

A LIMITED SURVEY
TO DETERMINE SPECIES OCCURRENCE AND RELATIVE ABUNDANCE OF BATS
ALONG AN APPROXIMATE THREE KM SEGMENT OF THE DES PLAINES RIVER,
NEAR THE CONFLUENCE OF BULL CREEK, LAKE COUNTY, ILLINOIS

FINAL REPORT

4 September 1985

For
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Technical Report 1985

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INTRODUCTION

The objective of this project was to conduct a limited survey to determine species occurrence and relative abundance of bats along an approximate three kilometer segment of the Des Plaines River, near the confluence of Bull Creek. This objective was identified in a two part nongame grant proposal to the Lake County Forest Preserve District entitled: A study to determine the feasibility of constructing a manmade cavern as habitat for cavern-dwelling bats.

Habitat losses and continually declining bat populations may suggest a need for new approaches to bat conservation and management. Caves, and in some instances mines, are extremely significant to some species of bats (particularly federally endangered species). The occurrence of natural caverns and mines is restricted geographically and only those with appropriate temperature and humidity characteristics meeting the narrow physiological requirements of a species are utilized.

The importance of bat conservation has been recognized in the tropics where bats are known to be pollinators of several crops and in the continental U. S. where they are considered significant insect predators. The contributions of bats to medical research have only recently been recognized. At the state level, the construction of a manmade cavern may lay foundations for new solutions to problems with bat conservation and management. Illinois' coal mine restoration and habitat mitigation programs could be important beneficiaries of a successful project. Caves are fragile, non-renewable natural resources in Illinois (only recently protected by law) and cavern-dwelling bats are only as secure and widespread as the habitat upon which they depend. A manmade cavern within a secure riparian location may provide alternative roosting habitat beneficial to some species of bats in northeastern Illinois.

Data collected during this limited survey of bats include: environmental descriptions of the project area, previous records of bats reported from or thought likely to occur in the study area, and discussions concerning data collected during field investigations.

The project focused upon three netting sites on the Des Plaines River near Bull Creek, Lake County, Illinois. Other sections of the Des Plaines River, either upstream or downstream from this study area, were not included in this assessment. However, results from a closely related project on a segment of the Des Plaines River approximately 10 kilometers north of the study area are also presented to support conclusions made from the results of this particular study.

DESCRIPTION OF STUDY AREA

The study area encompassed an approximate 3 km stretch of the Des Plaines River north from Ill. Rt. 137 (Figure 1). Bull Creek flows into the river at a point 1 km north of Rt. 137, but is too narrow and choked by vegetation to be used significantly by local bat fauna. Otherwise, only very small tributary drainages enter the study area. Some large gravel pit lakes occur in the southern portion of the study area, but they were far too deep and too large to sample effectively. Included within the study area was an approximate 66 acre area of dry-mesic forest, known as St. Francis Boys Camp, which was rated as grade A and B in Illinois Natural Areas Inventory classification. Elsewhere, only thin strips of riparian trees occurred along the Des Plaines River, which was bordered on either side by urban areas, pastures or rowcrops.

The aim of the description of mist net positions and stream characteristics was to contribute data to our understanding of summer habitat suitability for bat fauna. Past studies have shown that bats (particularly Indiana bats) forage for insects over riparian habitats (Humphrey *et al.* 1977; Gardner and Gardner 1980; LaVal and LaVal 1980; Gardner and Taft 1983, 1984), with a preference for contiguous woodlands and trees forming a canopy over streams and rivers. The Indiana Bat Recovery Team (USDI 1983) has established a category system which qualitatively rates riparian habitats in relation to their suitability for foraging Indiana bats (based on reported habitat preferences). This classification system was applied as follows:

Category I-Few or no trees on either bank.

II-Scattered small trees on either bank.

III-Mature trees on one bank only.

IV-Mature trees on both banks, but not extending past stream bank

V-Mature trees more than 3 m past stream bank.

The vegetative and stream categorization at selected sites on the Des Plaines River were visually assessed by walking both upstream and downstream of the netting location until the site was adequately characterized to meet the study objectives. In addition, the surrounding vegetation at each netting site was briefly described.

The Des Plaines River can be described as very sluggish within the study reach, flowing from north to south. Stream banks were steep in most sections with indications of bank erosion. In some areas, thick mats of exposed roots were obviously helping to check erosion. Deep deposits of silt and sewage sludge were evident along more sluggish areas of the river. Domestic trash and other solid waste materials were common along the river's course; one area along the northern section of the study reach had been used as a dumping site. Riffles were not common within the study area, but where found contained washed deposits of glacial rubble.

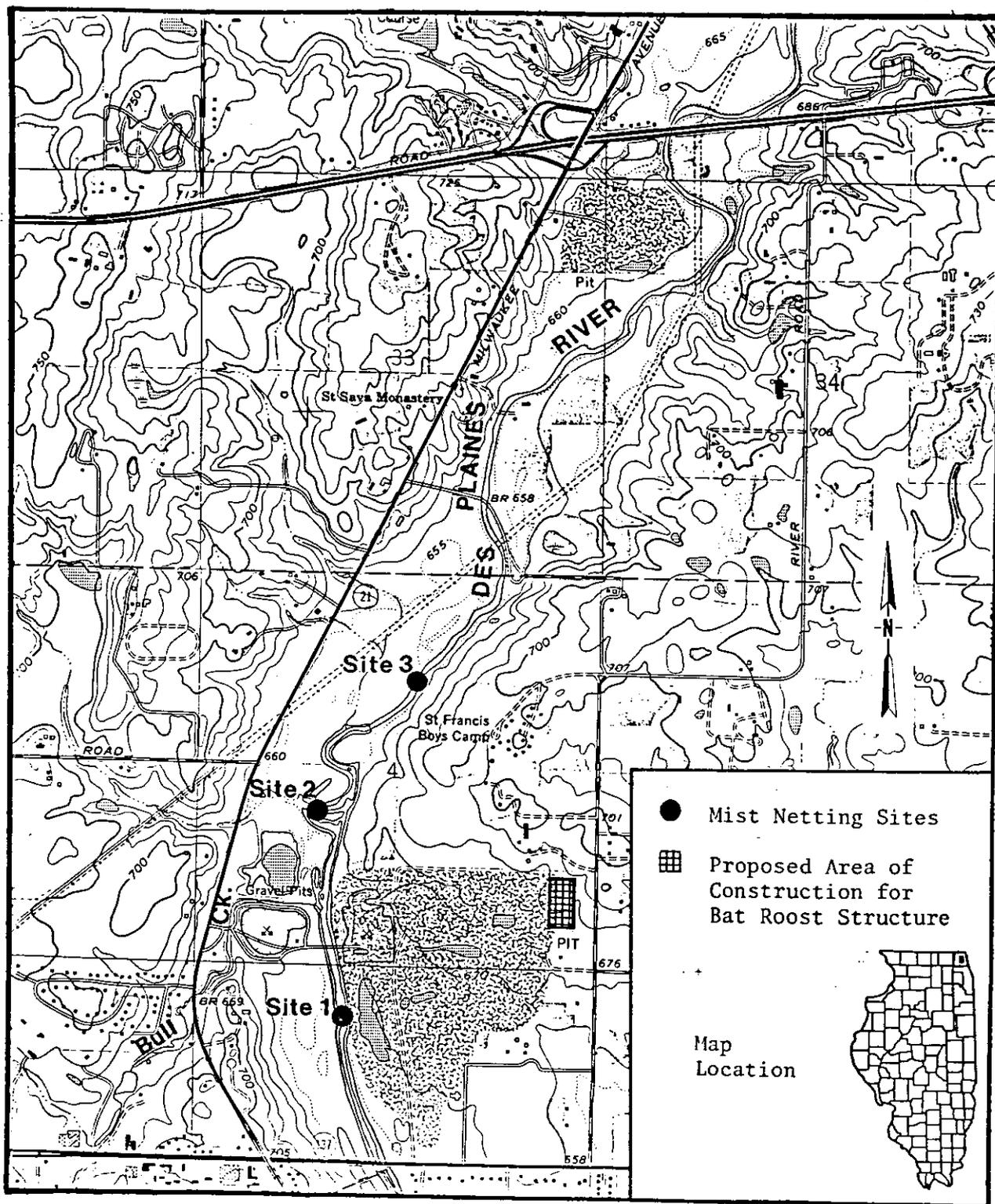


Figure 1. Location of mist netting sites and proposed area of construction for bat roost structure in the Lake County Forest Preserve District study area, Lake County, Illinois.

Site 1: Des Plaines River
 T44N, R11E, NW/4-SE/4-NE/4-NW/4 Sec. 9
 (Libertyville 7.5' quadrangle)
 Figure 1

This site was mist netted for bats on 6 August 1985. Four 12.8 m mist nets, suspended between a pair of 9.2 m high poles, were positioned across the Des Plaines River at a point 0.6 km upstream (north) of Ill. Rt. 137 bridge. The east pole was placed beneath and among overhanging branches of immature silver maple (*Acer saccharinum*) and green ash (*Fraxinus pennsylvanica*). A taller willow (*Salix* sp.) overhung the stream adjacent to this pole. The bank behind this pole was less than 1 m high and sloped gently toward the river. The west pole was positioned beneath a mature green ash with adjacent smaller green ash. Several green ash overhung the river adjacent to the west pole. This bank was steeper with some exposed rubble and was partially covered by roots.

Vegetation on the west bank of this netting site consisted of an 8 m wide strip of predominantly immature trees with a hayfield beyond (Table 1). The canopy on the east bank was more closed and was approximately 20 m wide. A large gravel pit bordered this side of the river with at least a 4 m rise in elevation from the river elevation. Some larger cottonwood (*Populus deltoides*) occasionally towered above the more common immature green ash.

The Des Plaines River averaged approximately 12 m wide at this site, but the channel was at least 15 m wide (Table 1). The river was a slowly flowing continuous pool in most sections, but short riffle areas occurred upstream and downstream of the netting position. The river was at best 0.3 m deep with a fairly consolidated bottom of mud and silt-covered rubble (Table 1).

Table 1. Vegetation classification and stream characteristics of Site 1: Des Plaines River, Lake County Forest Preserve District bat survey project, Lake County, Illinois.

Vegetation Category	Width of Vegetation (m)		Stream Channel Characteristics				
	west	east	Width (m)	Depth (m)	Bottom Type	Riffle/Pool Frequency	Man-made Alterations
V	8	20	15	0.3	mud/silt rubble	100 m+	none

Site 2: Des Plaines River
 T44N, R11E, SW/4-NW/4-NE/4-SW/4 Sec. 4
 (Libertyville 7.5' quadrangle)
 Figure 1

This site was netted on 7 August 1985. Four 12.8 m mist nets, suspended between a pair of 9.2 m high poles, were positioned across the Des Plaines River at a point 1.5 km upstream (north) of the Rt. 137 bridge. This site was 0.9 km upstream of netting Site 1. The east pole was placed beneath overhanging branches of silver maple. The bank near this pole was less than 1 m high and sloped gently toward the river. The west pole was positioned 3 m out into the river from the bank in order to avoid thick, low overhanging branches of green ash and elm (*Ulmus* sp.). This west bank was steeper in places than the east one and a wet weather drainage entered the river here. Silver maple created an extensive canopy near the nets, to the point of partially obstructing the flyway. An additional 9.1 m mist net was placed across an isolated pool in a high water meander channel of the river, 35 m east of the high net set. The small pool measured 9 m long, 4 m wide and 25 cm deep. This single net was stretched tightly across the pool, barely above the water level, in an attempt to capture bats as they drank from the pool.

Vegetation on the west bank at this site consisted of a 15 m wide strip predominantly of silver maple and green ash with pasture beyond (Table 2). On the east bank the forested area was more than 100 m wide. An occasional tall cottonwood or sycamore (*Platanus occidentalis*) extended above the other trees. Most areas above and below the netting site had branches overhanging the stream, but they did not form as good a canopy over the river as they did at the netting site.

The Des Plaines River was approximately 15.8 m and 0.3 m deep at the netting site (Table 2). The river was a calmly flowing pool beneath the nets, but a short riffle occurred 35 m upstream. The substrate was principally silt, but some sand and rubble was evident in areas (Table 2). Flood debris was backed-up above the riffle and protruded above the surface of the river throughout the netting area.

Table 2. Vegetation classification and stream characteristics of Site 2: Des Plaines River, Lake County Forest Preserve District bat survey project, Lake County, Illinois.

Vegetation Category	Width of Vegetation (m)		Stream Channel Characteristics				
	west	east	Width (m)	Depth (m)	Bottom Type	Riffle/Pool Frequency	Man-made Alterations
V	15	100+	15.8	0.3	silt/sand rubble	100 m+	none

Site 3: Des Plaines River
 T44N, R11E, SE/4-SW/4-NW/4-NE/4 Sec. 4
 (Libertyville 7.5' quadrangle)
 Figure 1

This site was sampled for bats on 8 August 1985. Two 18.3 m mist nets, suspended between a pair of 6.2 m high poles, were positioned across the Des Plaines River at a point 2.4 km upstream (north) of the Rt. 137 bridge. This site was 0.9 km upstream of netting Site 2. The east pole was placed beneath an overhanging willow. A grass-covered tractor lane extended up the east bank into a corn field. A concrete low-water bridge, serving as a permanent river ford, occurred below the mist nets. The west pole was positioned adjacent to very short, immature willow, elm and cottonwood. This west bank sloped gently toward the river from a large hayfield. Although these trees overhung the river considerably, they did not create a closed canopy area.

Vegetation along the west bank of this netting site was 10 m wide (Table 3) and consisted predominantly of 6 to 8 m high shrubs and immature trees with only a very occasional cottonwood extending above the subcanopy. One area of the west bank, north of the netting location, was devoid of any vegetation and heavy erosion of the bank was evident. The east bank was similar to the west bank upstream (north) of the netting position. Downstream from the netting site, the east bank had progressively larger trees, including silver maple, green ash, willow, cottonwood, and oaks (*Quercus* sp.) on the more upland slopes. However, only in narrower meanders of the river did branches of trees on opposite banks reach far enough over the river to create canopies.

The Des Plaines River was approximately 19 m wide at the netting site (Table 3). The low-water bridge, combined with some larger artificially introduced rocks, created a riffle area beneath the nets. The river in this location was otherwise a shallow (0.2 m deep), slowly flowing pool (Table 3). Some rubble was visible on the stream bottom, but most was silt covered. Flood debris was prominent in this area also.

Table 3. Vegetation classification and stream characteristics of Site 3: Des Plaines River, Lake County Forest Preserve District bat survey project, Lake County, Illinois.

Vegetation Category	Width of Vegetation (m)		Stream Channel Characteristics				
	west	east	Width (m)	Depth (m)	Bottom Type	Riffle/Pool Frequency	Man-made Alterations
V	10	25	19	0.2	silt/ rubble	100 m+	low water bridge

MATERIALS AND METHODS

Live Trapping Bats

Live trapping of bats was accomplished utilizing black, monofilament Japanese mist nets. These nets are 38 mm mesh and can be spread to a height of 2.2 m and range in length from 9.1 m to 18.3 m. Pairs of 9.2 m and 6.2 m high interconnecting poles are used to position nets well above ground level. On such high net sets, two or four mist nets of equal length are 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 9.2 m or 6.2 m and lowered easily to retrieve bats entangled 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. Oftentimes, an additional net is placed just above water level and adjacent to the high net set, because the high net set does not reach completely to the water surface. The rectangular plane area covered by mist nets range from 58.24 square meters to 117.12 square meters, depending upon the length of nets and height of poles used. Nets are placed in the capture position at sunset and checked at maximum intervals of fifteen minutes until midnight, and sometimes later. In all instances, high net sets were placed over the river, perpendicular to the banks, and positioned with tree canopies as described above.

Data recorded for each bat capture included: species, sex, age (adult or immature), reproductive condition, weight, direction and height in the mist net, and capture time. Bats were captured, examined, and immediately released unharmed at 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 juveniles 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 dorsolateral to the tail. Enlarged testes usually accompany descended epididymides. Female bats were diagnosed 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 pregnant bats.

Observations of early bat foraging activity were attempted at each netting locality. These observations provided valuable data on time of initial bat flight, as well as location of bats in relation to the tree canopy when they

first emerge. Foraging behavior of the bats can be observed in this manner and can be used to aid in evaluations of capture success and significance of foraging areas. Observed bats are identified to genus (if possible) on the basis of size, flight activity patterns, and subsequent capture.

Potential roost trees were investigated and recorded within each study site. Trees were determined to offer adequate roosting sites for certain bat species based on their structural characteristics. Potential roost trees are usually mature (over 40cm dbh), with at least some senescent portions. Although den cavities provide an obvious access for bats into hollow bole portions, trees with exfoliating sheets of bark are considered to provide more favorable roost structures. The Indiana bat (*Myotis sodalis*) is known to establish maternity roosts beneath the loose bark of trees (Cope *et al.* 1978; Humphrey *et al.* 1977). Trees such as black locust (*Robinia pseudoacacia*) and shagbark hickory (*Carya ovata*) produce long strips of loosened, but persistent, non-living bark. Cottonwood (*Populus deltoides*) predictably produces large and persistent sheets of bark because of its anatomical structure, offering excellent shelter to bats that may find their way beneath it (Gardner and Taft 1984).

RESULTS

Site 1: Bat Survey Results

Twenty-six bats representing three species were captured and examined at this netting site (Table 4). The first bats were observed flying above the river at 2028 hrs. and the first two bats were captured at 2030 hrs. *Lasiurus borealis* dominated the captures, accounting for 81% of the total captures. Thirteen of the red bats captured were nonreproductive juvenile females (Table 4).

Table 4. Results of bat captures from Site 1: Des Plaines River, Lake County Forest Preserve District bat survey project, Lake County, Illinois.

Date	Location	County	Species	No.	Age	Sex	Rep. Cond.
08-06-85	Des Plaines R.	Lake	<i>Lasiurus borealis</i>	1	A	F	PL
	LCFPD Site 1		" "	13	Juv	F	NR
			" "	2	A	M	Scr
			" "	5	Juv	M	Scr
			<i>Eptesicus fuscus</i>	1	A	F	PL
			" "	1	Juv	F	NR
			" "	1	A	M	Scr
			" "	1	Juv	M	Scr
			<i>Myotis lucifugus</i>	1	Juv	M	NR

M=male, F=female, A=adult, J=juvenile

Scr=scrotal, Pg=pregnant, L=lactating, PL=post lactating, NR=nonreproductive

Climatological factors were characterized by a temperature of 26 degrees C at dusk (2030 hrs.) that dropped to 23 degrees C by 2400 hrs. A mostly cloudy sky and occasional breezes were characteristic of the netting period. Thunderstorms occurred north and south of the study area. A waning moon toward the last quarter stage was not visible during the netting period.

Site 2: Bat Survey Results

A total of 19 *Lasiurus borealis* represent the only species captured at this netting site (Table 5). As on the previous night of netting, nonreproductive juvenile females dominated the captures (42% of captures) (Table 4). The first bats were observed flying above the river at 2015 hrs. and the first bats were captured at 2020 hrs. A scrotal juvenile male was the only bat captured in the single 9.1 m mist net positioned over the pool in the high water meander channel. This male was captured at water level suggesting that he was drinking from the pool.

Table 5. Results of bat captures from Site 2: Des Plaines River, Lake County Forest Preserve District bat survey project, Lake County, Illinois.

Date	Location	County	Species	No.	Age	Sex	Rep. Cond.
08-07-85	Des Plaines R. LCFPD Site 2	Lake	<i>Lasiurus borealis</i>	2	A	F	PL
			" "	1	A	F	NR
			" "	8	Juv	F	NR
			" "	2	A	M	Scr
			" "	5	Juv	M	Scr
			" "	1	-	F	-

M=male, F=female, A=adult, J=juvenile

Scr=scrotal, Pg=pregnant, L=lactating, PL=post lactating, NR=nonreproductive

Climatological factors were favorable for bat activity. A temperature of 19 degrees C at dusk (2020 hrs.) dropped to 15 degrees C by 2400 hrs. The sky was completely clear and a waning moon toward the last quarter stage was not visible during the netting period.

Site 3: Bat Survey Results

Eight *Lasiurus borealis* and two *Myotis lucifugus* were captured at this netting site (Table 6). Two bats were first observed flying high above the river in a straight line heading upstream (north) at 2038 hrs. Another bat was observed at 2044 hrs. as it foraged in a circular motion over the river. The first bat captured was a nonreproductive adult female *Myotis lucifugus* which flew into the net at 2048 hrs. A nonreproductive juvenile female *Lasiurus borealis* broke her wing when she became entangled in the net and had to be

sacrificed. The prepared study-skin specimen was submitted to Lake County Forest Preserve District for use in nature interpretive programs.

Table 6. Results of bat captures from Site 3: Des Plaines River, Lake County Forest Preserve District bat survey project, Lake County, Illinois.

Date	Location	County	Species	No.	Age	Sex	Rep. Cond.
08-08-85	Des Plaines R. LCFPD No. 3	Lake	<i>Lasiurus borealis</i>	5	Juv	F	NR
			" "	3	Juv	M	Scr
			<i>Myotis lucifugus</i>	1	A	F	NR
			" "	1	Juv	F	NR

M=male, F=female, A=adult, J=juvenile

Scr=scrotal, Pg=pregnant, L=lactating, PL=post lactating, NR=nonreproductive

Climatological factors included a clear sky with no breeze and a temperature of 17 degrees C at 2048 hrs. that dropped to 15 degrees C by 2400 hrs.

Potential Bat Roost Trees

A total of 33 dead or dying trees were examined within the three netting sites. The potential of these trees for providing suitable roost structures, based primarily on the amount of loose and peeling bark, was evaluated (Appendices 1, 2 and 3). Sixteen trees (or 48 % of the total) were categorized as exhibiting high potential. Willows (*Salix* sp.) most commonly provided potential roost structures; they ranged between 21 cm and 107 cm dbh (diameter at breast height). The average dbh for willows was 59 cm with most trees over this size exhibiting high potential. Cottonwoods, which often provide the best roosting structure, were too immature within the study area to have developed the characteristic slabs of loose and peeling bark.

One tree exhibited some evidence of past utilization by bats. A 70 cm dbh, predominantly living willow with a small cavity was discovered approximately 300 m downstream (south) of Site 1. The cavity had an opening (10 cm diameter) on the south side of the main trunk 3 m above the ground. A small accumulation of guano covered approximately 40 square cm of the ground below this opening and was only 4 cm deep. Some guano pellets were undoubtedly from bats, but others were from southern flying squirrel (*Glaucomys volans*). A thorough investigation of the cavity provided no additional evidence of present habitation by bats.

DISCUSSION

The objective of this study was to determine species occurrence and relative abundance of bats along a selected segment of the Des Plaines River, Lake County, Illinois. Once this objective has been met the Lake County Forest Preserve District plans to utilize bat capture and habitat suitability data to determine the feasibility of constructing an artificial bat roosting cavern. Comments concerning particular bat species and their occurrence and relative abundance in northeast Illinois are included below. In addition to these comments, some considerations involving the proposed construction of an artificial cavern for bats are offered in an attempt to help determine the feasibility of building such a structure.

Historical Records

Historically, fourteen species of bats have been reported from Illinois, but only eleven species are encountered with any regularity. Although any of these eleven species may be encountered in caves or mines, seven species are categorized as cave bats. Cave bats make regular use of and are dependent upon caves (or mines) during all or part of their life cycle. The other four species are categorized as tree bats because most migrate as an alternative to low temperatures and hibernation. Morphological, physiological, and social variations are used to differentiate cave bats from tree bats.

Two species of cave bats, the Indiana bat (*Myotis sodalis*) and gray bat (*Myotis grisescens*) are federally listed endangered species (50 CFR 17, subpart B, subsection 17.11). However, all species of bats occurring in Illinois are protected by law (Illinois Wildlife Code, as revised, Chapter 61, article 11, section 2.2), with the Indiana bat and gray bat listed as state endangered. These endangered species of bats are seriously threatened by human land use consumptions and associations. Alteration and destruction of habitat resulting from stream channelization, lake inundation, agricultural land clearing, road and utility construction, urban expansion, and a host of other "progress"-related developments all threaten the continued existence of Indiana and gray bat populations.

Nine species of bats have been reported from Lake and adjacent Cook, DuPage, Kane, and McHenry counties in northeast Illinois (Sanborn 1929, 1930; Gregory 1936; Mohr 1941; Necker and Hatfield 1941; Wetzel 1947; Parmalee and Smith 1954; Hoffmeister and Mohr 1957; Ill. Natural History Survey/Ill. Department of Conservation, unpubl. data). These species, listed in order of decreasing numbers of records, are *Lasiurus borealis* (77), *Eptesicus fuscus* (55), *Lasiurus cinereus* (53), *Lasionycteris noctivagans* (44), *Myotis lucifugus* (18), *Myotis keenii* (7), *Nycticeius humeralis* (5), *Myotis sodalis* (1) and *Pipistrellus subflavus* (1). Those species of bats not historically known from northeast Illinois include *Plecotus rafinesquii*, *Myotis austroriparius*, *Myotis grisescens*, *Tadarida brasiliensis*, and *Myotis leibii* (J. E. Gardner, unpubl. data).

Plecotus rafinesquii and *Myotis austroriparius* are restricted to southern Illinois. A *Tadarida brasiliensis* record (Walley 1970) is of an individual found in DeKalb County, but was obviously a migrant because Illinois is far outside the historic range of the species. *Myotis grisescens* has been found in a north-central Illinois mine, but only one individual was captured (Ill. Department of Conservation, unpubl. data). A *Myotis leibii* record is from the same north-central Illinois mine (J. E. Gardner, unpubl. data) and represents the first reported occurrence of this species in Illinois.

Comments on Cave Bats

Myotis sodalis - Indiana Bat

Myotis sodalis is a highly migratory species, widely distributed in summer, but more concentrated in caves during winter hibernation. The range of the species includes most of the eastern United States, being closely associated with major cave regions and areas north of these regions (Hall 1981). Approximately 66% of the known population (or about 350,000 bats) hibernate in a few caves and one abandoned mine in Missouri (LaVal and LaVal 1980; Schwartz and Schwartz 1981). The remaining one third of the population hibernates primarily in one cave in Indiana and one in Kentucky. One well known hibernaculum for Indiana bats occurs in north-central Illinois.

A great deal less information is known concerning *Myotis sodalis*' summer distribution within its range. Recaptures of banded bats have documented summer migrations northwest from Kentucky hibernacula into Indiana, Ohio, and Michigan (Barbour and Davis 1969). Banded female and juvenile Indiana bats from Missouri hibernacula were recaptured throughout northern Missouri, and one record is from Iowa (LaVal and LaVal 1980; J. B. Bowles, pers. comm.). Records of *Myotis sodalis* in extreme southern and west-central Illinois, suggest additional movements southeast, east, and northeast from Missouri hibernacula (Brack 1979; Thom 1981; Gardner and Taft 1983, 1984). Additionally, Indiana bats hibernating in north-central Illinois should characteristically migrate into summer areas in northern Illinois and possibly as far north as Wisconsin.

In Illinois, *Myotis sodalis* distribution records are reported from throughout the state, but in most cases probably more closely illustrate individual records and areas that have been selectively sampled rather than meaningful population structures. Juvenile and reproductively active adult female *Myotis sodalis* have been reported from 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). Additional Illinois records for the Indiana bat include Christian, Cook, Hardin, McDonough, and Morgan counties (Dunstan and Warnock 1981; Thom 1981; Gardner and Taft 1983, 1984; Illinois Department of Conservation, unpubl. data). LaSalle County records represent one of few remaining Illinois hibernacula for *Myotis sodalis*. One cave in Monroe County may be more significant to hibernating Indiana bats than was previously believed. There is a Madison County record from a cave and a JoDaviess County record that is a winter record over 30 years old.

A single record of an Indiana bat captured in Cook County in September 1928 was undoubtedly a migrant (Ill. Department of Conservation, unpubl. data). Northeast Illinois is at the northern limit of the reported range of the species. They are more closely associated with caves and mines in southern and west-central Illinois. It is highly unlikely that *Myotis sodalis* would benefit significantly from the construction of an artificial hibernaculum in northeast Illinois.

Eptesicus fuscus - Big Brown Bat

Occurring statewide, big brown bats are one of the most common species of bats in Illinois. Four *Eptesicus fuscus* were captured at Site 1. These bats were a post lactating female, a scrotal adult male and two juveniles. The 55 previous records for big brown bats in northeast Illinois include Waukegan. These captures, combined with historic documentation of their occurrence in the area, are a strong indication that big brown bats could be found in northeast Illinois year round. This conclusion is supported by the fact that big brown bat movements from summer to winter areas are short, sometimes covering only a few miles (Davis *et al.* 1968).

Eptesicus fuscus have adapted well to man's buildings and exhibit preferences for them. They often enter buildings for hibernation and have been seen flying in urban areas in December (Barbour and Davis 1969). However, big brown bats are more commonly found hibernating in caves and mines. Although they have been observed hibernating in a variety of situations they are more characteristically found in holes, cracks and crevices in the ceiling and walls. In caves, they prefer areas near the entrance where temperatures are low and relative humidity is below 100 %. A range between 32 degrees F and 64 degrees F (0-18 degrees C) has been reported for the species (Barbour and Davis 1969).

If an artificial bat roost structure were designed to meet the physiological and behavioral requirements of hibernating *Eptesicus fuscus*, they would be the species most likely to inhabit such a structure. Their high relative abundance, high adaptability and tolerance to a wide range of temperatures make them a prime candidate for introduction.

Myotis lucifugus - Little Brown Bat

The little brown bat is known to occur statewide and is one of the most commonly encountered bat hibernating in some areas of Illinois. Large numbers of this species hibernate in an abandoned mine in north-central Illinois. Three *Myotis lucifugus* were captured within the study area, one at Site 1 and two at Site 3. The 18 previous records from northeast Illinois include Waukegan and a nursery colony inhabits a building approximately 9 km north of the study area (Henry Birtek, Lake County Forest Preserve District, pers. comm.). More than 73% of the previous records of occurrence were between May and September, suggesting that most bats probably migrate to hibernacula further south. Banding studies have shown that female little brown bats move several hundred km between summer areas and hibernacula (Davis and Hitchcock 1965; Fenton 1970; Griffin 1970; Humphrey and Cope 1976). However, Walley

(1971) documented shorter movements from a large hibernaculum in north-central Illinois, southwest into summer ranges along the Illinois River.

Little brown bats are most commonly found hibernating in caves and mines, although some individuals may find alternate sites. The species usually does not enter hibernacula until November and may leave by mid-March. They limit the number of arousals during hibernation and drink when they do arouse (Fenton and Barclay 1980). Female and scrotal adult male *Myotis lucifugus* were captured in mid-April over a creek near a large hibernaculum in north-central Illinois (Ill. Natural History Survey/Ill. Department of Conservation, unpubl. data).

Temperature and water vapor pressure in roosts significantly influence rates of water loss by little brown bats (Proctor and Studier 1970). Studies have shown that *Myotis lucifugus* prefer hibernating in areas with high levels of humidity (> 90%) and temperatures above freezing (Hitchcock 1949, 1965; Fenton 1970; Humphrey and Cope 1976). This highly gregarious species packs itself into tight clusters, apparently to benefit from group thermoregulation and reduce evaporative water loss.

If an artificial bat roost structure were designed to meet the physiological and behavioral requirements of *Myotis lucifugus*, they could conceivably be introduced to such a structure. However, it seems more reasonable to assume that bats spending the summer farther north, in Wisconsin, would benefit from shorter migration to closer hibernacula.

Myotis keenii - Keen's Myotis

Keen's myotis is known from scattered locations throughout Illinois, but could not be considered a commonly encountered bat. In Illinois, it is more closely associated with cave and mine areas in the southern two-thirds of the state. *Myotis keenii* were not captured during this study. However, seven previous records from northeast Illinois indicate its presence there between May and December (Ill. Natural History Survey/Ill. Department of Conservation, unpubl. data).

Hibernating colonies are usually very small when compared to other more gregarious species of *Myotis*, but may be as large as 100 to 350 individuals (Hitchcock 1949; Jackson 1961). There are no records of hibernating individuals in northeast Illinois. The closest known hibernaculum for Keen's myotis is an abandoned mine in north-central Illinois. Although they frequently roost singly in the open, they seem to prefer tight crevices and holes. *Myotis keenii* show a preference for cool, moist hibernating sites where the air is still. However, three have been reported hibernating in a sewer where the temperature was 1.5 degrees C and the relative humidity was 69% (Fitch and Shump 1979).

If an artificial bat roost structure were designed to meet the physiological and behavioral requirements of hibernating *Myotis keenii*, they could conceivably use such a structure to their benefit. However, since they are not common in northeast Illinois and usually hibernate in small numbers farther south, they would probably never form a large colony.

Pipistrellus subflavus - Eastern Pipistrelle

Eastern pipistrelles are widely distributed throughout Illinois and can be considered one of the most commonly encountered hibernating bats in the state. However, they appear to be much less common in northern portions of Illinois. For example, less than 90 eastern pipistrelles were observed hibernating in an abandoned mine in north-central Illinois, while over 7,000 hibernating *Myotis lucifugus* were counted there. In comparison, hibernating *Pipistrellus subflavus* accounted for almost 33% of the over 200 hibernating bats observed in a southwest Illinois cave (Ill. Natural History Survey/Ill. Department of Conservation, unpubl. data).

Eastern pipistrelles were not captured during this study. The only known historical record of an eastern pipistrelle in northeast Illinois was of an individual captured during September (Ill. Natural History Survey/Ill. Department of Conservation, unpubl. data). A recent study by Brack and Mumford (1984) suggested that *Pipistrellus subflavus* is absent in most areas of northeast Illinois because it was covered by the Wisconsin glacier.

If an artificial bat roost structure were constructed in northeast Illinois, it seems likely that *Pipistrellus subflavus* would not benefit from it. It is unfortunate that the proposed site of construction is located on the northeastern edge of the range of one of Illinois' most common species of cave bat.

Comments on Tree Bats

Probably the most commonly encountered bat in Illinois is *Lasiurus borealis*. The species ranges from southern Canada southward throughout the United States, Mexico, Central America, and into South America (Shump and Shump 1982). Forty-eight of the 55 bats captured during three nights of netting on the Des Plaines River were red bats. Red bats are nomadic tree dwellers and roost singly in a wide variety of places. The species migrates south in response to low temperatures and has no dependency on caves or mines for roosting or hibernating.

The other three species of tree bats reported from northeast Illinois (*Lasiurus cinereus*, *Lasionycteris noctivagans* and *Nycticeius humeralis*) are similar to red bats in their roosting habits and would not benefit from the construction of an artificial bat roost.

Structural Requirements

A most difficult problem exists with the physical construction of a subterranean artificial bat roost structure. The design of such a structure must take into account changes in the internal environment of the structure caused by external factors and must ensure that internal environments remain within the physiological tolerances of the bats.

Some elements of a "cave-like" environment which influence its suitability for bat roosts include: 1) temperature of the air, walls and ceiling and 2) relative humidity. These factors in turn are influenced by conduction of temperature through the ground, air movements within the cave (called breathing), water circulation and the geographic location and aspect of the structure (ie. north or south facing). Tuttle and Stephenson (1977) provide an excellent outline of factors responsible for variation in cave environments. Included in their work is a section on temperature constraints of cave bats.

Management Considerations

The design and subsequent construction of an artificial bat roost structure is only the beginning of such an experimental introduction. This experiment would not be meaningful without proper management to protect potential populations of bats. Vandalism of helpless hibernating bats can be very detrimental to populations. Repeated disturbances, even without directly touching the bats can cause weight loss and reduce the ability of hibernating bats to survive the winter. To avoid vandalism and disturbance, the structure would have to be gated. The design and construction of an appropriate bat gate which bats will fly through is discussed below.

A good bat gate is one that minimizes the effect on natural air flow and does not cause the bats to reduce their speed of entry or exit from the structure. Appendix 4 (Gardner 1984) presents an illustration of an adequately designed gate. In order to minimize interference with bat flight, a gate should have the fewest number of vertical bars possible. A spacing of not less than 12 inches between vertical bars allows bat passage and creates a strong gate. However, the greatest allowable distance between vertical bars can be as much as three to four feet. This maximum spacing between vertical bars reduces the amount of materials and labor expenditures, but increases the possibility of vandals breaking in or squeezing through the gate. The greatest allowable spacing between horizontal bars is six inches. Any smaller spacing acts as a barrier to some species of bats (ie. gray and Indiana bats), while horizontal spacing of more than six inches allows vandals to squeeze between bars.

SUMMARY

Fifty-five bats representing three species were captured during three nights of mist netting on the Des Plaines River while conducting a survey of bats for the Lake County Forest Preserve District, Lake County, Illinois. Species captured, listed in order of decreasing numbers, were *Lasiurus borealis*, (48), *Eptesicus fuscus* (4) and *Myotis lucifugus* (3). In comparison, these three species were the only species captured during a closely related project on the Des Plaines River conducted approximately 10 km north of the study area (Appendix 5). Other species of bats reported from Lake and adjacent Cook, DuPage, Kane and McHenry counties in northeast Illinois, but not captured during this study include *Lasiurus cinereus*, *Lasionycteris noctivagans*, *Myotis keenii*, *Nycticeius humeralis*, *Myotis sodalis* and *Pipistrellus subflavus*.

The results of this limited survey, combined with previous records for northeast Illinois, indicate that an artificial bat roost structure would most likely benefit *Eptesicus fuscus* and *Myotis lucifugus*. These two species have physiological and behavioral attributes which make them highly adaptable. An artificial "cave" roost could be utilized by bats as an alternate nocturnal roost, a site for autumn swarming, and finally as a hibernaculum. As a result of this use, it is reasonable to assume that young of the year would be introduced to the structure. Repeated utilization of the structure over a period of years might establish site loyalty. Determining the length of time it would take each species to find and adapt to the structure would be an interesting study.

ACKNOWLEDGEMENTS

We are grateful to Mr. Dennis Laurie, biologist, Lake County Forest Preserves Commission, for his invaluable assistance during the course of this investigation. Funding for this study was provided through a grant from the Illinois Non-Game Fund, Illinois Department of Conservation. Data presented from another study area on the Des Plaines River was collected as part of the wetlands demonstration project, Lake County, Illinois (Appendix 5).

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APPENDIX I
FIELD FORM
POTENTIAL ROOST TREES

Study area: LCFPD Site No. 1 Date: 6 Aug 1985

County: Lake

Tree No.	Description	dbh (cm)	* Bark Potential	Hollow Bole Potential
1.	<u>Willow</u>	<u>46</u>	<u>high</u>	<u>no</u>
2.	<u>Cottonwood - 15 m tall</u>	<u>51</u>	<u>high</u>	<u>yes</u>
+ 3.	<u>Willow - predominately alive</u>	<u>70</u>	<u>high</u>	<u>yes (see below)</u>
4.	<u>Elm</u>	<u>23</u>	<u>moderate</u>	<u>no</u>
5.	<u>Cottonwood</u>	<u>55</u>	<u>low</u>	<u>yes</u>
6.	<u>Unidentifiable - tall tree</u>	<u>53</u>	<u>none</u>	<u>none</u>
7.	<u>" - snag 3m tall</u>	<u>48</u>	<u>none</u>	<u>yes</u>
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				
19.				
20.				

* high=25% or more of main trunk and limbs having loose and peeling bark
 moderate=10% to 25% of main trunk and limbs having loose and peeling bark
 low=10% or less of main trunk and limbs having loose and peeling bark
 none=snag trees devoid of loose and peeling bark, or dead and dying trees with bark still firmly attached

+ = Cavity 3m above with 10cm diameter opening. Some guano beneath opening. Some guano bat, some flying squirrel.

APPENDIX 2
FIELD FORM
POTENTIAL ROOST TREES

Study area: LCFPD Site No. 2 Date: 7 Aug. 1985
County: Lake

Tree No.	Description	dbh (cm)	* Bark Potential	Hollow Bole Potential
1.	Elm	35	high	no
2.	Cottonwood - snag	92	none	no
3.	Willow - 3 branches from base	one/ 93	high	no
4.	" - 4 " " "	one/ 50	high	yes
5.	Willow	107	moderate	no
6.	Cottonwood	100	high	yes
7.	Willow	64	low	no
8.	"	67	high	no
9.	"	75	high	no
10.	"	46	moderate	no
11.	"	68	"	
12.	"	66	high	no
13.	"	45	low	no
14.	"	45	high	yes
15.	"	46	low	no
16.	"	50	moderate	no
17.	"	77	"	yes
18.	"	74	high	yes
19.				
20.				

* high=25% or more of main trunk and limbs having loose and peeling bark
moderate=10% to 25% of main trunk and limbs having loose and peeling bark
low=10% or less of main trunk and limbs having loose and peeling bark
none=snag trees devoid of loose and peeling bark, or dead and dying trees with bark still firmly attached

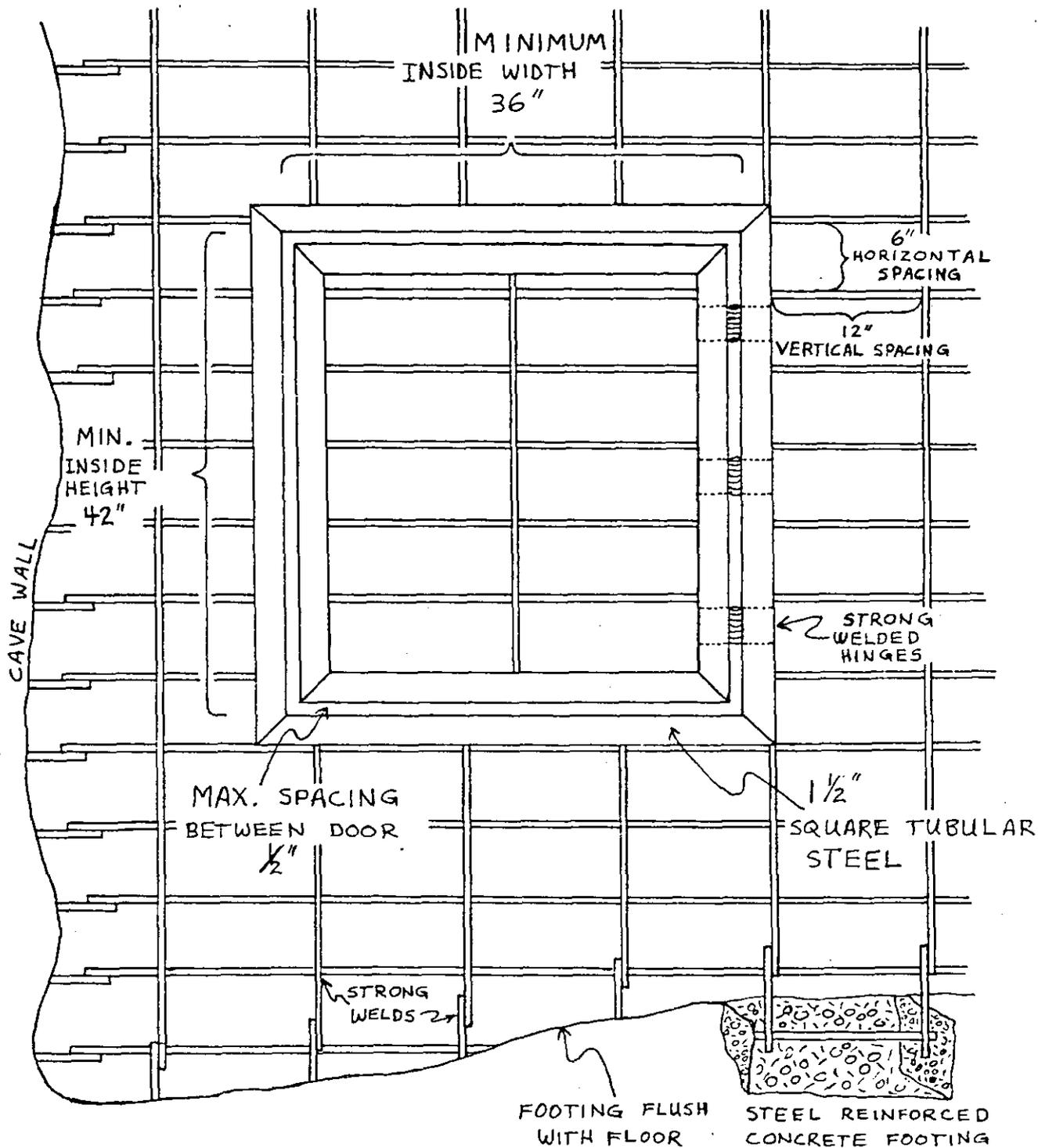
APPENDIX 3
FIELD FORM
POTENTIAL ROOST TREES

Study area: LC FPD Site No. 3 Date: 8 Aug. 1985
 County: Lake

Tree No.	Description	dbh (cm)	* Bark Potential	Hollow Bole Potential
1.	Elm - snag 8 m tall	25	high	no
2.	Willow - snag 14 m tall	21	low	no
3.	"	30	"	"
4.	Silver maple double trunks	^{one} 22	"	"
5.	Willow - partially dead	48	high	yes
6.	" " "	38	high	no
7.	Unidentifiable - snag tree	39	none	yes
8.	Willow - 5 trunks from base	^{one} 64	high	yes
9.				
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19.				
20.				

* high=25% or more of main trunk and limbs having loose and peeling bark
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 low=10% or less of main trunk and limbs having loose and peeling bark
 none=snag trees devoid of loose and peeling bark, or dead and dying trees
 with bark still firmly attached

Illustration of an acceptable bat gate design (from Gardner 1984).



APPENDIX 5

Results of mist netting during the Des Plaines River Wetlands Demonstration Project: A limited survey and assessment for *Myotis sodalis* (Indiana bat), Lake County, Illinois.

Date	Location	County	Species	No.	Age	Sex	Rep. Cond.
07-29-85	Mill Ck./at confluence to Des Plaines R. (13 km north Ill. Rt. 137)	Lake	<i>Myotis lucifugus</i>	1	A	F	PL
			" "	2	A	F	NR
			<i>Lasiurus borealis</i>	1	A	F	PL
			" "	1	Juv	M	NR
			<i>Eptesicus fuscus</i>	1	A	F	PL
08-05-85	Des Plaines R./ 120 m upstream confluence of Mill Ck. (13 km north Ill. Rt. 137)	Lake	<i>Lasiurus borealis</i>	1	Juv	F	NR
			<i>Eptesicus fuscus</i>	1	A	F	PL
			" "	1	Juv	F	NR

M=male, F=female, A=adult, J=juvenile

Scr=scrotal, Pg=pregnant, L=lactating, PL=post lactating, NR=nonreproductive



2000 North Milwaukee Avenue • Libertyville, Illinois 60048 • (312) 367-6640

85-

September 12, 1985

Mr. Carl Becker
Manager
Natural Heritage Section
524 South Second Street
Springfield, IL 62706

Dear Carl:

Please find enclosed the final reports for our two nongame grant projects.

We feel that the projects were successful and we look forward to an opportunity to work with you again to benefit our nongame resources.

Sincerely,

A handwritten signature in black ink, appearing to read "Dan Brouillard".

Dan Brouillard
Supervisor of Conservation

DB/ep
Enclosure