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ILLINOIS NATURAL HISTORY SURVEY

PROGRESS REPORT:
1987 INVESTIGATIONS OF MYOTIS SODALIS (INDIANA BAT)
DISTRIBUTION, ABUNDANCE, HABITAT USE, AND STATUS
IN ILLINOIS

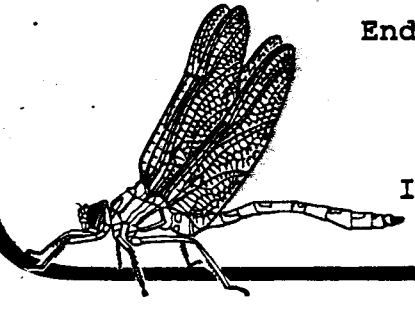
FINAL REPORT

FEBRUARY 5, 1988

Section of Faunistic Surveys and Insect Identification Technical Report

1988 (1)

by
James E. Gardner
Joyce E. Hofmann
James D. Garner



Prepared for:
Endangered Species Coordinator, Region 3
USDI, Fish and Wildlife Service
Twin Cities, Minnesota
and
Bureau of Location and Environment
Illinois Department of Transportation
Springfield, Illinois

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ABSTRACT

This project involves a 5-year (1985 through 1989) investigation into the distribution, abundance, habitat use and status of Myotis sodalis (Indiana bat) in Illinois. During the third year of field work, extending from 20 April through 17 August 1987, 63 nights of mist netting and other collecting techniques were conducted at 34 surface sites and two cave sites. These efforts resulted in the captures of 443 bats representing 10 species. Twenty-one Myotis sodalis were mist netted over surface creeks and rivers and 13 were captured at one cave. Data strongly indicated the occurrence of Indiana bat maternity populations near seven mist netting sites in five counties. Indiana bats were captured in one Illinois county during 1987 from which they had not been previously reported.

A total of 16 Myotis sodalis were banded in Illinois during 1987. Bands were placed on an additional 121 bats at Fishhook Creek as part of long-term studies there. One Lasiurus borealis (red bat) banded at Fishhook Creek in 1985 was recaptured there during 1987 and several bats banded during 1986 were recaptured this year, including a male Myotis sodalis.

Radio-telemetry tracking efforts resulted in the identification of 21 roost trees used by Indiana bats within the Fishhook Creek study area. Five roost trees were discovered at sites in three other Illinois counties. Fixed station tracking of three females and two males provided 20 nights of data on patterns of movement, home range size, and habitat use.

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 was limited to studies of one cave in the extreme southeastern region of the state (Hardin County) and one abandoned mine in north-central Illinios (LaSalle County) (Layne 1958; Hall 1962; Walley 1971; Humphrey 1978). Myotis sodalis also has been reported from a cave in Madison County. Winter records from a lead mine in JoDaviess County are over 30 years old. In 1982, an additional hibernaculum in Monroe County was confirmed (R. Clawson, pers. comm.; Illinois Dept. Cons., unpubl. data).

In Illinois, juvenile and reproductively active adult female Myotis sodalis have been captured in Adams, Bond, Jackson, Johnson, Perry, Pike, Pulaski, Schuyler, Scott, Union, and Wabash/Edwards counties (Brack 1979; Sparling et al. 1979; Gardner and Gardner 1980; Kessler and Turner 1980; Kirkpatrick 1980; Dunstan and Warnock 1981; Gardner and Taft 1984; Illinois Nat. Hist. Surv./Illinois Dept. Cons., unpubl. data) (Figure 1). Additional Illinois records for the Indiana bat are of migrating individuals or adult males. These records are from Adams, Christian, Cook, Hardin, McDonough, Madison, Morgan, and Sangamon counties (Thom 1981; Gardner and Taft 1983; INHS/IDOC, unpubl. data).

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

Human disturbance has been the single most detrimental factor leading to declines in hibernating populations of Indiana bats. However, flooding, ceiling collapses, and freezing are all natural disasters that have been responsible for population declines in hibernacula (Hall 1962; Humphrey 1978; Brady 1982; Clawson 1987). Other factors contributing to the decline of the species include stream channelization and deforestation. Conlin (1976) reported that 29.7% of the interior streams in Illinois had been channelized by 1976. Deforestation for agriculture, surface mining, road and utility construction, urban expansion and a host of other "progress-" related developments all adversely affect the continued existence of Myotis sodalis throughout its range. Pesticide-induced mortality of insectivorous bats has been documented for other states and probably has contributed to the decline of Indiana bat summer populations in Illinois (Mohr 1972; Geluso et al. 1976; Clark et

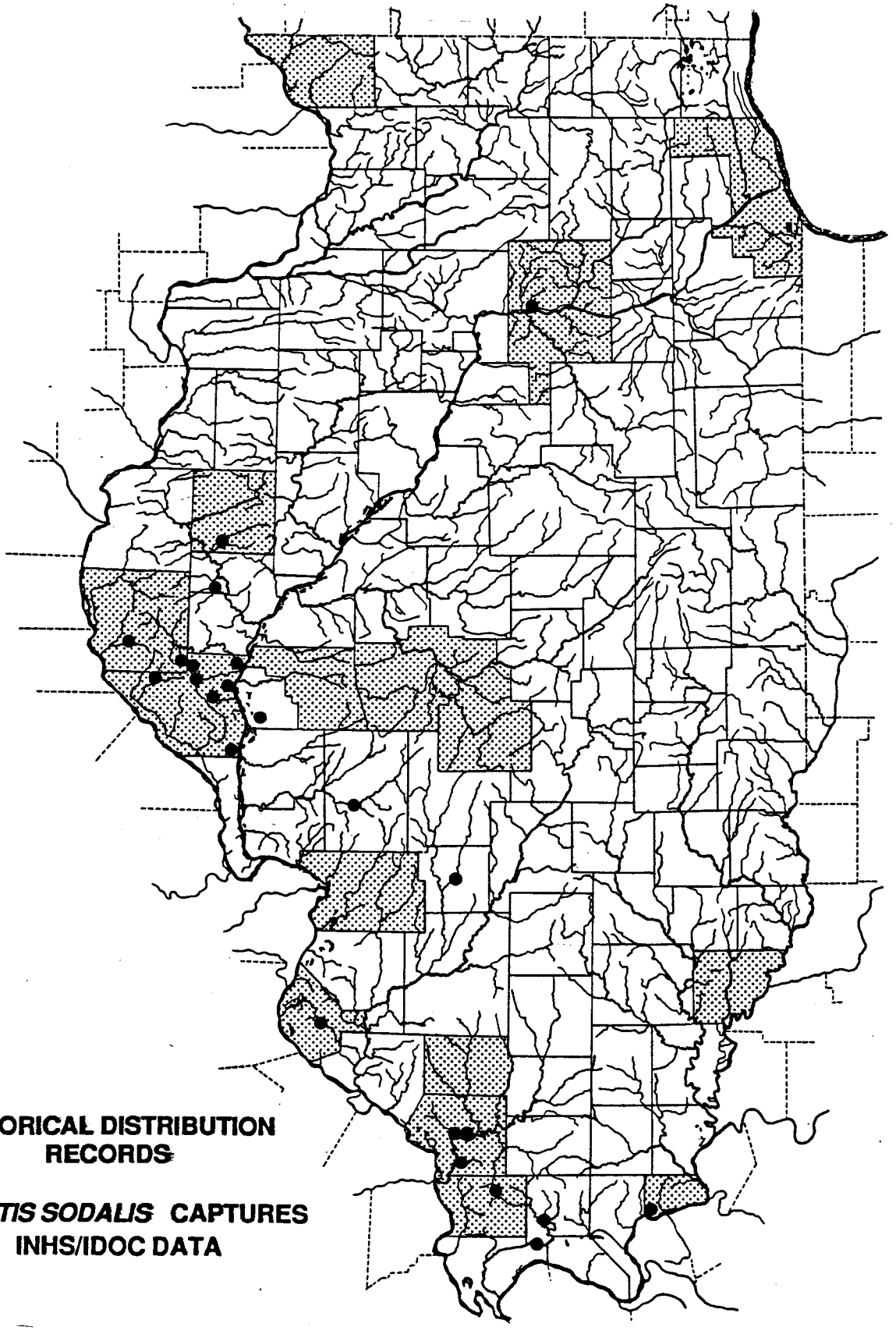

Figure 1. Distribution records of Myotis sodalis collected during 1985, 1986, and 1987 field work compared to the previously reported (historical) distribution of the species in Illinois.

al. 1983). Poor water quality and shortages in food sources, may have even more adverse effects on populations.

Approximately 33% of the study sites investigated during 1987 were areas where potential Myotis sodalis habitat might be affected by Illinois Department of Transportation (IDOT) construction activities. The remaining sites represented initial attempts to collect base-line data on habitat use by Indiana bats throughout Illinois and to conduct detailed investigations within one particular telemetry study area (Figure 2).

The overall objectives of the five year project are as follows:

1. To determine the summer and winter distribution of Myotis sodalis populations in Illinois.

2. To evaluate the abundance and status of Myotis sodalis in Illinois, based upon recognition and understanding of distribution patterns.

3. To gather data concerning all aspects of Myotis sodalis ecology, including habitat use and selection.

4. To make recommendations to ensure the continued existence of Myotis sodalis in Illinois.

In addition, the following objectives were incorporated for the radio-telemetry studies conducted during 1987:

A. To determine the home range size of selected sex and age classes of Indiana bats.

B. To identify roosts and collect data to aid in the analysis of roost selection and preference.

C. To determine foraging range size, describe habitat types within that range, and perform quantitative analysis of each habitat type.

These objectives will be accomplished through cooperative funding from the Bureau of Location and Environment (IDOT), Division of Natural Heritage (IDOC), Section of Faunistics Surveys (INHS), and U.S. Fish and Wildlife Service (USDI). Additional support in this study is provided by the Indiana Bat Recovery Team (USFWS). The Shawnee National Forest (USDA) actively participated in field studies and provided some support funding for computer analysis of data.

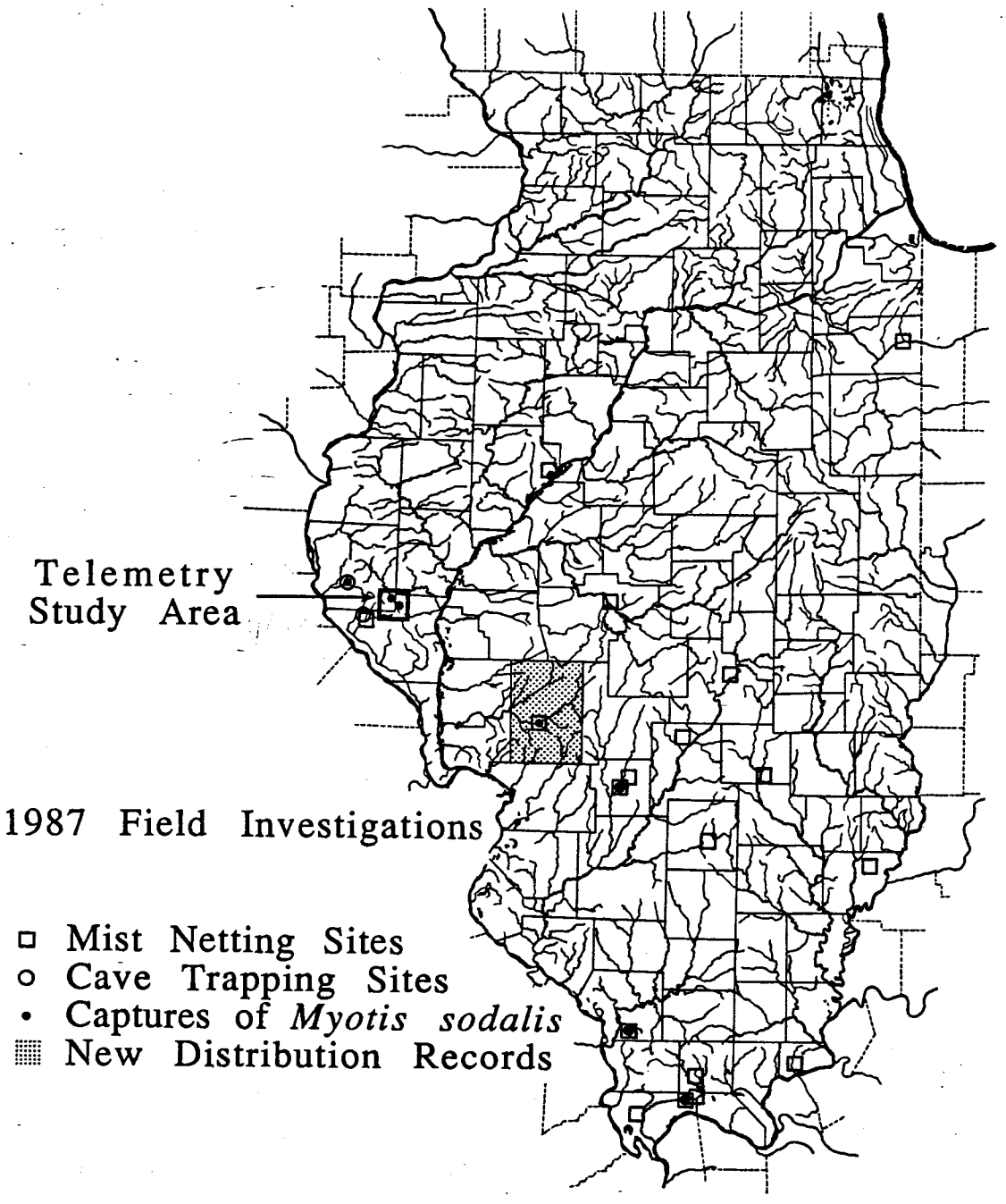

Figure 2. Locations of mist netting sites and cave collecting sites in Illinois, during 1987 field investigations showing captures of Myotis sodalis (more than one mist netting site may be indicated by a single symbol).

MATERIALS AND METHODS

Live Capturing Bats

Live capturing bats at surface locations was accomplished using black nylon Japanese mist nets. Nets ranged in length from 5.5 m to 18.3 m. A pair of 9.2 m high interconnecting poles was used to position nets well above ground level. On such high net sets, four mist nets of equal length were stacked vertically and suspended between the poles by a rope and pulley system. The top of the uppermost net could be raised to a height of 9.2 m and lowered easily to retrieve bats captured in upper sections of the nets. Whenever these nets were set over streams, areas were chosen where the trees created a complete, natural canopy. The nets were placed immediately behind, or underneath, the canopy to create a netting plane between the water and the tree canopy. Often, an additional net was placed at water level adjacent to the high net set to completely close-off the flyway. Nets were placed in the capture position at sunset and checked at maximum intervals of 15 min until midnight, and sometimes later.

A collapsible, portable trap similar to the one described by Tidemann and Woodside (1978) was used to live-trap bats at the cave entrance. Measuring approximately 1.5 m square, the trap has an aluminum frame with strands of monofilament fishing line suspended vertically under tension. When the trap is positioned in a cave entrance or passageway, heavy nylon netting is draped around its edges and attached to the ceiling, walls, and floor. This arrangement forces bats to fly towards the monofilament strands, which they cannot perceive with their echolocation. Stopped in flight by the strands, the bats fall uninjured into a canvas bag from which they are easily removed.

Data recorded for each bat capture included: species, sex, age (adult or juvenile), reproductive condition, weight, direction and height in the net, and capture time. Bats were captured, 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. Bats were designated as juvenile by their small overall size and incomplete ossification of the epiphyses.

Reproductive condition of males was determined by size and position of the epididymides. Scrotal bats were characterized by enlarged, or swollen, epididymides in pigmented sheaths lateral to the tail. Enlarged testes usually accompany descended epididymides. Female bats were diagnosed either as lactating or post-lactating on the basis of teat examination. Pregnant females were examined and their condition diagnosed by

gently palpating the fetus through an obviously enlarged abdomen (care must be taken not to mistake a food-distended stomach for a fetus), or by body weights characteristic of pregnancy.

Observations of early foraging activity by bats were conducted at each netting locality. In addition to visual observations, activity of bats was monitored with QMC S200 and Mini bat detectors.

Potential roost trees were located and examined within each study area. Trees were determined to offer potential as roosts if they provided some loose bark for bats to roost beneath. The Indiana bat is known to establish maternity roosts beneath the loose bark of certain trees (Humphrey et al. 1977; Cope et al. 1978; INHS/IDOC, unpubl. data).

Radio-tracking

In addition to those data recorded for each bat captured, miniature radio transmitters (Holohill Systems, Ltd., Ontario, Canada) were attached to selected individuals of Myotis sodalis. Transmitters were attached to the mid-sagittal dorsal surface midway between the scapulae and the base of the tail. Attachment was accomplished with non-toxic skin-bond cement (Pfizer Hospital Products Group Inc., Largo, Florida).

Model TRX-1000S tracking receivers with a frequency range of 172.0 to 173.0 mHz (Wildlife Materials Inc., Carbondale, Illinois) were used in conjunction with collapsible (series F172-3FB), three-element Yagi antennas (AF Antronics, White Heath, Illinois).

Tracking began immediately upon release of bats and continued for consecutive nights until the transmitter became detached. Null signals from radio-tagged bats were recorded as bearings from three fixed stations situated on higher elevations above the corridors traveled by the bats. Bearings were taken every five minutes, synchronized through constant radio communications between stations. Bats were tracked to diurnal roosts by using single, hand-held antennas and following the peak signal to its source. The exact position of the bat beneath tree bark was determined by moving the antenna to within a few centimeters of the transmitter; this created a signal distortion, indicating the bat's position.

A micro-computer software package was used in conjunction with the ARC/INFO geographic information system to triangulate the azimuthal data to identify fix locations of bats. In addition to generating fixes, the computer program calculates: (1) home range polygons by the convex polygon, capture radius, non-circular, modified minimum, and percent home range methods;

(2) the geometric center; (3) the circumference of the area; and (4) statistics describing distances traveled between consecutive locations and daily travel.

RESULTS

Capture Data

Capture data for the 1985 and 1986 field seasons have been summarized in previous reports. During the 1987 field season, extending from 20 April through 17 August, 34 surface sites were mist netted for bats (Figure 2). These activities resulted in 63 nights of mist netting. An additional night was devoted to trapping bats at one cave entrance, and a cluster of bats (containing 13 Indiana bats) was captured by hand at one cave (Adams County). These combined efforts resulted in the captures of 443 bats (310 surface captures and 133 cave captures). Ten species of bats were represented in these captures. Of special interest was the capture of 21 Myotis sodalis from surface sites in six Illinois counties (Adams, Bond, Jackson, Macoupin, Pike, and Pulaski).

Ten reproductively active female Indiana bats (pregnant or lactating adults) were captured at seven of the surface mist netting sites in five counties, indicating the occurrence of maternity populations nearby. Adult male Indiana bats were captured at five sites in three counties. Fishhook Creek was sampled repeatedly throughout the summer (39 nights), accounting for 16 of the 21 Myotis sodalis captured from surface sites. Capture results for Indiana bats from Fishhook Creek are given in Table 1.

Table 1. Sex and age data for Myotis sodalis captured at Fishhook Creek, Pike County, Illinois, during 1987.

Date	Adult Female				Juv Female	Adult Male		Juv Male
	NR	PG*	L	PL	NR	SCR	NR*	NR
20 April		2					1	
30 April		3						
17 June							2	
22 June			1					
20 July				1				2

*=accounts for a total of four recaptures
NR=nonreproductive; PG=pregnant; L=lactating;
PL= post lactating; SCR=scrotal

Roost Tree Selection

Extensive searches for and examinations of potential roost trees within the Fishhook Creek study area were successful in 1986. The first roost tree (northern red oak) was discovered during May with the aid of a bat detector, while the second tree (cottonwood) was identified during September by tracking a radio-tagged bat. An additional 21 roost trees were identified within the Fishhook Creek study area (Adams and Pike counties) during the 1987 telemetry study. Although specific data concerning these trees will be published at a later date, species of roosts and their sizes (cm dbh), respecitively, include silver maple (24, 40), cottonwood (41, 41), shingle oak (28, 35, 35), slippery elm (14, 15, 18, 22, 33, 38, 43), northern red oak (22, 56, 61), bitternut hickory (24), sassafras (8), and shagbark hickory (39, 58). Five roost trees used by Indiana bats at sites in three other Illinois counties include sugar maple (33), slippery elm (28), sassafras (29), silver maple (31), and post oak (24).

During the 1987 telemetry study, one radio-tagged, pregnant Indiana bat returned to the same cottonwood at Fishhook Creek after four consecutive nights of tracking. On one occasion, at least one other bat was observed emerging from this roost tree at dusk along with the radio-tagged bat. This tree occurred 21 m from the cottonwood maternity roost identified during 1986. These data indicate that some female Indiana bats at Fishhook Creek had chosen this cottonwood as a maternity roost in early May. Unfortunately, this roost was destroyed when all of the bark was stripped away during a violent hail storm. The transmitter was recovered at the base of another tree nearby, but the fate of the bats using this maternity roost were not determined. No evidence was found to suggest mortality as a result of the storm.

Banding Data

Specific banding data are submitted to the National Fish and Wildlife Laboratory (Fish and Wildlife Service, National Museum of Natural History, Washington, DC), Indiana/Gray Bat Recovery Team, and to other states cooperating in this project.

Of the total 21 Myotis sodalis captured during the 1987 field season, 16 were banded. Twelve Indiana bats were banded at Fishhook Creek alone (Table 2). One male Indiana bat captured at Fishhook Creek on 30 April 1987 originally was banded there on 22 May 1986.

Bands were placed on an additional 121 bats (including two Myotis austroriparius - category 2 candidate species for federal endangered status). Whereas Indiana bats were banded at other

locations statewide, banding of other species was limited primarily to bats captured within the Fishhook Creek long-term study area (Table 2). As a result of these banding studies, a Lasiurus borealis banded at Fishhook Creek during 1985 and four Pipistrellus subflavus and another L. borealis banded during 1986 were recaptured this year. Ten bats banded at Fishhook Creek during 1987 were recaptured over the creek from one night to two months later, but often at different sites along the creek.

As per the terms of the U.S. Fish and Wildlife Service banding authorization for this study, Indiana bats no longer are banded during their arrival at hibernacula. However, during the regularly scheduled biennial census of one hibernacula in Illinois (1987), 38 of 177 Indiana bats banded at the cave entrance during autumn 1985 were observed among ceiling clusters of this species that totaled 395 bats.

Table 2. Data for species of bats banded and recaptured at Fishhook Creek, Pike County, Illinois, during 1987.

SPECIES	NUMBER BANDED	COLOR	NUMERICAL SEQUENCE	RECAPTURES
Myotis sodalis	12	Orange	61-65, 67, 70, 72-74	61, 62, 63, *50
		Dk Blue	31, 33	
Myotis keenii	14	Dk Pink	7, 8, 12-18, 22, 31, 32	18
		White	101, 102	
Myotis lucifugus	2	Dk Pink	5, 10	
Pipistrellus subflavus	32	Lt Green	34-54, 61-64 71-73	*16(twice) *17, *23, 35, 39, 41,
		Dk Pink	21	44
Eptesicus fuscus	11	Dk Blue	15-18, 20-22 26, 32, 41, 42	41(twice)

(Table 2 continued next page)

Table 2. (concluded)

SPECIES	NUMBER BANDED	COLOR	NUMERICAL SEQUENCE	RECAPTURES
Lasiurus borealis	49	Black	43-52, 54-56, 58-62, 64, 65, 68-72, 77-81, 83-85, 88, 91, 93	*4,*40, 45, 51
		White	20-23, 103-111	
Lasiurus cinereus	12	Black	53, 57, 63, 67, 82, 86, 87, 92, 94-96	
Lasionycteris noctivagans	1	Black	42	

*denotes bands from bats banded either during 1985 or 1986

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. Studies of small summer populations in Illinois have provided much needed information on the species' patterns of distribution in summer, and contributed greatly needed knowledge concerning the natural history of Indiana bats. These data, collected in Illinois, hopefully will aid in nation-wide recovery efforts.

As a result of the first 3 years of investigations, information concerning summer habitat requirements and roost tree selection have been gathered. Capture efforts have resulted in the addition of six counties to the known distribution of the species in Illinois (Bond, Johnson, Macoupin, Pulaski, Schuyler, and Scott). A total of 81 Indiana bats have been captured in mist nets set over creeks and rivers, 214 trapped at cave and/or mine entrances, and 1,459 censued at hibernacula. Twenty-eight roost trees used by Indiana bats have been identified in five counties.

The utilization of technologically advanced miniature transmitters in the study of Indiana bat ecology has greatly enhanced our understanding of the species. Computer analysis of the 1987 telemetry data is underway. However, preliminary indications suggest that upland habitats are used more extensively than previously was known. Home ranges of several male and female Indiana bats have been calculated, indicating a

definite loyalty to specific foraging areas. Further analysis is expected to yield quantitative data on foraging habitat, patterns of movement, and roost tree selection. Furthermore, computer programs designed to indicate habitat preference will be applied to evaluate more accurately habitat suitability.

ACKNOWLEDGEMENTS

This year's efforts could not have produced such good results without the assistance of a large number of people too numerous to mention here, but all for whom we are truly grateful. A special acknowledgement is extended to Tap Sangpan, Ray Smith and Karen Tyrell who served as part of the team. Many thanks to Bob Lindsay, who also spent many hours in the field during the telemetry study. Mark Wetzel not only aided us in the collection of telemetry data, but collected water quality data within the telemetry study area. We are extremely grateful to Liz Cook for her invaluable knowledge of computer programs used in the analysis of telemetry data and for her active participation in ARC/INFO- and GIS-based analysis of habitat use.

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