl. data, Illinois Department of Conservation (IDOC)/Illinois Natural History Survey (INHS)]. Additional Illinois records for the Indiana bat include Adams, Christian, Cook, Hardin, McDonough, Morgan and Sangamon counties (Thom 1981; Gardner and Taft 1983; unpubl. data, IDOC/INHS).

Scant information exists on the migration patterns of Illinois *Myotis sodalis*. Hall (1962) reported the recovery of a female *Myotis sodalis* banded at Blackball Mine, LaSalle County, Illinois on 6 December 1958 and recovered at Collossal Cave, Edmonson County, Kentucky on 18 December 1959. Another *Myotis sodalis* (sex unknown) was banded at Blackball Mine on 10 November 1963 and was recovered at Palmyra, Marion County, Missouri on 20 August 1966 (Walley 1971).

Flooding, ceiling collapses, and freezing are all natural disasters that have been responsible for population declines in hibernacula (Hall 1962; Humphrey 1978; Brady 1982). Other factors contributing to the decline of the species include stream channelization, deforestation, and pesticide poisoning. Conlin (1976) reported that 29.7% of the interior streams (or 5,566 km) in Illinois had been channelized by 1976. Deforestation by agricultural clearing, road and utility construction, urban expansions, and a host of other "progress-" related developments all adversely impact the continued existence of *Myotis sodalis*. Pesticide-induced mortality of insectivorous bats has been well documented (Mohr 1972; Geluso *et al.* 1976; Clark *et al.* 1983) and has

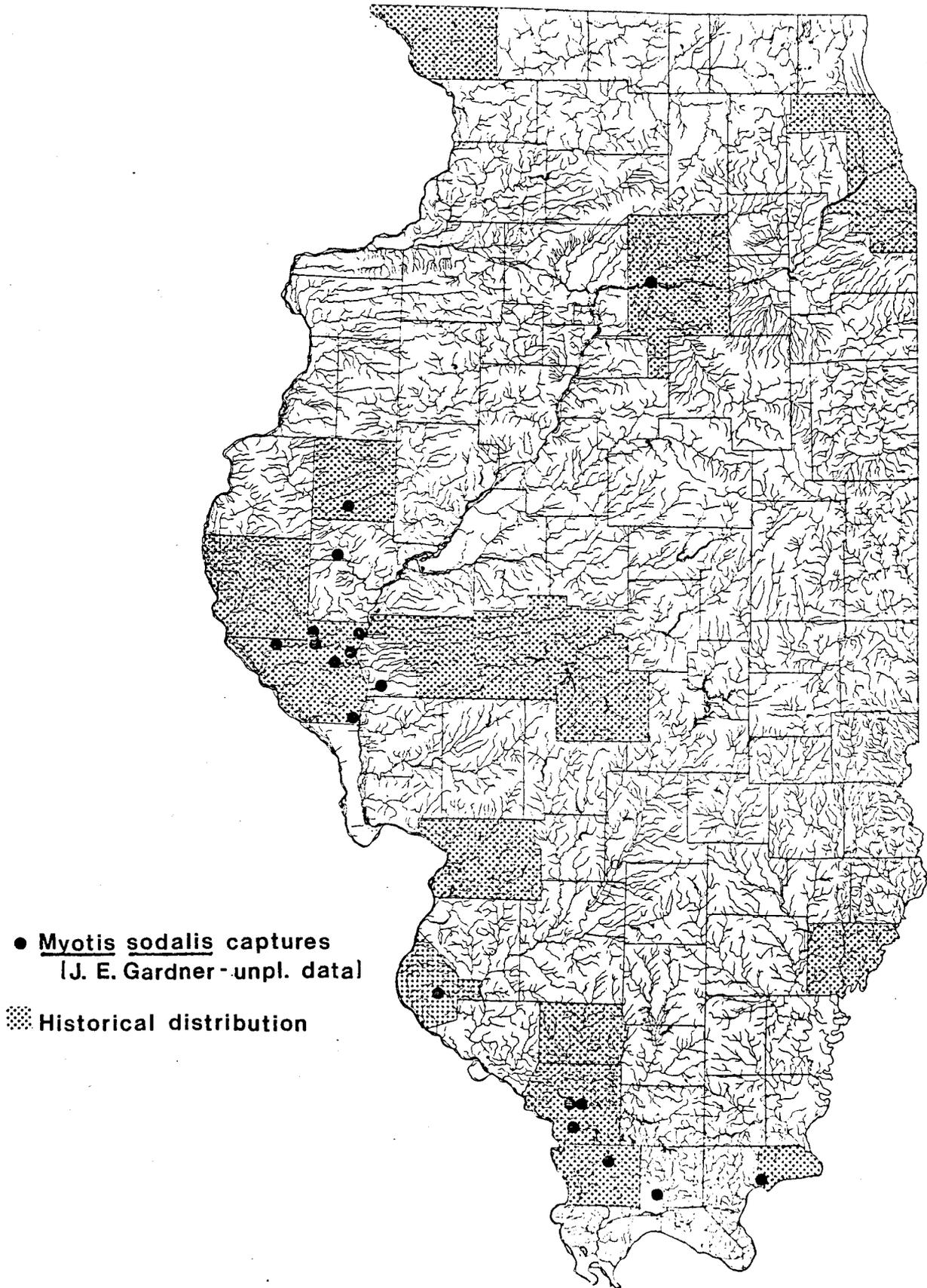


Figure 1. Historical distribution of *Myotis sodalis* in Illinois, including unpublished records of occurrence from Gardner and Gardner 1980, Gardner and Taft 1983, and Gardner and Taft 1984.

undoubtedly contributed to the decline of Indiana bat populations in Illinois. Questions still unanswered concern possible impacts from poor water quality and food sources, which may have even more adverse impacts on *Myotis sodalis*.

Most study sites of this project occurred haphazardly throughout Illinois and were chosen on the basis of potential *Myotis sodalis* habitat which might be affected by Illinois Department of Transportation (IDOT) construction activities. Other sites represent initial attempts to collect base-line data on habitat utilization by bats and to identify areas where in-depth investigations could be focused. One surface site and three cave and/or mine sites had data on previous captures (or observations) of *Myotis sodalis*. Additional efforts to document the occurrence and distribution of *Myotis sodalis* in Illinois will be focused upon filling obvious gaps in our knowledge of the distribution of the species (Figure 1).

The primary objectives of this project are as follows:

- (1) To determine the summer and winter distribution of *Myotis sodalis* populations in Illinois.
- (2) Once distribution patterns are recognized and understood, the abundance and status of *Myotis sodalis* in Illinois will be evaluated.
- (3) Data will be gathered concerning all aspects of *Myotis sodalis* ecology, including habitat utilization and possibly preferences.
- (4) Recommendations will be made to insure the continued existence of *Myotis sodalis* in Illinois.

These objectives will be accomplished primarily through funding from the Bureau of Locations and Environment, IDOT. Environmental assessments for threatened and endangered flora and fauna are undertaken at IDOT project areas as part of a state-wide biological survey and assessment program conducted by INHS staff. Technical support and cooperation (including indirect funding by providing professional assistance) is provided by the Division of Forest Resources and Natural Heritage, IDOC. The Shawnee National Forest (USDA, Forest Service) provided valuable field assistance and makes available National Forest lands for the purposes of this project (under Memorandum of Understanding dated 26 December 1972). It is anticipated that the Shawnee National Forest will contribute supportive funding for future aspects of this study involving National Forest lands. Additional cooperation in this study involves the Missouri Department of Conservation and the Iowa Conservation Commission.

Work involving the capture and handling of endangered species currently is being performed under a cooperative agreement between the U. S. Fish and Wildlife Service and IDOC, dated 17 July 1979.

## MATERIALS AND METHODS

### Live Capturing Bats

Live capturing bats at cave and mine entrances was accomplished by using a collapsible, highly portable trap similar to the one described by Tidemann and Woodside (1978). This trap measures approximately 1.5 square meters and is constructed of an aluminum frame with strands of monofilament fishing line suspended vertically under tension. When positioned in entrances or passageways, heavy nylon netting is draped around the edges of the trap and attached to the entrance ceiling, walls and floor. This heavy netting forces the bats to fly through the monofilament strands of the trap, which they cannot perceive with their ecolocation. The bats are stopped in flight by the strands, and fall harmlessly into a canvas bag where they are easily removed.

Live capturing bats at surface locations throughout Illinois was accomplished by utilizing black nylon, Japanese mist nets. These nets are 38mm mesh and each can be spread to a height of 2.2m. The nets range in length from 5.5m to 18.3m. Pairs of 9.2m high interconnecting poles are used to position nets well above ground level. On such high net sets, four mist nets of equal length stacked vertically, one on top of the other, and suspended between pairs of poles by a simple rope and pulley system. The top of the uppermost net can be raised to a height of 9.2m and lowered easily to retrieve bats captured in top sections of the nets. Whenever these nets are set over streams, areas are chosen where the trees create a complete, natural canopy. The nets are placed immediately behind, or underneath the canopy to create a netting plane between the ground and tree canopy. Often, an additional net will be placed at ground level and adjacent to the high net set to completely close-off the flyway. Nets are placed in the capture position at sunset and checked at maximum intervals of 15 minutes until midnight or later.

Data recorded for each bat capture included: species, sex, age (adult or immature), reproductive condition, weight, site location, direction and height in the mist net (for surface collections), arriving or departing (for caves and mines), and capture time.

Captured bats were examined and immediately released unharmed at the site of capture. Environmental factors, such as sky condition, moon phase, temperature, and wind, were used to assess bat activity and capture success. Age was determined by the degree of closure of the phalangeal epiphyses and, to a lesser degree, by tooth wear. Bats were designated as immature by their small overall size and incomplete ossification of the epiphyses.

### Bat Banding

Bats were banded with size XCL consecutively numbered, color-coded, celluloid split-ring bird bands (A. C. Hughes, Middlesex, England). A single, solid-colored band was placed upon the forearm of the right wing for males and left wing for females. Colors were chosen that would least likely be confused with bats banded during previous studies conducted in Missouri. Number 9 bands were removed from all groupings of bands (except for Orange) and not used, because they cannot be distinguished from number 6 bands. Likewise,

number 99 bands were removed because they are indistinguishable from number 66 bands. In the future, number 98 bands will not be used because they cannot be distinguished from number 86 bands.

## RESULTS

### Capture Data

During the 1985 field season, extending from 16 April through 12 August, 24 surface sites were mist netted for bats (Figure 2). These activities resulted in 33 successful capture nights and one night with no captures. An additional 13 nights were devoted to trapping bats at seven cave and/or mine entrances. These combined efforts resulted in the captures of 1513 bats (324 surface mist netting captures; 1189 cave and/or mine captures) (Table 1). Eleven species of bats were represented in these captures. Of special interest was the capture of 35 *Myotis sodalis* from surface sites in seven Illinois counties. Trapping cave and/or mine entrances resulted in capturing 197 *Myotis sodalis* from five of the seven entrances trapped.

Table 1. Tabulation of numbers of each species of bat captured during the 1985 field season, Illinois.

Species	Captured on Surface	Captured at Cave/Mine Entrances	Total Captured	Number Banded
<i>Myotis sodalis</i>	35	197	232	219
<i>Myotis grisescens</i>	2	16	18	18
<i>Myotis lucifugus</i>	60	470	530	3
<i>Myotis keenii</i>	14	36	50	8
<i>Pipistrellus subflavus</i>	51	460	511	19
<i>Eptesicus fuscus</i>	19	10	29	6
<i>Lasiurus borealis</i>	129	-	129	25
<i>Lasiurus cinereus</i>	7	-	7	2
<i>Lasionycteris noctivagans</i>	3	-	3	-
<i>Nycticeius humeralis</i>	3	-	3	-
<i>Plecotus rafinesquii</i>	1	-	1	-
	<u>324</u>	<u>1189</u>	<u>1513</u>	<u>300</u>

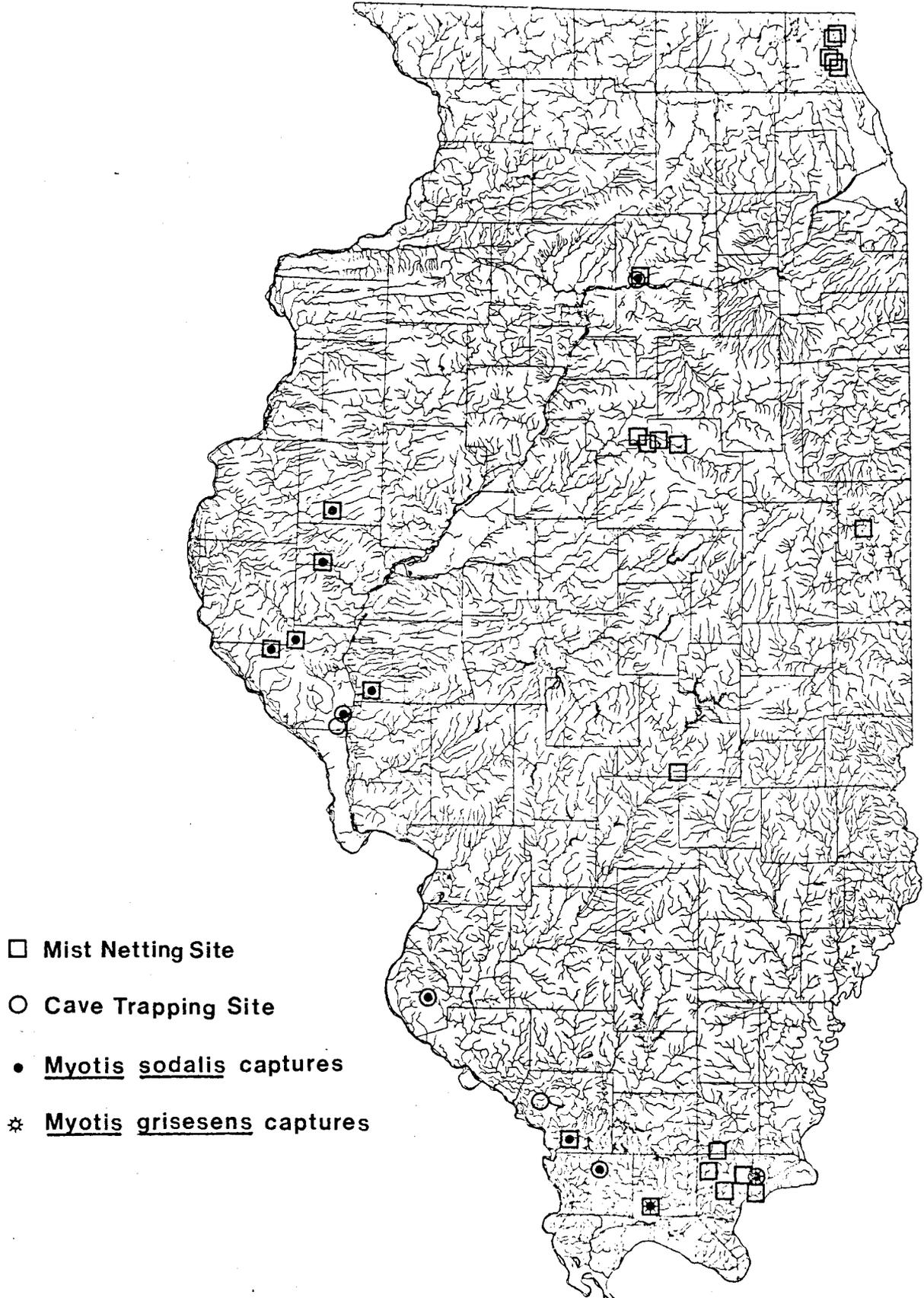


Figure 2. Locations of mist netting sites and cave and/or mine trapping sites sampled during the 1985 field investigations for Myotis sodalis and Myotis grisescens. Captures of each species at a particular site are indicated.

Pregnant or lactating adult female and/or juvenile *Myotis sodalis* were captured at seven of the 24 surface mist netting sites. Adult male Indiana bats were captured at three of these seven sites. One site (Fishhook Creek) was sampled repeatedly throughout the summer, accounting for 22 of the 35 *Myotis sodalis* captured during the 1985 field season. Fishhook Creek was undoubtedly utilized by a maternity colony of Indiana bats. The first pregnant female was captured on 7 May, and was followed by captures of lactating and post-lactating females during June and July, respectively (Table 2). The three nonreproductive adult females captured on 7 May could have been pregnant, but their weights averaged only 6.7 grams (compared to the 8.2 gram weight of the obviously pregnant female captured that same night). Several extensive searches for and examinations of potential maternity trees in the study area were unsuccessful. Efforts to locate the colony by observing first flight from the roost at dusk proved unsuccessful.

Table 2. Tabulation of sex and age data for *Myotis sodalis* captured at Fishhook Creek, Pike County, Illinois during the 1985 field season.

Date (1985)	Adult Female				Juvenile Female	Adult Male		Juvenile Male
	NR	PG	L	PL	NR	SCR	NR	NR
29 April	1							
7 May	3	1				1		
22 May						1		
7 June		1	1			2	1	
25 June			1				1	
16 July				1		1		
24 July				2	2			
12 August				1				1

NR=nonreproductive  
 PG=pregnant  
 L=lactating  
 PL=post-lactating  
 SCR=scrotal

The occurrence of a nearby *Myotis sodalis* maternity colony was strongly suggested by the capture success from at least three other sites (Jackson, Pike, and Schuyler counties). Pregnant and lactating adult female and juvenile Indiana bats were captured a short time after dusk at these sites. Adult male Indiana bats were captured within three study areas where reproductively active female Indiana bats were captured. Additionally, juvenile *Myotis sodalis* and juvenile *Myotis grisescens* were captured simultaneously in mist nets set over the Cache River (Johnson County) in southern Illinois.

Banding Data

Specific banding data are included in Appendix A. These data are submitted to the National Fish and Wildlife Laboratory (USDI, Fish and Wildlife Service, National Museum of Natural History, Washington, D. C.), Indiana/Gray Bat Recovery Team, and to cooperators in this project. Of the total 232 *Myotis sodalis* captured during the 1985 field season, 219 (94%) were banded. Bands were placed on an additional 81 bats of seven species (including 18 *Myotis grisescens*). Banding was limited primarily to bats captured during repeated sampling of Fishhook Creek (Tables 1 and 3).

Table 3. Summary of banding data on species of bats banded during the 1985 field season.

Species	Banded on Surface	Banded at Cave or Mine Entrance	Color	Numerical Sequence(s)
<i>Myotis sodalis</i>	X		Orange	5-11, 15-28, 30-35
" "		X	Orange	1-4, 12-14, 36-37
" "		X	Red	1-8, 10-35, 37-98, 100-168, 201-214
" "		X	Yellow	1-4
<i>Myotis grisescens</i>	X		White	18-19
" "		X	White	1-8, 10-17
<i>Myotis lucifugus</i>		X	Dk. Pink	1-3
<i>Myotis keenii</i>	X		Dk. Green	4
<i>Pipistrellus subflavus</i>	X		Lt. Green	6-7, 13-15
" "		X	Lt. Green	1-5, 8, 10-12
" "		X	Lt. Blue	1-5
<i>Eptesicus fuscus</i>	X		Dk. Blue	4-5
" "		X	Dk. Blue	1-3
" "		X	Red	1
<i>Lasiurus borealis</i>	X		Black	1-8, 10-13, 15-24, 26-27, 31
<i>Lasiurus cinereus</i>	X		Black	14, 25

The majority of Indiana bats (156) were banded on 9 and 10 September as they arrived at one Illinois hibernaculum (a cave). A second banding effort conducted at the same cave entrance on 3 October resulted in the banding of an additional 21 Indiana bats. Six *Myotis sodalis* banded on 9 and 10 September were recaptured on 3 October.

#### Proposed Habitat Evaluation Procedure for *Myotis sodalis*

Habitat evaluation procedures (HEP) are designed to describe life requisites (e.g. reproductive cover, food requirements, and cover) and define, as habitat characteristics, the plant species composition and structure comprising the life requisites for each habitat type. These evaluations are not difficult for animals whose life history requisites have long been studied and are well known (e.g. white-tailed deer), but become exceedingly frustrating when attempting to apply models to animals for which information on habitat suitability and life requisites is incomplete. The Indiana bat is a good example of a species for which we do not have sufficient data on life requisites to construct an adequate model.

Suggested guidelines for evaluating the suitability of riparian habitats as maternity sites for Indiana bats was developed by Joseph A. Janecek (ret. U. S. Fish and Wildlife Service, Marion, Illinois). This model was intended to evaluate a 1.5 km linear strip of riparian habitat for its suitability in meeting the life requisites of female and juvenile Indiana bats during the summer reproductive season. Habitat-use information for the Indiana bat was synthesized into scaled values to produce a Habitat Suitability Index (HSI). These values range from 0.0 (completely unsuitable habitat) through 1.0 (optimal habitat). Such a procedure is based on the limiting factor concept and assumes that the HSI is equal to the lowest life requisite value for the species.

This type of modeling allows for a large margin of subjective interpretation on the part of the evaluator. Additionally, the HEP appraisal guidelines developed from the model must be compared to estimates of animal abundance to ensure that they produce reasonable projections of habitat quality. This type of model testing is exceedingly difficult for *Myotis sodalis*, primarily due to limited and biased sampling techniques. The effectiveness of live capturing bats by mist netting is highly variable and biased by a number of factors. Other methods for sampling populations of bats involve the use of electronic bat detectors. However, the ecolocation signals of *Myotis sodalis* are of such low intensity that they are not detected easily.

The HEP model for *Myotis sodalis* has been field tested at 12 mist netting sites in Illinois. Definite problems emerged concerning the evaluation criteria used to measure life requisite values. For example, the HSI for the Cedar Creek, Jackson County, site was very low (0.0016). However, a post-lactating adult female, a non-reproductive adult female, and a juvenile male *Myotis sodalis* were captured within the evaluation area. A Schuyler County site and a Scott County site had HSI values of 0.0025 and 0.0284, respectively, but juvenile Indiana bats were captured at both sites

and a lactating female was captured at the Schuyler County site. In contrast, one site in Shelby County had an HSI of 0.37 and was evaluated as potentially good Indiana bat habitat. Yet when this seemingly suitable habitat was sampled, no *Myotis sodalis* and only six bats (5 *Lasiurus borealis* and 1 *Nycticeius humeralis*) were captured.

There is a problem with the life requisite value (LRV) which numerically ranks the number and size of dead trees with loose and peeling bark. Since HSI values are based on the limiting-factor concept, it is reasonable to assume that a lack of potential maternity trees in a riparian habitat is a factor limiting that habitat's suitability for providing reproductive cover. This assumption is biased because it is based on limited information concerning maternity site requirements for Indiana bats. Indiana bats have been reported to utilize both dead and living trees during summer, and no preference has been demonstrated. One tree utilized by Indiana bats occurred in a riparian habitat, but another was discovered in an open grazed pasture with only a pond nearby. Further studies are needed to determine the maternity site requirements of *Myotis sodalis* before its potential habitat value can be accurately evaluated.

#### DISCUSSION

Humphrey (1978) favored research on the biology of small populations of *Myotis sodalis* because he felt that such populations may become increasingly important in management of the species if larger populations continue to be threatened. It is hopeful that banding studies of small populations in Illinois will provide much needed information on the species' patterns of movements between summer and winter habitats. It is hopeful that information concerning summer habitat requirements and possibly habitat preferences will be gathered during these investigations.

Studies on *Myotis sodalis* in summer habitats may result in the discovery of additional maternity colonies, with the ultimate objective being determination and designation of critical summer habitats. The potential recovery of banded bats returning to summer habitat should provide data on site selection and loyalty. Investigations and accurate census of winter populations should provide insight into the status of presently known hibernacula and identify additional ones. Information on the distribution, abundance, and status of Illinois populations of *Myotis sodalis* should benefit nation-wide recovery efforts.

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## LITERATURE CITED

- Brack, V., Jr. 1979. Determination of presence and habitat suitability for the Indiana bat (*Myotis sodalis*) and gray bat (*Myotis grisescens*) for portions of three ditches, Big Five Levee and Drainage District, Union and Alexander counties, Illinois. Unpubl. report, St. Louis Dist., U. S. Army Corps Engr. 23pp.
- Brady, J. T. 1982. Status and management of the Indiana bat. Proc. Natl. Cave Mngt. Symp., Pygmy Dwarf Press, Oregon City, Oregon. 234pp.
- Clark, D. R., Jr., R. L. Clawson, and C. J. Stafford. 1983. Gray bats killed by Dieldrin at two additional Missouri caves: Aquatic macroinvertebrates found dead. Bull. Environ. Contam. Toxicol. 30: 214-218.
- Conlin, M. 1976. Stream channelization in Illinois-1976 update. Unpubl. report, Illinois Dept. Cons., Springfield. np.
- Dunstan, T. C., and J. E. Warnock. 1981. Species inventory of mammals. Chapter M. Pages M1-M43. In: Description of the biota in the areas of proposed Illinois River bridge sites for the central Illinois expressway. (FAP 408). Unpubl. report, Illinois Dept. Trans., Springfield. xv + (399+) pp.
- Gardner, J. E., and T. L. Gardner. 1980. Determination of presence and habitat suitability for the Indiana bat (*Myotis sodalis*) and gray bat (*Myotis grisescens*) for portions of the lower 6.6 miles of McKee Creek, McGee Creek Drainage and Levee Dist., Pike County, Illinois. Unpubl. report, St. Louis Dist., U. S. Army Corps Engr. 22pp.

- Gardner, J. E., and J. B. Taft. 1983. Determination of presence and habitat suitability for the Indiana bat (*Myotis sodalis*) and gray bat (*Myotis grisescens*) at nine Illinois Department of Transportation project areas. Unpubl. report, Bureau Location and Environment, Illinois Dept. Trans., Springfield. 133pp.
- Gardner, J. E., and J. B. Taft. 1984. A limited survey and assessment of the bat fauna occurring in twenty-six selected Illinois Department of Transportation study areas in eight Illinois counties. Unpubl. report, Bureau Location and Environment, Illinois Dept. Trans., Springfield. 205pp.
- Geluso, K. N., J. S. Altenbach, and D. E. Wilson, 1976. Bat mortality: Pesticide poisoning and migratory stress. *Science* 194:184-186.
- Hall, J. S. 1962. A life history and taxonomic study of the Indiana bat, *Myotis sodalis*. Reading Publ. Mus. Art. Gallery Publ. 12:1-68.
- Humphrey, S. R. 1978. Status, winter habitat, and management of the endangered Indiana bat, *Myotis sodalis*. *Florida Sci.* 41(2):65-76.
- Kessler, J. S., and W. M. Turner. 1980. Survey for the Indiana bat, *Myotis sodalis*, Bonpas Creek, Illinois. Unpubl. report, Louisville Dist., U. S. Army Corps Engr. 4pp.
- Kirkpatrick, R. D. 1980. Determination and habitat suitability for the Indiana bat (*Myotis sodalis*) and gray bat (*Myotis grisescens*) for a portion of Pipestem Creek, Perry County, Illinois. Unpubl. report, AMAX Coal Co., Indianapolis, Indiana. 8pp.
- Layne, J. N. 1958. Notes on mammals of southern Illinois. *Amer. Midl. Nat.* 60:219-254.
- Miller, G. S. and G. M. Allen. 1928. The American bats of the genus *Myotis* and *Pisonyx*. *U. S. Nat. Mus. Bull.* 144:1-218.
- Mohr, C. E. 1972. The status of threatened species of cave dwelling bats. *NSS Bull.* 34:33.
- Sparling, D. W., S. Sponsler, and T. Hickman. 1979. Limited biological assessment of Galum Creek. Unpubl. report, Southwestern Illinois Coal Co., Perry, Illinois. 22pp.
- Thom, R. H. 1981. Endangered and threatened mammals. pp. 59-69. In *Natural Land Institute. Endangered and threatened vertebrate animals and vascular plants of Illinois*, Illinois Dept. Cons., Springfield. 214pp.
- Tidemann, C. R. and D. P. Woodside. 1978. A collapsible bat-trap and a comparison of results obtained with the trap and with mist-nets. *Aust. Wildl. Res.* 5:355-362.
- Walley, H. D. 1971. Movements of *Myotis lucifugus* from a colony in LaSalle County, Illinois. *Trans. Illinois St. Acad. Sci.* 63:409-414.