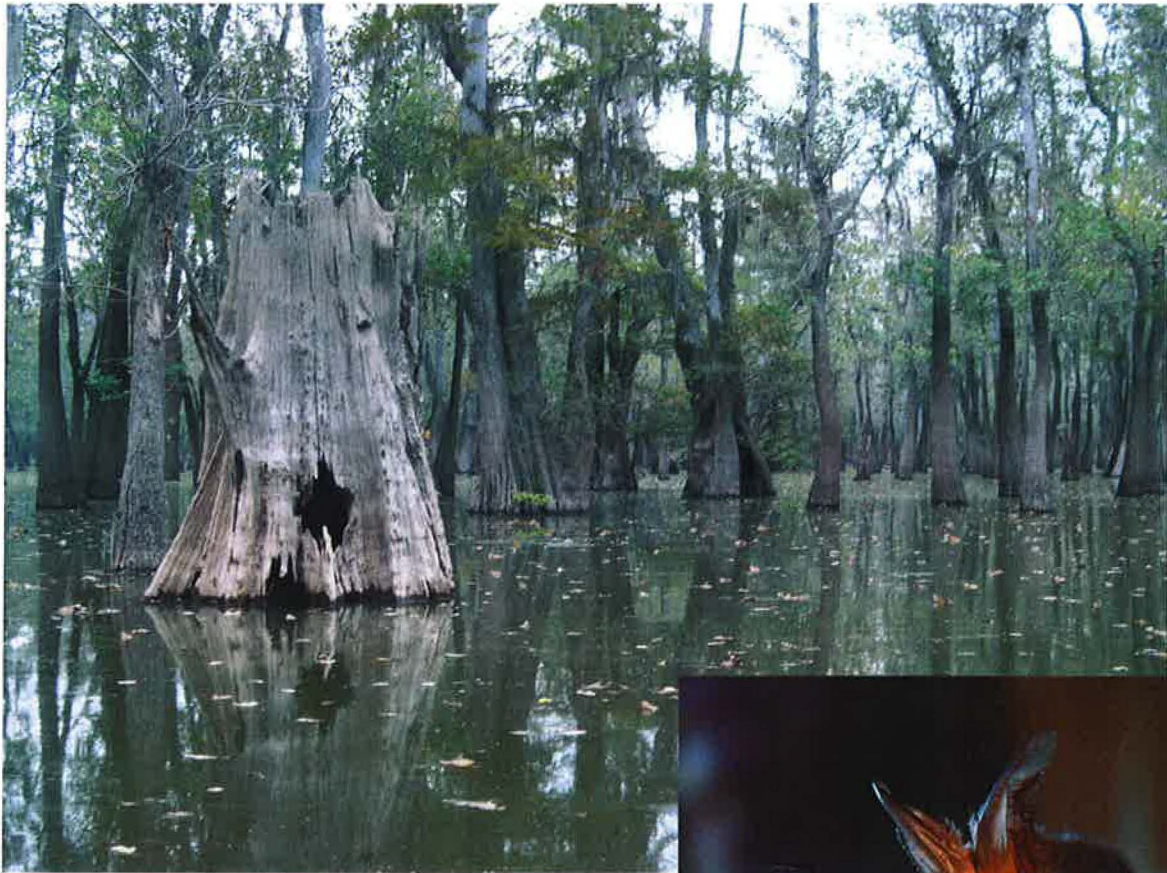


Distribution and Abundance of Rafinesque's Big-eared Bat (*Corynorhinus rafinesquii*) and Southeastern Myotis (*Myotis austroriparius*) in Mississippi



Research Report

Submitted to U.S. Fish and Wildlife Service, Jackson, MS

Distribution and Abundance of Rafinesque's Big-eared Bat (*Corynorhinus rafinesquii*) and Southeastern Myotis (*Myotis austroriparius*) in Mississippi

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Research Report

Prepared for U.S. Fish and Wildlife Service
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ABSTRACT

Mist net and roost surveys were conducted from March 2002 – February 2007 to determine the distribution and relative abundance of Rafinesque's big-eared bat (*Corynorhinus rafinesquii*) and southeastern myotis (*Myotis austroriparius*) in Mississippi. Mist net surveys were conducted at 9 study areas in 12 counties from March 2002 – August 2006. A total of 425 bats were captured representing 8 species. Twenty-nine Rafinesque's big-eared bats, representing 7% of all captures, were captured at 2 study areas (St. Catherine Creek National Wildlife Refuge [NWR] and Camp Shelby). Thirty-three southeastern myotis, representing 8% of all captures, were captured at 6 study areas (St. Catherine Creek NWR, Camp Shelby, Noxubee NWR, Meridian Naval Air Station, Caney Creek Wildlife Management Area and Laurel Hill Plantation).

To determine relative abundance and roost preferences for Rafinesque's big-eared bat and southeastern myotis, abandoned buildings, culverts, cisterns, and caves were surveyed in select locations in 17 counties in Mississippi. Seven abandoned buildings located on St. Catherine Creek NWR, Adams County, were surveyed 2 – 9 times a month from August – October 2002 and March – October 2003. Rafinesque's big-eared bat individuals used all 7 buildings as roosts, 3 of which were confirmed maternal colonies. One of these maternal roosts contained 50 individuals in July 2003. Six of the 7 roosts were also used by southeastern myotis with a maximum of 5 individuals observed in 1 of the roosts in June 2003. Four artificial bat houses constructed at St. Catherine Creek NWR specifically designed to attract Rafinesque's big-eared bat (1 shed design and 3 artificial tree designs), were surveyed in April and July 2005, February, May, and August 2006, and March 2007. Bats were never observed in the shed design artificial roost. One to 2 Rafinesque's big-eared bats were observed in each of the artificial tree roosts on several occasions, with 1 roost containing 48 individuals in August 2006. Two abandoned houses on Noxubee NWR, Noxubee County, were surveyed in May 2004 and were found to contain 2 Rafinesque's big-eared bats each. One abandoned house owned by the Conservation Club, a private land holding in Clay County, was surveyed in May and June 2004. Sixty-two individuals were observed in May 2004 making this the largest known maternal colony for this species in Mississippi.

Ten cisterns in Adams County were surveyed from February 2003 - January 2006. Rafinesque's big-eared bats were not observed in these cisterns during the survey period, however 3 cisterns contained large colonies of southeastern myotis. Using infrared cameras, bats were recorded emerging from occupied cisterns at sunset to determine abundance. In August 2004, 5,479 individuals were recorded emerging from a cistern at Laurel Hill Plantation and 6,486 were recorded emerging from a cistern at Hollywood Plantation. A second cistern at Hollywood Plantation contained 5,681 in May 2004. These are the largest known maternal colonies for southeastern myotis in Mississippi.

One culvert on Laurel Hill Plantation, a private holding adjacent to St. Catherine Creek NWR, was surveyed for bat occupancy 6 times from February 2003 – January 2005. One Rafinesque's big-eared bat was observed several times and 5 southeastern myotis were observed in January 2005. Seven culverts on Meridian Naval Air Station, Lauderdale County, were surveyed for bat occupancy in May 2002 and monthly from

March 2005 – November 2006. Five Rafinesque's big-eared bats were observed in May 2002, but have not been observed since. All 7 of the culverts were commonly used by southeastern myotis, 1 of which was a confirmed maternal colony. This roost contained 584 individuals in September 2006.

Twenty-two caves were surveyed in 11 counties from October 2005 – February 2007. Rafinesque's big-eared bats were not observed in any of the caves, however, a large colony of southeastern myotis was observed in Waddell Cave, a private holding in Smith County. This cave was confirmed to be a maternal roost and contained over 1000 individuals in June 2006. An additional cave located in Wayne County contained 1 southeastern myotis in October 2005. Due to intensive survey efforts from this project and many others over the last 12 years, county records in the Mississippi Natural Heritage Database have increased from 6 to 22 records for Rafinesque's big-eared bat and from 5 to 19 records for southeastern myotis.

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INTRODUCTION

Rafinesque's big-eared bat (*Corynorhinus rafinesquii*) and southeastern myotis (*Myotis austroriparius*) are two rare bat species found in the southeastern United States. Both of these species have similar geographic and ecological distributions and show a preference for comparable foraging and roosting habitats (National Biological Resources 1995, Clark 2000a). They can be found in bottomland hardwood (BLH) forests using large hollowed out trees as roosts (Horner and Maxey 1998, Clark 2000b, Bat Conservation International 2001, Kentucky Bat Working Group 2003), particularly water tupelo (*Nyssa aquatica*) and bald cypress (*Taxodium distichum*) (Hofmann et al. 1999, Clark 2000a). In the northern states within their range, they are prevalent in caves. However, in states such as Mississippi where caves are rare, they are more commonly found occupying tree roosts and man-made structures. Rafinesque's big-eared bat and southeastern myotis are species of special concern in Mississippi (Mississippi Natural Heritage Program 2001a) and their population numbers are thought to be declining regionally (Gore and Hovis 1992, Clark 2000b, Bat Conservation International 2001, Kentucky Bat Working Group 2003).

Conservation Status

Rafinesque's big-eared bat and southeastern myotis were formerly listed as category 2 species (a classification no longer in use) under the Federal Endangered Species Act, meaning that these species were possibly endangered or threatened, but sufficient data for classification were lacking. Rafinesque's big-eared bat is federally listed as a species of special concern and state listed as endangered, threatened or a species of special concern throughout its range. Southeastern myotis is federally listed as a species of special concern and state listed as endangered, threatened or a species of special concern in every state within its range, excluding Florida. Surveys conducted prior to 1990 estimated the numbers of southeastern myotis in Florida at 400,000 adult females, located in 15 maternity caves (Gore and Hovis 1992). However, in 1991 fewer than 200,000 female adults were counted and several of these caves showed signs of human disturbance (Gore and Hovis 1992, Nature Serve 2003). It is thought that Florida still has large numbers of this species although there has been a 45-50% decline in the last 30-40 years (Nature Serve 2003). Over 40 officials from states within the range of southeastern myotis have agreed that this species is in decline and should be federally listed as threatened (Hofmann et al. 1999). According to the National Biological Resources (1995), Rafinesque's big-eared bat and southeastern myotis are at risk of extinction. Because total populations of both species are thought to be declining (Gore and Hovis 1992, Clark 2000b, Bat Conservation International 2001, Kentucky Bat Working Group 2003), further research is needed to determine the status of regional and local populations.

Habitat Needs

One of the primary causes for bat population declines in the southeastern United States is habitat destruction (Fenton 1983, Clark 2000b). The loss of BLH forests is a

prime example of the reduction of ideal bat habitat. These forests were once common in the Southeast, and existing stands contain some of the best remaining habitats for bats. Studies conducted by Clark (2000a) and Cochran (1999) have shown that mature BLH forests are used by 11 of 18 bat species found in the East, including Rafinesque's big-eared bat and southeastern myotis. BLH forests are becoming greatly reduced due to silviculture practices that eliminate mature stands. Fifty-six percent of southern BLH and bald cypress forests were lost between 1900 and 1978 (Bass 1989). Remaining BLH forests are often fragmented. Rafinesque's big-eared bat is reluctant to cross large open areas between roosts (Clark 2000b), making fragmented habitats unsuitable for this species.

BLH forests provide optimal foraging habitat for Rafinesque's big-eared bat and southeastern myotis and often contain large, buttressed trees with cavities for roosting (Horner and Maxey 1998, Clark 2000b). Both species have been found to roost in black gum (*Nyssa sylvatica*), water tupelo, and bald cypress trees with large diameters and a triangular opening at the base (Horner and Maxey 1998, Clark 2000b, Trousdale and Beckett 2001). Roost trees provide sites for mating, hibernation, and rearing of young as well as protection from harsh weather and predators (Kunz 1982). Bats spend over half of their time in roosts, which are considered a limiting factor for Rafinesque's big-eared bat and southeastern myotis (Clark 2000a). As a result of declining habitat, these species can often be found in alternative roost sites such as abandoned houses (Hall 1999, Trousdale and Beckett 2000, Sherman 2004), old cisterns (Harvey et al. 1999, Sherman 2004), and bridges (Trousdale and Beckett 2000, Lance and Garrett 1997). In fact, the majority of known maternity colonies of Rafinesque's big-eared bat are found in abandoned and decayed buildings (Barbour and Davis 1969). The largest maternal colonies known in Mississippi are located in abandoned buildings for Rafinesque's big-eared bat and cisterns for southeastern myotis (Sherman 2004).

Research Needs

To determine the extent of decline or general population trends of Rafinesque's big-eared bat and southeastern myotis, studies focused on roost availability and occupancy rates at roost sites are essential. The availability and quality of nursery roosts are especially important for determining the distribution and abundance of bats (Humphrey 1975). Given that these roosts are sites needed for gestation, lactation, and development of young, they are critical for the preservation of bat species. Maternal roosts must provide both protection from predators and optimal microclimate for gestating and lactating females and developing young (Humphrey 1975). Bats have small litters and extended periods of infant dependency, compared to other mammals of similar size. This puts bats at a greater risk for population decline when confronted with habitat alteration or destruction (Lacki 2000). In order for adequate conservation practices to be developed for bats, research studies regarding habitat and roost preferences, particularly those for maternity roosts, are critically needed. By determining habitat and roost needs, conservation tactics can be specifically designed to maintain appropriate and relevant land areas.

GOALS/OBJECTIVES

The objectives for this project were to: 1. identify foraging and roosting habitats being used by Rafinesque's big-eared bat and southeastern myotis in Mississippi, 2. examine colony dynamics at roosts with regard to sex/age class characteristics, reproductive condition and number of individuals, and 3. conduct surveys to examine overall bat species composition, relative abundance of individuals, and activity in specific locations in Mississippi.

METHODS

Mist Net Surveys

To determine potential foraging habitat being used by Rafinesque's big-eared bat and southeastern myotis and to record overall bat species diversity, mist net surveys were conducted at nine study areas throughout Mississippi from 2002 - 2006. Study areas were chosen based on the presence of appropriate habitat for these two species and the ability for researchers to access the property (i.e. – state or federally owned). Within the 9 study areas, mist net sites were selected based on the presence of ponds and other potential foraging habitat identified from topographic maps, aerial maps, and field surveys. Selected sites were surveyed using mist nets (6 m. – 18 m. length, 30 mm mesh, Avinet) with nets being opened 15 minutes before sunset and closed approximately four hours later (1 net night is equal to 4 or more hours of netting). A minimum of two nets were used per site and were placed above waterways, dirt roads, or other potential flyways. Ambient temperature, relative humidity, and other relevant climatic conditions were recorded when nets were first raised and closed for the evening. Nets were checked every fifteen minutes for captured bats.

Upon capture, bats were identified to species and sex. Reproductive status (pregnant, lactating, or scrotal) was derived using methods described by Kunz (1988). Age class was estimated by pelage color (Jones and Suttkus 1975) and degree of ossification of epiphyseal caps on phalanges of fingers (Kunz 1988). Weight, using a spring scale (30g. Pesola Micro-Line), and forearm length, using a plastic dial caliper (Forestry Suppliers) was determined. Location of capture was recorded using a Global Positioning System (GPS) (Garmin Etrex Vista).

Diagrams of net placement were made and the habitat type of each site was determined using a community key (Mississippi Natural Heritage Program 2001b). Water body dimensions (depth, length) were recorded using a 50 meter graduated measuring tape.

Study Areas

The following nine study areas were chosen for mist net surveys; St. Catherine Creek NWR, Noxubee NWR, Camp McCain, Camp Shelby, Meridian Naval Air Station (NAS), Divide Section Wildlife Management Area (WMA), Caney Creek WMA, Canal Section WMA, and Laurel Hill Plantation (Figure 1).

St. Catherine Creek NWR

St. Catherine Creek NWR encompasses 9,891 hectares (ha) and is located in the western section of Adams County 11.3 km south of Natchez, Mississippi. Bald cypress swamps and hardwood forests with a prevalence of oak (*Quercus* spp.), gum (*Nyssa* spp.), elm (*Ulmus* spp.), ash (*Fraxinus* spp.), and eastern cottonwood (*Populus deltoides*) comprise 8,426 ha (85% of total acreage) of the refuge (St. Catherine Creek 2005). Almost 50% of this acreage (4,746 ha) is reforested agricultural land with trees being planted in 2000 and is currently in early successional stages. Eighty-five ha of the total

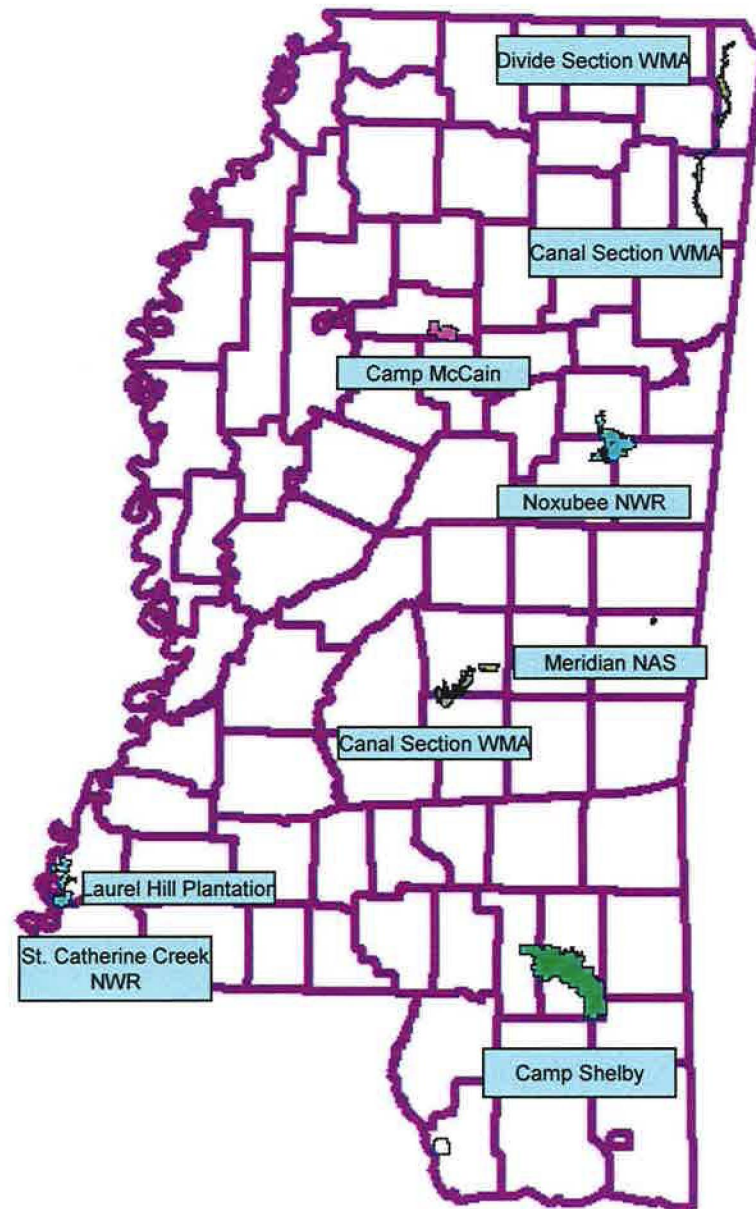


Figure 1. Nine study areas chosen for mist net surveys conducted from 2002 - 2006 in Mississippi.

acreage is open water (7%), while the remaining 119 ha consists of cleared land (8%). The Mississippi River is located along the western boundary of the refuge and the Homochitto River is located along the southern boundary. The refuge floods yearly from backwater from St. Catherine Creek and the Mississippi River.

Noxubee NWR

Noxubee NWR is located 5.19 km south of Starkville, Mississippi in Oktibbeha, Noxubee and Winston Counties. The refuge encompasses 19,425 ha of land comprised of 6,498 ha of pine forests (33% of total acreage), 6,274 ha of bottomland hardwoods (32%), 4,088 ha of mixed hardwoods and pine forests (21%), 1,374 ha of upland hardwoods (7%), and 506 ha of open fields (3%) (Richardson 2005). Bald cypress swamps and hardwood forests containing oaks, ironwood (*Carpinus caroliniana*), shagbark hickory (*Carya ovata*), tulip tree (*Liriodendron tulipifera*), sweetgum (*Liquidambar styraciflua*), red maple (*Acer ruber*), ash spp., and sugarberry (*Celtis laevigata*) are prevalent on the refuge (McCartney 2006). Two large lakes (Bluff Lake and Loakfoma Lake) and numerous rivers and creeks including Cypress Creek, Oktoc Creek, Lynn Creek, Loakfoma Creek and Noxubee River are located within the refuge.

Camp McCain

Camp McCain is located in Montgomery and Grenada Counties 8 km southeast of Grenada, Mississippi. According to the Forest Resources Management Plan (Resource Consulting International, LTD., 1987), this military base is comprised of 5,261 ha with the following land cover types: 335 ha planted pines (6% of total acreage), 518 ha agricultural land (10%), 521 ha open area (10%), 3,201 ha forest (61%), and 710 ha of other land cover types (13%). Because this data was attained in 1987, it may not accurately represent current land cover types. Extensive logging has occurred on this installation beginning in 1993, so it is possible that the forest acreage has decreased since this publication in 1987. Current dominant tree species on the base include loblolly pine (*Pinus taeda*), sycamore (*Platanus occidentalis*), sweetgum, tulip tree, red maple, water oak (*Quercus nigra*), and southern red oak (*Q. falcata*) (pers. obs.). Chester Martin, U.S. Army Engineer Research and Development Center (ERDC), was the Lead Investigator for bat surveys conducted at Camp McCain. I was contracted by ERDC to conduct mist net surveys and preliminary data analysis.

Camp Shelby

Camp Shelby is located in Forrest and Perry Counties 8 km southeast of Hattiesburg, Mississippi. This is the largest state-owned and operated reserve training site in the United States and contains 55,037 ha of land. Most of this acreage is located within DeSoto National Forest. Exact acreage for specific habitat types has not been published and therefore is unavailable. However, the following habitat types have been delineated by the Mississippi Natural Heritage Program: black gum-bay-pine swamp, bottomland hardwood-pine forest, longleaf pine forests, pitcher plant wetlands, grasslands and pine plantations. Dominant tree species include magnolia (*Magnolia grandiflora*), sweetbay

(*Magnolia virginiana*), holly sp. (*Ilex* sp.), sweetgum, white oak (*Q. alba*), water oak, swamp chestnut oak (*Q. michauxii*), black willow (*Salix nigra*), tulip tree, loblolly pine, and black tupelo (*N. sylvatica*) (pers. obs.). Numerous creeks run through the base including Black Creek, Cypress Creek, Joes Creek, and Whiskey Creek. Twenty conservation sites within Camp Shelby have been identified by the Mississippi Natural Heritage Program as being biologically significant. These areas were recognized as Heritage conservation sites due to the number and/or rarity of plants and animals with the greatest conservation need (Mississippi Department of Wildlife, Fisheries, and Parks 2005). Chester Martin was the Lead Investigator for bat surveys conducted at Camp Shelby. I was contracted by ERDC to conduct mist net surveys and preliminary data analysis.

Meridian NAS

Meridian NAS is located 19 km northwest of Meridian, Mississippi in Lauderdale County. This military training facility contains 3,282 ha of land comprised of 1,433 ha of pine forests (44% of total acreage), 807 ha of upland and bottomland hardwoods (25%), and 1,042 ha of cleared land (31%) (Bucciantini 2006). Dominant tree species include sweet gum, tulip tree, red maple, pine, sycamore, American elm (*Ulmus americana*), water oak, ironwood, laurel oak (*Q. laurifolia*), shagbark hickory, and southern red oak (pers. obs.). Chester Martin was the Lead Investigator for bat surveys conducted at Meridian NAS. I was contracted by ERDC to conduct mist net surveys and preliminary data analysis.

Caney Creek WMA

Caney Creek WMA is comprised of 12,950 ha and is located within Bienville National Forest (NF) in Scott and Smith Counties. Land cover types are not available specifically for Caney Creek WMA however Bienville NF, which contains 72,034 ha of land is comprised of 55,118 ha of pine forests (76% of total acreage), 4,128 ha of mixed hardwood and pine forests (6%), 12,141 ha of hardwoods (17%), and 405 ha of cleared land (1%) (Elson 2006). Dominant tree species on Caney Creek WMA include bald cypress, water tupelo, pine sp., water oak, southern red oak, and ironwood (pers. obs.). Both the Strong River and Leaf River run through the NF in addition to several creeks including Caney Creek, Tallahalla Creek, and Davis Creek.

Divide Section and Canal Section WMAs

Divide Section WMA is ~ 35 km long and is located in Tishomingo County. Canal Section WMA is ~ 51 km long and is located just south of Divide Section WMA. The Tenn-Tom Waterway runs through the center of both WMA's. Habitat information has not been published, however I would estimate that over 80% of the WMA's consist of water from the Tennessee -Tombigbee River.

Laurel Hill Plantation

Laurel Hill Plantation is a private land holding located on the eastern boundary of St. Catherine Creek NWR. This property contains 614 ha of land and is within the Loess

Bluff physiographic region (Rosso 1992). Specific land cover acreage information is not available. The Plantation is predominantly mixed hardwoods with a prevalence of oaks, bitter-nut hickory (*Carya cordiformis*), tulip tree, maples, and black walnut (*Juglans nigra*) (Rosso 1992). The owner of the property granted the Mississippi Department of Wildlife, Fisheries, and Parks a conservation easement in 1998. This property is one of only two known protected sites for loess bluff forests in Mississippi (Wietzel 2001).

Roost Surveys

To obtain information regarding relative abundance and roost preferences for Rafinesque's big-eared bat and southeastern myotis and to record overall bat species diversity in roosts, abandoned buildings, cisterns, culverts and caves in select locations were surveyed for occupancy. Upon finding occupied roosts, species were identified and number of individuals was documented. Roost type, dimensions, surrounding habitat type, and GPS coordinates were also recorded.

Abandoned Buildings

Fourteen abandoned houses were surveyed for bat occupancy at St. Catherine Creek NWR, Noxubee NWR, and the Conservation Club (a private land holding in Clay County) from 2002 – 2006 (Figure 2). Three abandoned houses (Roost # 1 – 3) previously documented to serve as roost sites for Rafinesque's big-eared bat at St. Catherine Creek NWR (Hall 1999) were surveyed for bat occupancy 2 to 9 times a month from March - October, 2002 and 2003 and once a month in November - December, 2002 (Table 1 and Figures 3 - 5). Four new roosts (Roosts # 4 – 7) were located on and adjacent to the refuge, totaling 7 roosts (Figures 6 – 7). These roosts were surveyed 2 to 9 times a month from August - October, 2002 and March - October, 2003. Two of the abandoned buildings (Roost # 6 – 7) were torn down in January 2003, prohibiting further surveys after this date.

An alternative bat house with a shed design (Roost # 8), was constructed by refuge personnel in September 2002 and was located 6 m east of Roost #1 (Table 1 and Figure 8). This house was surveyed once a month from September - December 2002, March - October 2003, April and July 2005, February, May, and August 2006, and March 2007. Three additional alternative roosts with a tree design (Roost # 9 – 11) were constructed in August 2004 in different locations surrounding Roost #1 (Figure 9). These roosts were surveyed in April and July 2005, February, May and August 2006 and March 2007.

Two abandoned houses at Noxubee NWR were surveyed in May 2004 (Roosts # 12 – 13) (Figure 10) and one house on property owned by the Conservation Club was surveyed in May and July 2004 (Roost # 14) (Figure 11). These houses were first discovered by Dave Richardson, US Fish and Wildlife Service, in 1998.

Cisterns

Ten cisterns located on St. Catherine Creek NWR, Laurel Hill Plantation, Hollywood Plantation, and Egypt Plantation (private holdings in Adams County) were surveyed a minimum of two times each from 2003 – 2006 (Figure 12). These cisterns

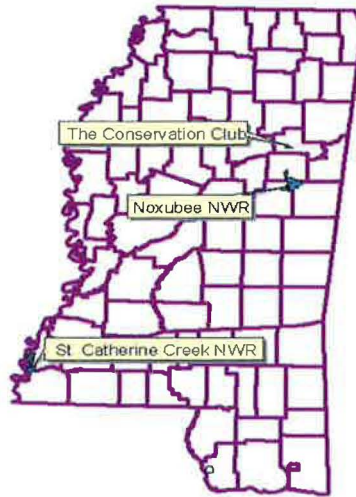


Figure 2. Study areas chosen for roost surveys conducted in abandoned buildings in Mississippi, 2002 – 2006.

ROOT #	ROOST TYPE/LOCATION	CONDITION	OVERALL LENGTH	OVERALL WIDTH	HEIGHT	HABITAT
1	Abandoned House St. Catherine Creek NWR	Badly dilapidated	17.50 m	12.50 m	3.30 m	Upland Mixed Hardwood/Pine Forest
2	Abandoned House St. Catherine Creek NWR	Intact - some ceiling damage	16.42	7.95	2.43	Bottomland Mixed Hardwood Forest
3	Abandoned House St. Catherine Creek NWR	Intact - some ceiling damage	16.42	7.95	2.43	Bottomland Mixed Hardwood Forest
4	Abandoned House Private Property adjacent to St. Catherine Creek NWR	Dilapidated - ceiling damage	10.70	9.70	2.28	Upland Mixed Hardwood Forest
5	Abandoned Trailer Private Property adjacent to St. Catherine Creek NWR	Intact – Some ceiling damage	12.44	3.04	2.15	Upland Mixed Hardwood Forest
6	Abandoned Trailer St. Catherine Creek NWR	Intact (torn down 1/03)	11.28	3.35	2.10	Bottomland Mixed Hardwood/Swamp Forest
7	Abandoned Trailer St. Catherine Creek NWR	Intact (torn down 1/03)	6.16	3.08	2.10	Bottomland Mixed Hardwood/Swamp Forest
8	Artificial Roost - Shed Design St. Catherine Creek NWR	Intact	3.04	2.44	2.44	Upland Mixed Hardwood/Pine Forest
9	Artificial Roost - Tree Design St. Catherine Creek NWR	Intact	1.00 (diameter)		6	Upland Mixed Hardwood/Pine Forest
10	Artificial Roost - Tree Design St. Catherine Creek NWR	Intact	1.00 (diameter)		6	Upland Mixed Hardwood/Pine Forest
11	Artificial Roost - Tree Design St. Catherine Creek NWR	Intact	1.00 (diameter)		6	Upland Mixed Hardwood/Pine Forest
12	Abandoned House Noxubee NWR	Dilapidated	9.50	7.65	N/A	Upland Mixed Hardwood Forest
13	Abandoned House Noxubee NWR	Dilapidated	8.50	6.80		Upland Mixed Hardwood Forest
14	Abandoned House The Conservation Club	Badly dilapidated	9.75	.80	20	Upland Mixed Hardwood/Pine Forest

Table 1. Abandoned buildings surveyed for bat occupancy during roost surveys conducted from 2002 – 2006 including roost type, location, condition, dimensions and surrounding habitat type.



Figure 3. Roost #1, Abandoned building surveyed for bat occupancy at St. Catherine Creek National Wildlife Refuge, 2002 - 2003.



Figure 4. Roost #2, Abandoned building surveyed for bat occupancy at St. Catherine Creek National Wildlife Refuge, 2002 - 2003.



Figure 5. Roost #3, Abandoned building surveyed for bat occupancy at St. Catherine Creek National Wildlife Refuge, 2002 - 2003.



Figure 6. Roost #4, Abandoned building surveyed for bat occupancy at St. Catherine Creek National Wildlife Refuge, 2002 - 2003.



Figure 7. Roost #5, Abandoned trailer surveyed for bat occupancy at St. Catherine Creek National Wildlife Refuge, 2002 - 2003.



Figure 8. Roost #8, Artificial bat house with shed design surveyed for bat occupancy at St. Catherine Creek National Wildlife Refuge, 2002 – 2007.



Figure 9. Roost #9, Artificial bat house with tree design surveyed for bat occupancy at St. Catherine Creek National Wildlife Refuge, 2005 - 2007.



Figure 10. Roost #12, Abandoned building surveyed for bat occupancy at Noxubee National Wildlife Refuge, 2004.



Figure 11. Roost #14, Abandoned building surveyed for bat occupancy at the Conservation Club, 2004.

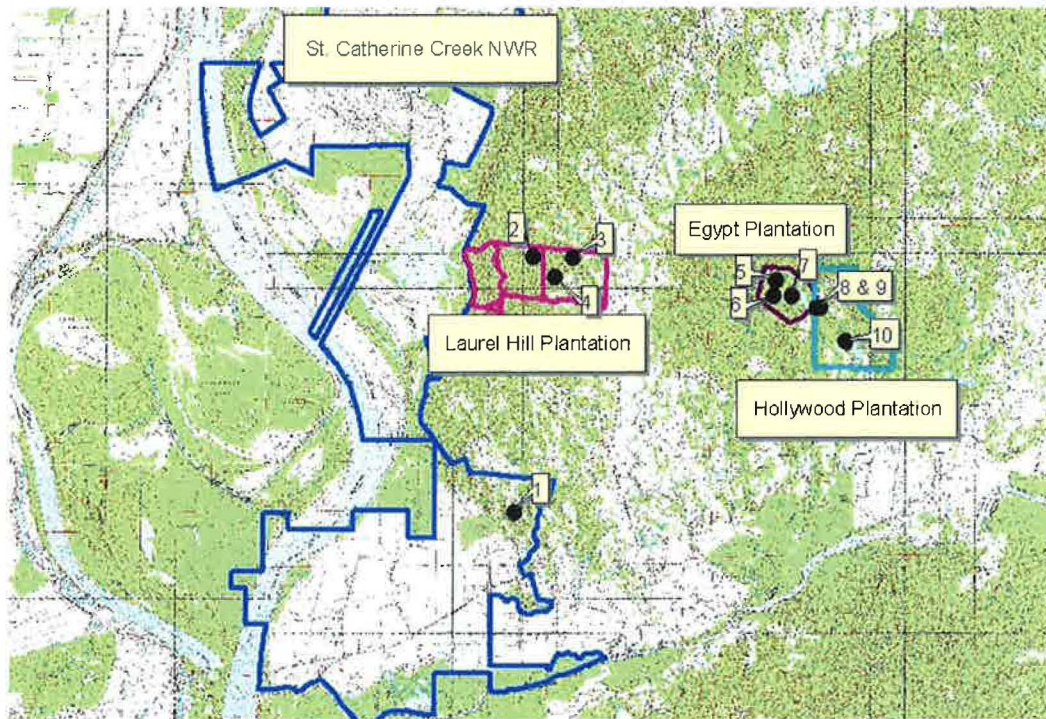


Figure 12. Study areas chosen for roost surveys conducted in cisterns in Mississippi, 2002 – 2005.



Figure 13. Cistern #2, Abandoned cistern surveyed for bat occupancy at Laurel Hill Plantation, 2003 - 2006.

were abandoned wells constructed in the 1800's to provide water for plantation owners. Nine of the ten cisterns were constructed from cement with the tenth cistern constructed from brick (Table 2). Most of the cisterns had an above ground portion ranging from 0.50 – 1 m in height and 0.50 – 1 m in diameter. The underground portion of the cisterns ranged from 5 – 10 m deep and 3 – 4 m in diameter. Water presence and level, surrounding habitat type, and % canopy cover varied between cisterns.

One of the cisterns located on Laurel Hill Plantation (Cistern #2) was monitored once a month from February - November 2003 (Figure 13). A Tropic Net (BioQuip, Inc.) was used to capture bats as they were emerging from the cistern at sunset to determine species and record data regarding sex/age class characteristics and reproductive condition.

To determine the number of bats within occupied cisterns, a thermal infrared camera (Indigo TVS 620) was periodically used to record bats emerging from cisterns at sunset. The infrared imagery was recorded on a digital mini DVD tape. Using developmental research software designed by Bruce Sabol, ERDC, a computerized count of emerging bats was attained from the recording. A manual count from the recording was also made for comparison.

Thermal infrared recordings were made at Cistern #2 at Laurel Hill Plantation on December 2003, May and August 2004, and January 2005. Recordings were made at Cisterns # 8 and # 10 at Hollywood Plantation in May and August 2004 and January 2005.

Culverts

Eight culverts were surveyed at Laurel Hill Plantation and Meridian NAS (Figure 14 and Table 3). One culvert on Laurel Hill Plantation was surveyed 5 times in 2003 and once in 2005. This culvert was located in a dry creek bed with water being present only during periodic flooding (Figure 15).

Seven culverts on Meridian NAS were monitored in May 2002 and once a month from March 2005 - November 2006 excluding Apr. 2005 and 2006, Sept. 2005, and June – Aug 2006. Three of these culverts were located next to one another under the south end of the air strip (Figure 16). The culverts were 200 m long and 3 m wide with a height of 8 m. Four additional culverts were located next to one another under the north end of the airstrip. These culverts were 300 m long and 2 m wide with a height of 3 m. Ponta Creek ran through the culverts under the south end of the airstrip and Big Reed Creek ran through the culverts under the north end.

Caves

Twenty-two caves in 11 counties were surveyed for bat occupancy from July 2005 - February 2007 (Figure 17 and Table 4). The general location and approximate GPS coordinates for most of the caves were attained through the Mississippi Natural Heritage Program Database. More detailed directions to some caves were attained from a study conducted by Trousdale and Beckett (2000). Further information regarding cave opening size and general characteristics were attained from the book, "Mississippi Caves" (Knight et. al. 1974). The study areas for cave surveys were located primarily on

CISTERN #	LOCATION	COMPOSITION	ABOVE GROUND HEIGHT	ABOVE GROUND DIAMETER	OPENING	BELOW GROUND DEPTH	BELOW GROUND DIAMETER	% CANOPY COVER	DISTANCE OF CANOPY ABOVE OPENING	WATER DEPTH	CLEARING DIAMETER	HABITAT
1	St. Catherine Creek NWR	Cement	1 m	1 m	0.10 m	6 m	4 m	100%	0.10 m	None	None	Upland Mixed Hardwood/Pine Forest
2	Laurel Hill Plantation	Cement	0.75	1	0.5	5	6.2	25	10	0.5	1.5 - 2 m on three sides	Mixed Hardwood Forest
3	Laurel Hill Plantation	Cement	1 m	1	0.10	6	4	0	N/A	0 - 50 m	15 m on three sides	Clearing/yard
4	Laurel Hill Plantation	Cement	0.5	1	0.75	6	4.2	50	20	0 - 50 m	1 m on all sides	Mixed Hardwood Forest
5	Egypt Plantation	Cement	0	N/A	0.75	7.5	4.25	100	6	None	1 m on all sides	Upland Mixed Hardwood Forest
6	Egypt Plantation	Cement	0	N/A	0.75	7.5	4.25	100	6	None	1 m on all sides	Upland Mixed Hardwood Forest
7	Egypt Plantation	Cement	0.5	1	1	3	3	100	3	3.25	1 m on all sides	Mixed Hardwood Forest
8	Hollywood Plantation	Cement	1	0.5	0.5	5.1	6	50	6	None	5 m on three sides	Mixed Hardwood Forest
9	Hollywood Plantation	Cement	1	0.5	0.5	5.1	6	100	3	None	0.5 on all sides	Mixed Hardwood Forest
10	Hollywood Plantation	Brick	0.50 on 1 side	N/A	1	6	4.25	100	10	None	1 m on all sides	Mixed Hardwood Forest

Table 2. Cisterns surveyed for bat occupancy during roost surveys conducted in Mississippi from 2003 - 2005 including location, dimensions, % canopy cover, water depth, clearing size, and surrounding habitat type.



Figure 14. Study areas chosen for roost surveys conducted in culverts in Mississippi, 2003 – 2006.

CULVERT #	LOCATION	LENGTH	WIDTH	HEIGHT	WATER DEPTH	HABITAT
1	Laurel Hill Plantation	5 m	1.5 m	2 m	0 m	Mixed Hardwood Forest
2	Meridian NAS - south	200	3	8	0.25 - 1.5	Bottomland Mixed Hardwood Forest
3	Meridian NAS - south	200	3	8	0.25 - 1.5	Bottomland Mixed Hardwood Forest
4	Meridian NAS - south	200	3	8	0.25 - 1.5	Bottomland Mixed Hardwood Forest
5	Meridian NAS - north	300	2	3	0.10 - 0.50	Bottomland Mixed Hardwood Forest
6	Meridian NAS - north	300	2	3	0.10 - 0.50	Bottomland Mixed Hardwood Forest
7	Meridian NAS - north	300	2	3	0.10 - 0.50	Bottomland Mixed Hardwood Forest
8	Meridian NAS - north	300	2	3	0.10 - 0.50	Bottomland Mixed Hardwood Forest

Table 3. Culverts surveyed for bat occupancy during roost surveys in Mississippi conducted from 2002 – 2006 including location, dimensions, water depth, and surrounding habitat.

Cave Name	County	Total Length	Width Range	Height Range	Water Presence	% Canopy Cover	Surrounding Habitat
Randall's Cave	Amite	5 m	4 – 5 m	0.5 - 1.75 m	Small pools	40%	Mixed Bottomland Hardwoods
Spider Lead Cave	Benton	3.25	2.25	1	No	0	Mixed Upland Hardwoods
Bound's Cave	Calhoun	Filled In					Mixed Bottomland Hardwoods
Calcott Branch Cave	Franklin	6.25	3.25	0.75 - 1.75	Small trickle	30	Mixed Upland Hardwoods
Roger's Hole	Jasper	10	4	0.50 - 1	No	0	Cleared Land
Nahih Waiyah Cave	Neshoba	8	1 - 2	0.75 - 1.5	Large Pool	100	Mixed Bottomland Hardwoods
Cat's Den Cave	Smith	~ 10	1 - 1.5	0.5 - 0.75	No	0	Mixed Upland Hardwoods
Indian Cave	Smith	Filled In					Cleared Land
Waddell Cave	Smith	~20	1.25 - 2.25	1.25 - 2.25	Shallow Stream	60	Mixed Bottomland Hardwoods
Muddy Ridge Cave	Tippah	10	0.75 - 1	0.75 - 2	Shallow Stream	75	Mixed Upland Hardwoods
Unnamed Cave	Tishomingo	Under Water					Pickwick Lake
Unnamed Cave	Tishomingo	Under Water					Pickwick Lake
Mingo Cave/Spring Cave	Tishomingo	17.5	17.5	10	Large Pool	0	Cleared Land
Peole's Cave	Tishomingo	7	0.75 - 1.25	0.75 - 1.75	No	100	Mixed Upland Hardwoods
Tishomingo State Park Cave	Tishomingo	6.75	3.25	1.75	No	50	Mixed Upland Hardwoods
Tripoli Cave (Chalk Mine)	Tishomingo	100	60	8.5	No	30	Mixed Bottomland Hardwoods
Land of Caves #1	Union	50	4 - 5	0.75 - 1.75	Shallow Stream	50	Mixed Bottomland Hardwoods
Land of Caves #3	Union	13.25	3	0.25 - 2	No	40	Mixed Bottomland Hardwoods
Graham Waterfall Cave	Wayne	?	1 - 2	0.25 - 0.75	Stream	0	Cleared Land
Little H Cave	Wayne	?	?	?	No	0	Cleared Land
Pitt's Cave	Wayne	?	0.50 - 1	0.75 - 6.5	Shallow Stream	90	Mixed Upland Hardwoods
Triple H Cave	Wayne	?	1 - 2.5	?	No	0	Cleared Land

Table 4. Caves surveyed for bat occupancy during roost surveys conducted in Mississippi from 2005 – 2007 including cave name, county, dimensions, water presence, % canopy cover, and surrounding habitat type.

private property in the following counties: Amite, Benton, Calhoun, Franklin, Jasper, Neshoba, Smith, Tippah, Tishomingo, Union, and Wayne.

RESULTS

Mist Net Surveys

One hundred and thirteen mist net surveys were conducted at 79 sites in 12 counties (Table 5). Four hundred and nineteen bats representing 8 species were captured (Figure 18). A total of 29 Rafinesque's big-eared bats were captured, representing 7% of all captures, at 2 study areas (St. Catherine Creek NWR and Camp Shelby). Rafinesque's big-eared bats were captured in the following habitat types: 2 mixed upland hardwood forests, 1 mixed hardwood forest, and 2 bottomland hardwood forests. Thirty-three southeastern myotis were captured, representing 8% of all captures, at 6 study areas (St. Catherine Creek NWR, Camp Shelby, Noxubee NWR, Meridian NAS, Caney Creek WMA and Laurel Hill Plantation). Southeastern myotis were captured in the following habitat types: 5 mixed hardwood forests, 3 upland mixed hardwood forests, 2 bottomland hardwood forests, and 1 swamp forest. Other species captured included the: evening bat (*Nycticeius humeralis*) (35% of total captures), red bat (*Lasiurus borealis*) (31%), Seminole bat (*L. seminolus*) (9%), eastern pipistrelle (*Pipistrellus subflavus*) (7%), big brown bat (*Eptesicus fuscus*) (2%), and hoary bat (*L. cinereus*) (1%).

The average number of bats captured per net night was highest at Camp Shelby with an average of 9.42 bats captured per night (Figure 19). Caney Creek had the second highest capture rate with an average of 8 bats captured per net night, followed by Noxubee NWR (5.9 captures), Meridian (5.56), Divide Section WMA (5), Laurel Hill Plantation (3.5), Camp McCain (2.58), St. Catherine Creek (1.33), and Canal Section WMA (0).

Species diversity for the 9 study areas was also highest at Camp Shelby with 7 species captured during the survey period (Figure 20). Meridian NAS and Noxubee NWR had the second highest species diversity with 6 species captured each, followed by St. Catherine Creek NWR (5 species), Caney Creek WMA and Camp McCain (3 species each), Divide Section WMA and Laurel Hill Plantation (2 species each), and Canal Section WMA (0 species).

St. Catherine Creek NWR

Forty-nine mist net surveys were conducted at 22 sites at St. Catherine Creek NWR from 2002 - 2003 (Figure 21 and Table 6). Sixty-five individuals representing 5 species were captured, averaging 1.33 bats captured per net night (Figure 22). Rafinesque's big-eared bat was the most commonly captured species representing 34% of total captures (22 individuals). Eight southeastern myotis were captured representing 12% of all captures. Other captures included the: evening bat (32 %), red bat (19%), and big brown bat (3%).

Bats were successfully captured at 8 out of 22 sites surveyed (Table 6). Eighty percent (52 individuals) of the total number of bats captured, representing 5 species,

STUDY AREA	NIGHTS NETTED	# OF SITES	TOTAL BAT CAPTURES	AVG. # OF BATS CAPTURED PER NET NIGHT
Noxubee NWR	10	9	61	5.90
St. Catherine Creek NWR	49	22	65	1.33
Laurel Hill Plantation	2	2	7	3.50
Camp Shelby	19	18	175	9.21
Camp McCain	19	16	43	2.58
Meridian NAS	9	8	50	5.56
Caney Creek WMA	2	2	16	8.00
Divide Section WMA	1	1	5	5.00
Canal Section WMA	1	1	0	0

Table 5. Study areas for mist net surveys conducted in Mississippi from 2002 – 2006 including number of mist net survey nights, number of sites within each study area, total number of bat captures, and average number of bats captured per net night.

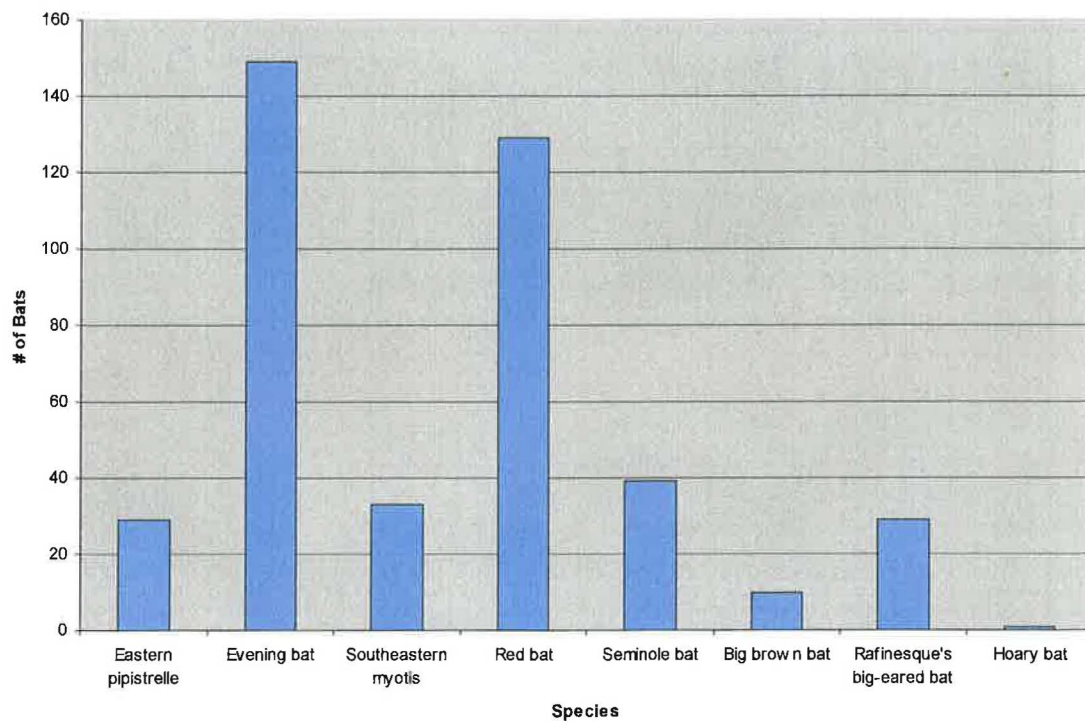


Figure 18. Number of bats captured per species during mist net surveys conducted at nine study areas in Mississippi, 2002 – 2006.

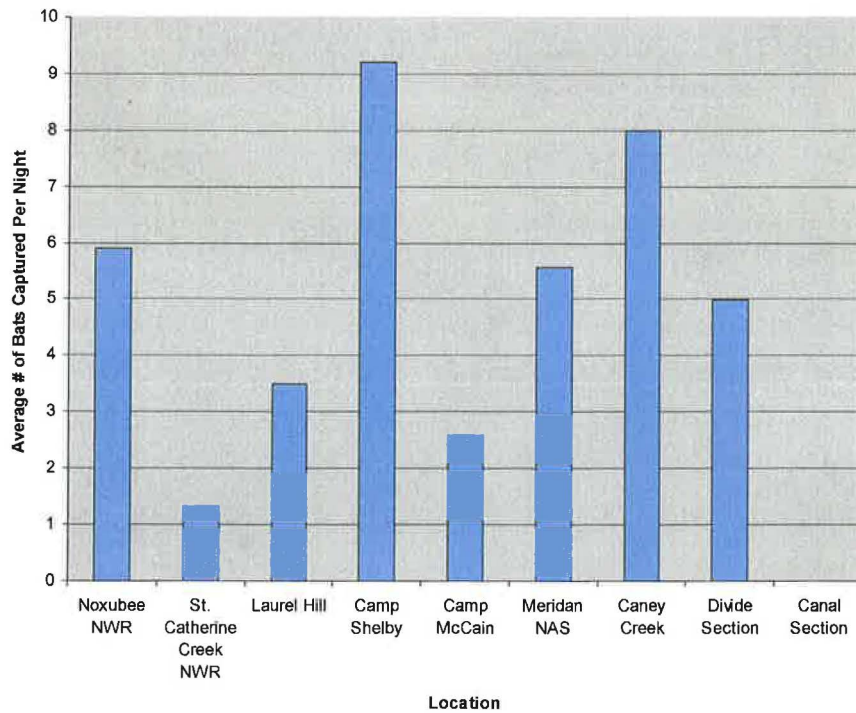


Figure 19. Average number of bats captured per net night during mist net surveys conducted from 2002 – 2006 at 9 study areas in Mississippi.

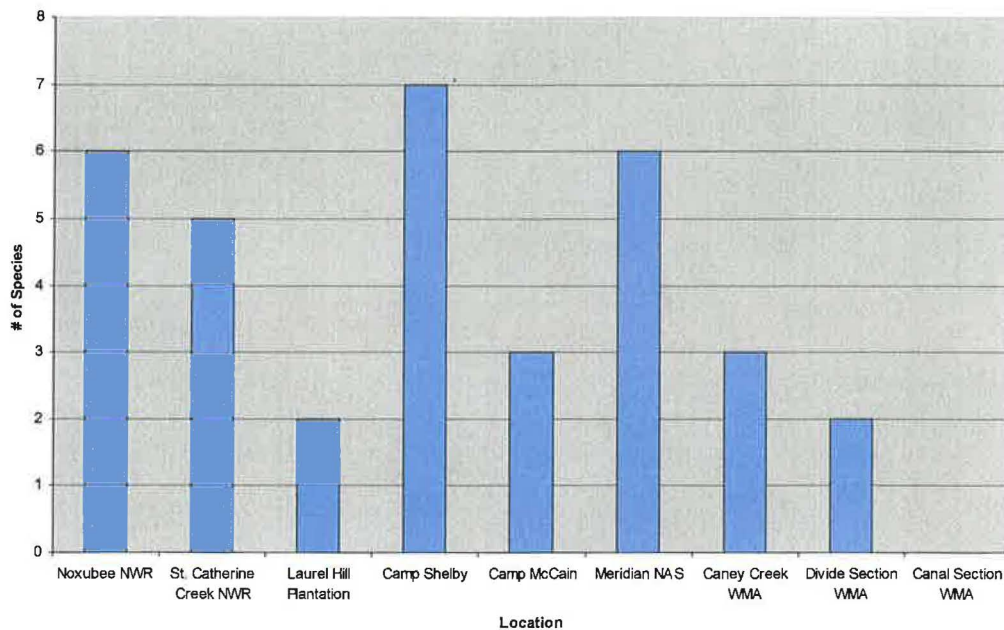


Figure 20. Number of species captured during mist net surveys conducted from 2002 – 2006 at 9 study areas in Mississippi.

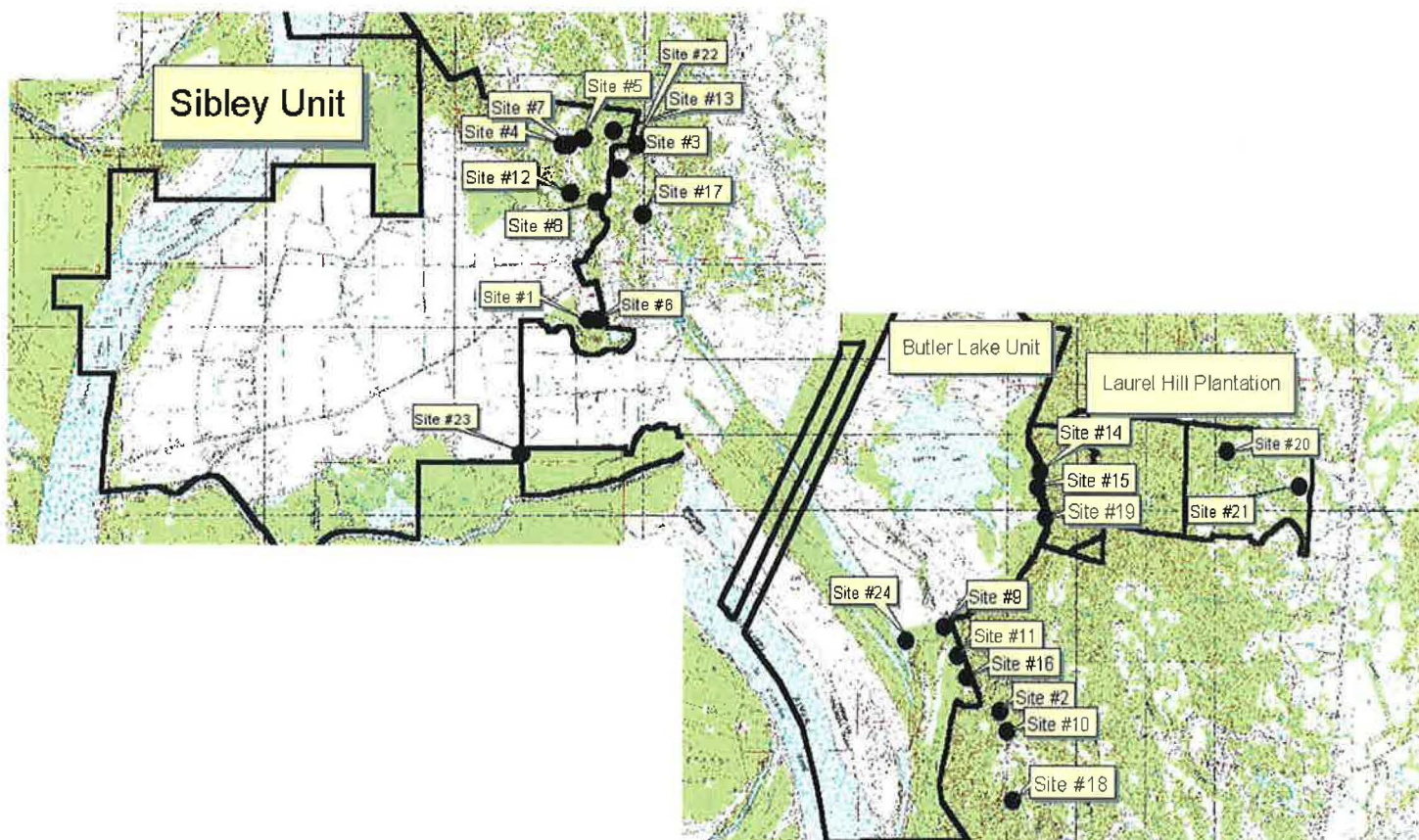


Figure 21. Twenty-two sites chosen for mist net surveys conducted from 2002 - 2003 at St. Catherine Creek National Wildlife Refuge.

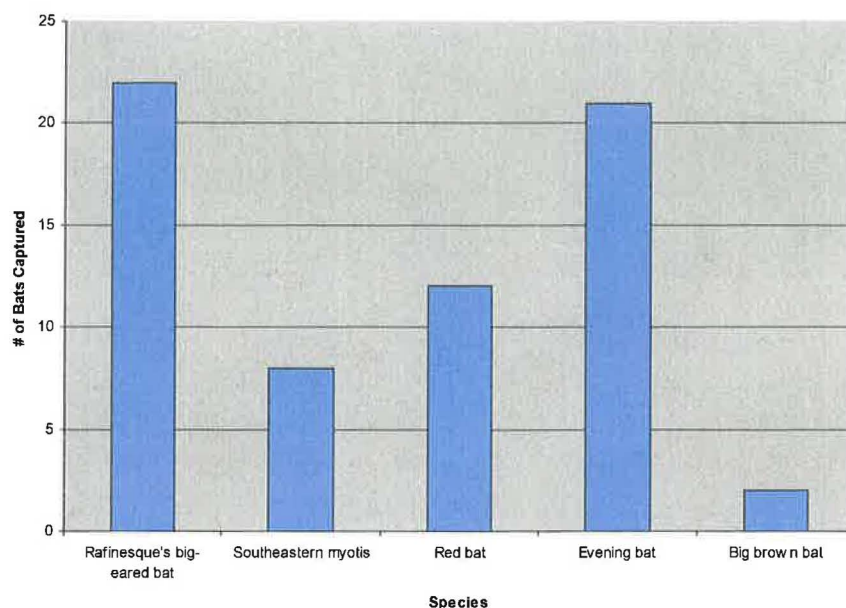


Figure 22. Number of bats captured per species during mist net surveys conducted from 2002 – 2003 at St. Catherine Creek NWR.

Site #	Nights Netted	Site Type	Habitat Type	Species Caught	# of Individuals
1	1	ATV Trail	Upland Mixed Hardwood Forest	CORA	1
2	18	Small Pond	Mixed Hardwood Forest	CORA	18
				LABO	10
				MYAU	4
				NYHU	19
				EPFU	1
3	2	Medium Pond	Upland Mixed Hardwood Forest	LABO	1
4	2	Small Pond	Upland Mixed Hardwood Forest	0	
5	2	Small Creek	Mixed Hardwood Forest	0	
6	1	Water Hole	Open Pasture	LABO	1
7	3	Dirt Road	Disturbed – Road	0	
8	2	Cleared Land	Disturbed - Lawn	0	
9	1	Small Creek	Bald Cypress Swamp	0	
10	1	Water Hole	Mixed Hardwood Forest	0	
11	1	ATV Trail	Mixed Hardwood Forest	0	
12	1	Creek	Bald Cypress Swamp	0	
13	4	Small Pond	Upland Mixed Hardwood Forest	CORA	1
				MYAU	2
				NYHU	1
14	1	Outside Roost#2	Mixed Hardwood Forest	CORA	2
				EPFU	1
15	1	Permanent Swamp	Bald Cypress Swamp	0	
16	1	Medium Pond	Upland Mixed Hardwoods	0	
17	1	Medium Pond	Upland Mixed Hardwood Forest	0	
18	1	Small Pond	Mixed Hardwood Forest	MYAU	1
19	1	Small Creek	Bald Cypress Swamp	0	
22	1	Creek	Disturbed	0	
23	2	Creek	Bald Cypress Swamp	MYAU	1
				NYHU	1
24	1	Creek	Mixed Hardwood Forest	0	

Table 6. Number of bats captured per species during mist net surveys conducted from 2002 – 2003 at St. Catherine Creek National Wildlife Refuge including date, site type and surrounding habitat type.

Note: CORA = Rafinesque's big-eared bat, LABO = red bat, NYHU = evening bat, EPFU = big brown bat, MYAU = southeastern myotis.

occurred at 1 site (Site #2) which was a small pond (~ 30 X 20 m and 2 – 3 m deep) surrounded by a mixed upland hardwood forest and was located 0.23 km from 2 known building roosts for Rafinesque's big-eared bat and southeastern myotis. Rafinesque's big-eared bat was successfully captured at 4 sites out of 22 surveyed. Two of these sites were ATV trails; one of which was surrounded by a mixed upland hardwood forest and the other was surrounded by a bottomland hardwood forest. The two other capture sites were small ponds surrounded by a mixed upland hardwood forest. Eighty-two percent of Rafinesque's big-eared bat captures were caught at one site (Site #2). Southeastern myotis was successfully captured at 4 sites; 2 of which were the same capture sites as Rafinesque's big-eared bat (Site #2 and # 13). Three of these sites were small ponds surrounded by a mixed upland hardwood forest. The fourth site was a creek surrounded by a bottomland hardwood/swamp forest (Site #23).

Noxubee NWR

Ten mist net surveys were conducted at 9 sites at Noxubee NWR from March - August, 2006 (Figure 23 and Table 7). Sixty-one bats were captured representing 6 species, averaging 6.1 bats captured per net night (Figure 24). Three southeastern myotis individuals were captured representing 5% of all captures. Other captures included the: evening bat (39 %), red bat (21%), eastern pipistrelle (18%), big brown bat (12%), and Seminole bat (5%). Bats were successfully captured at 7 out of 10 sites. Sixty-six percent (40 individuals) of the total captures, representing 5 species, occurred at 1 site (Site #7) which was a thin shallow creek (1-2 m wide and 0.25 – 1 m deep) located in a mixed upland hardwood forest. The three southeastern myotis captures occurred at 1 site (Site #24) which consisted of a medium size creek (~ 20 – 30 m wide and 0 – 3 m deep) surrounded by a bottomland hardwood/swamp forest.

Other Research

The Mississippi Bat Working Group (MBWG) First Annual Mist Net Event occurred at Noxubee NWR in 2004. During this event 4 research teams conducted mist net surveys at 8 different locations over a two night period. The 4 research teams were led by myself, Darren Miller, Weyerhaeuser, Lann Wilf, MS Department of Wildlife, Fisheries, and Parks (MDWFP), and Gypsy Gooding, US Fish and Wildlife Service. Two southeastern myotis were captured representing 8% of total captures. Other captures included the: red bat (56%), evening bat (20%), eastern pipistrelle (8%), big brown bat (4%), and Seminole bat (4%) (Miller 2004).

Camp McCain

Seventeen mist net surveys were conducted at 13 sites at Camp McCain from 2004 – 2005 (Figure 25 and Table 8). Forty-four bats were captured, representing 3 species, with an average of 2.58 bats captured per net night (Figure 26). The red bat was the most frequently captured species representing 81% of total captures. Other captures included the: evening bat (12%) and eastern pipistrelle (7%). Bats were captured at 9 out of 13 sites (Martin et. al. 2007).

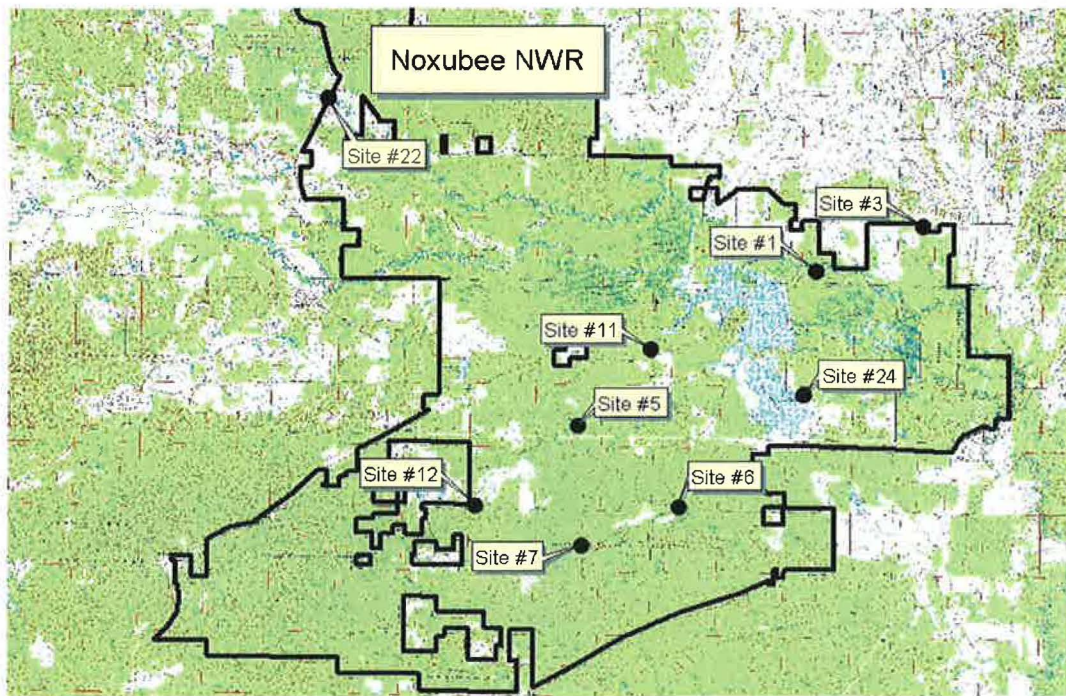


Figure 23. Nine sites chosen for mist net surveys conducted from April – August 2006 at Noxubee National Wildlife Refuge.

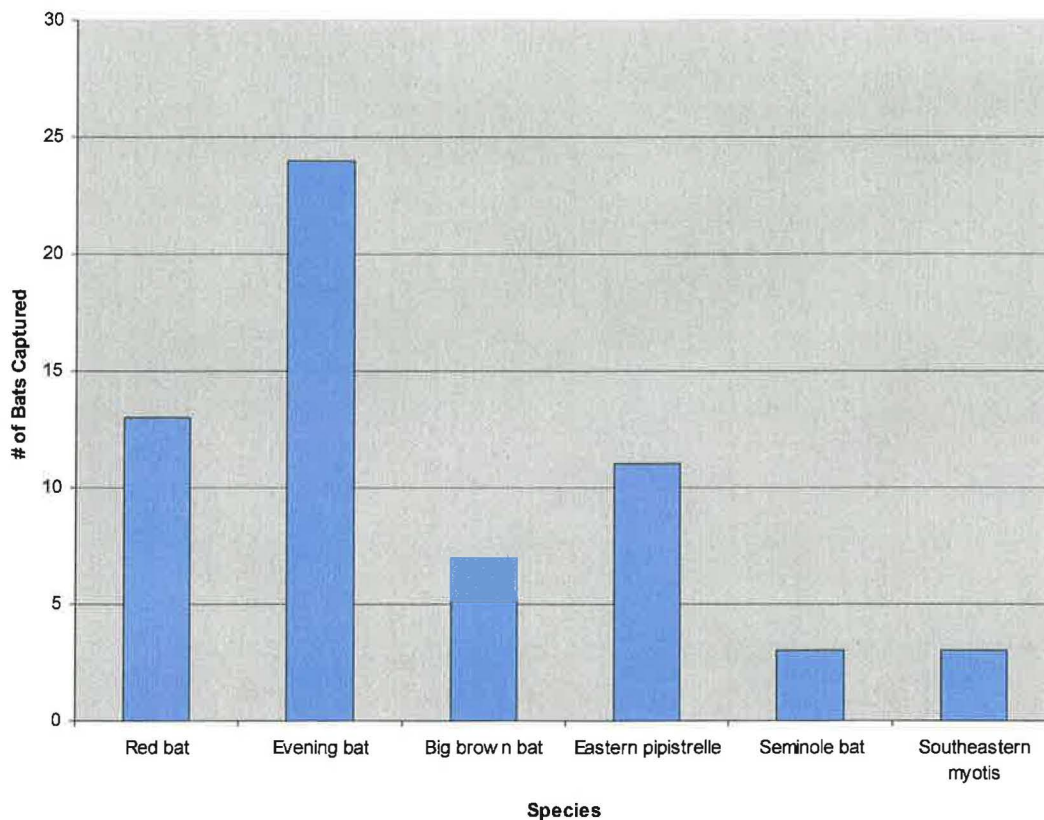


Figure 24. Number of bats captured per species during mist net surveys conducted from March - August 2006 at Noxubee National Wildlife Refuge.

Date	Site #	Site Type	Habitat Type	Species Caught	# of Individuals
3/10/06	1	Ditch	Bottomland Hardwood	0	
3/11/06	3	Pond	Pine	0	
4/22/06	6	Creek	Bottomland Hardwood	LABO	2
				NYHU	3
				EPFU	1
4/21/06	7	Creek	Upland Hardwood	Rained Out	
5/25/06	11	Pond	Pine	LABO	1
				NYHU	1
5/26/06	12	Creek	Bottomland Hardwood	LABO	2
6/23/06	5	Creek	Bottomland Hardwood	LABO	1
				NYHU	1
				EPFU	1
				PISU	2
6/24/06	7	Creek	Upland Hardwood	LABO	4
				NYHU	6
				EPFU	1
				PISU	3
				LASE	3
7/7/06	7	Creek	Upland Hardwood	LABO	3
				NYHU	12
				EPFU	4
				PISU	4
7/8/06	22	Dug Canal	Bottomland Hardwood	0	
8/4/06	24	Creek	Bottomland Hardwood	NYHU	1
				PISU	2
				MYAU	3

Table 7. Number of bats captured per species during mist net surveys conducted from April - August 2006 at Noxubee National Wildlife Refuge including date, site type and surrounding habitat type.

Note: LABO = red bat, NYHU = evening bat, EPFU = big brown bat, PISU = eastern pipistrelle, MYAU = southeastern myotis, LASE = Seminole bat.

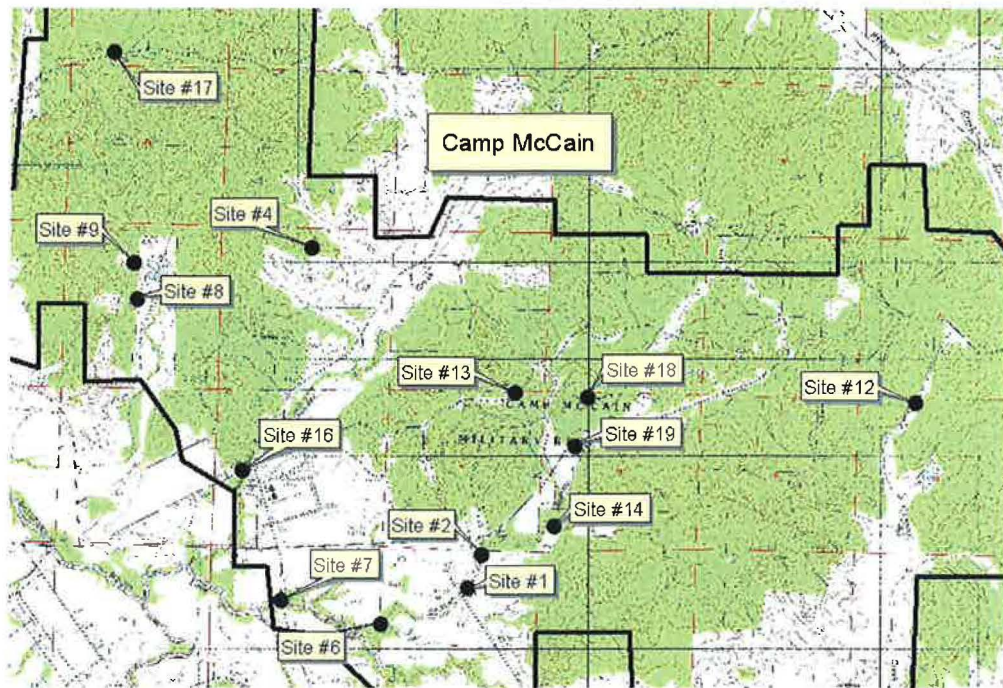


Figure 25. Fourteen sites chosen for mist net surveys conducted from 2004 – 2005 at Camp McCain.

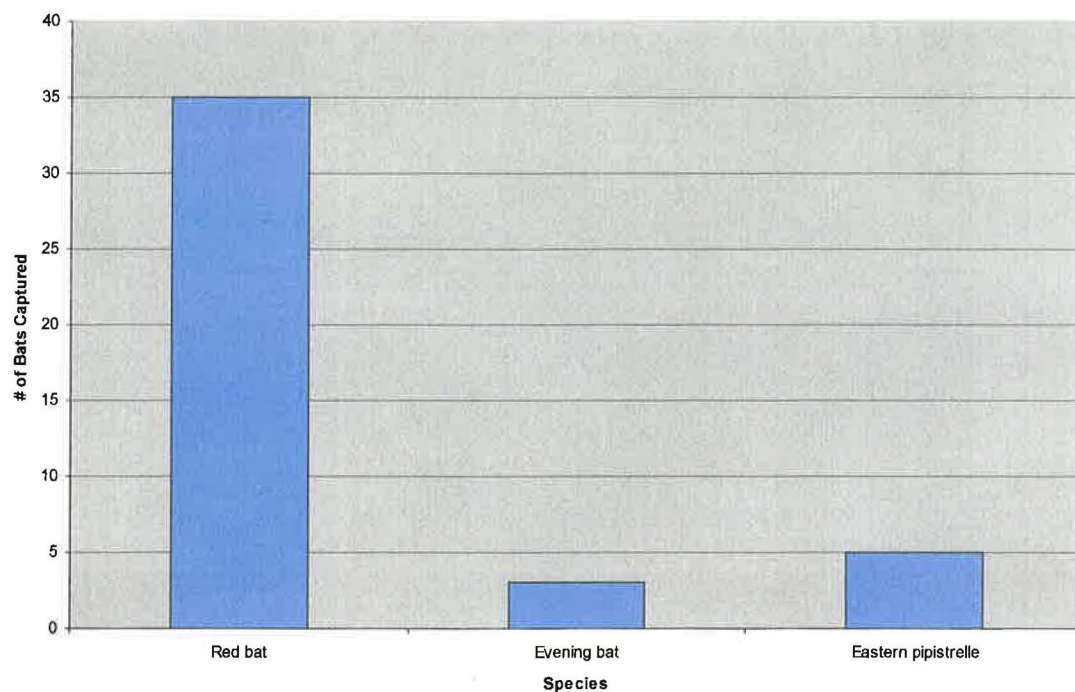


Figure 26. Number of bats captured per species during mist net surveys conducted from 2004 – 2005 at Camp McCain.

Date	Site #	Site Type	Habitat Type	Species Caught	# of Individuals
5/5/04	1	Medium Creek	Mixed Hardwood Forest	LABO	2
6/7/04	2	Man-made Impoundment	Mixed Hardwood/Pine Forest	LABO	1
6/8/04	4	Small Pond	Pine Forest	0	
6/9/04	7	Large Creek	Mixed Hardwood Forest	LABO	5
				NYHU	2
7/9/04	6	Creek	Mixed Hardwood Forest	LABO	2
7/10/04	8	Creek	Mixed Hardwood Forest	LABO	5
10/4/04	9	Small Pond	Mixed Hardwood/Pine Forest	0	
10/5/04	12	Small Pond Small Creek	Mixed Hardwood/Pine Forest	LABO	5
10/4/04	16	Small Creek	Mixed Hardwood	LABO	8
11/12/04	17	Creek	Bottomland Hardwood Forest	0	
6/3/05	17	Small Creek	Mixed Hardwood Forest	LABO	1
6/4/05	8	Medium Creek	Mixed Hardwood Forest	LABO	3
				PISU	3
7/15/05	7	Large Creek	Mixed Hardwood Forest	LABO	2
				NYHU	1
7/16/05	13	Small Pond	Mixed Hardwood/Pine Forest	0	
7/22/05	19	Small Creek	Mixed Hardwood Forest	LABO	2
				PISU	1
7/23/05	14	Small Creek	Mixed Hardwood Forest	0	
8/26/05	12	Small Pond	Upland Mixed Hardwood Forest	NYHU	1

Table 8. Number of bats captured per species during mist net surveys conducted from 2005 – 2006 at Camp McCain including date, site type and surrounding habitat type.

Note: LABO = red bat, NYHU = evening bat, PISU = Eastern pipistrelle.

Camp Shelby

Nineteen mist net surveys were conducted at 14 sites on Camp Shelby from 2004 – 2005 (Figure 27 and Table 9). One hundred and seventy-five bats were captured, representing 7 species, with an average of 9.21 bats captured per net night (Figure 28). Seven Rafinesque's big-eared bats were captured representing 4% of the total captures and five southeastern myotis were captured representing 3% of total captures. Other species captured included the: evening bat (43%), red bat (26%), Seminole bat (18%), eastern pipistrelle (5%), and hoary bat (1%) (Martin et. al. 2007). The hoary bat capture was the first county record for this species in Perry County and 1 of only 5 records in Mississippi (Mississippi Natural Heritage Program 2007). Camp Shelby had the highest average for bats captured per net night as well as the highest species diversity out of the 9 study areas surveyed.

Rafinesque's big-eared bats were captured at 2 locations (Site #9 and 20). Both of these sites contained small thin streams (~ 1 – 2 m wide and 0.50 – 1 m in depth) surrounded by bottomland hardwood forests. Southeastern myotis were captured at 3 sites (Site # 2, 9, and 16). Site # 2 was a small pond surrounded by mixed hardwoods and Site #16 was a stream surrounded by mixed hardwoods.

Meridian NAS

Nine mist net surveys were conducted at 8 sites on Meridian NAS in 2005 (Figure 29 and Table 10). Fifty bats were captured, representing 6 species, with an average of 5.56 bats captured per net night (Figure 30). Five southeastern myotis were captured representing 10% of the total number of bats captured. Other species captured included the: red bat (36%), Seminole bat (10%), evening bat (4%), eastern pipistrelle (8%), and big brown bat (2%) (Martin et. al. 2006).

Seventy-six percent (38 bats) of the total captures occurred at 1 site (Site #5) which was a small pond (~ 35 X 12 m and 0.25 – 1.25 m deep) surrounded by a mixed hardwood forest. The surrounding habitat was periodically flooded as evidenced by water line marks on buttressed trees. The 5 southeastern myotis were captured at 3 different sites (Site # 3, 14A, and 14B). Site #3 was a small mud hole (~ 2 X 1.5 m and 0.10 – 0.25 m deep) in mixed hardwood forest. Sites # 14A and 14B were different areas of the same creek (~ 3 – 6 m wide and 0.25 – 1 m deep) surrounded by a mixed hardwood forest.

Caney Creek WMA

Two mist net surveys were conducted at 2 sites on Caney Creek WMA in 2005 (Figure 31 and Table 11). Sixteen bats were captured, representing 3 species, with an average of 8 bats captured per net night (Figure 32). Six southeastern myotis were captured representing 38% of the total number of bats captured. Other species captured included the: evening bat (44%) and red bat (18%). The southeastern myotis captures occurred at 1 site (Site #1) which was a slough located in a bottomland hardwood forest.

Other Research

The mist net surveys noted above were conducted during the MBWG Second Annual Mist Net Event which occurred at Caney Creek and Tallahalla WMAs (both on Bienville NF). During this event 4 research teams conducted mist net surveys at 8

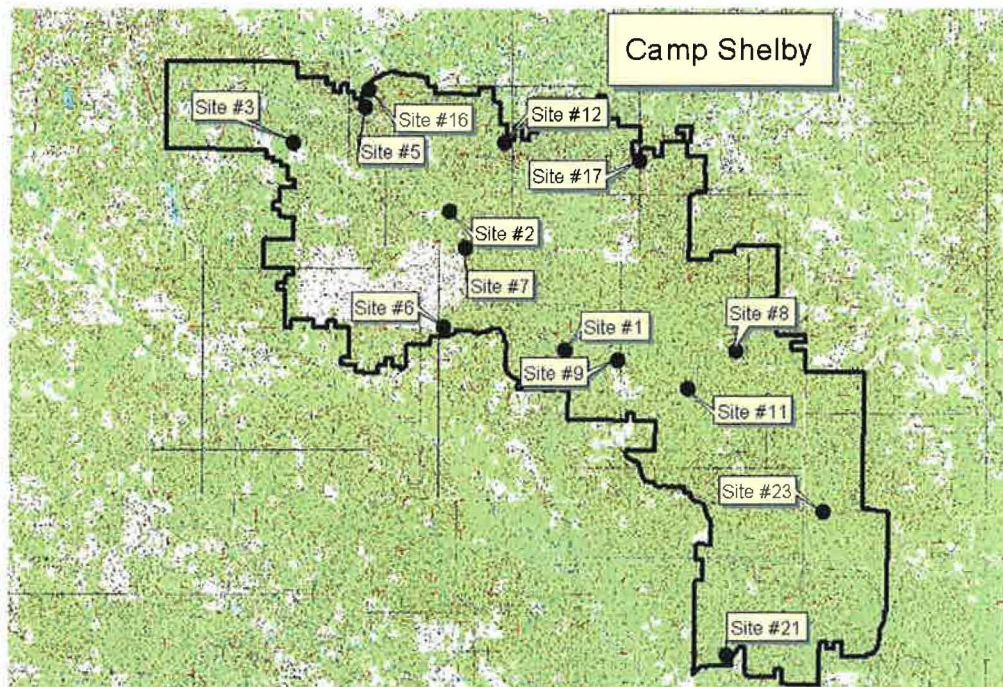


Figure 27. Fourteen sites chosen for mist net surveys conducted from 2004 – 2005 at Camp Shelby.

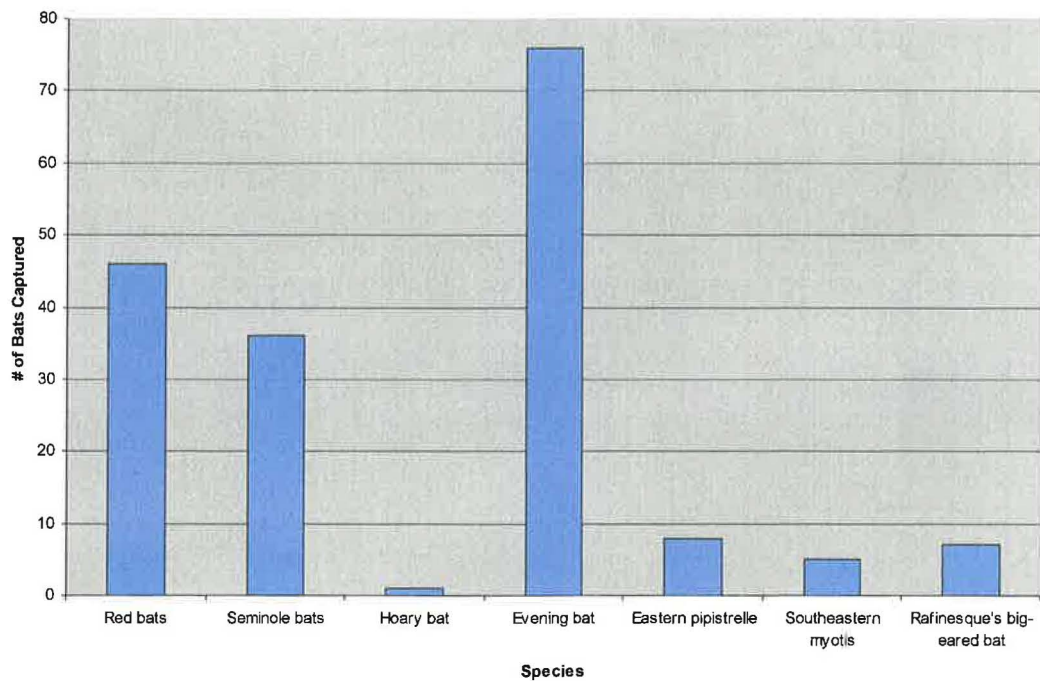


Figure 28. Number of bats captured per species during mist net surveys conducted from 2004 – 2005 at Camp Shelby.

Date	Site #	Site Type	Habitat	Species Caught	# of Individuals
5/4/04 4/18/05	1	Creek	Mixed Hardwood Forest	LABO	4
				LASE	6
				NYHU	4
				PISU	1
5/26/04	5	Creek	Mixed Hardwood Forest	LABO	2
5/27/04	2	Pond	Mixed Hardwood Forest	LABO	4
				NYHU	3
				LASE	3
				MYAU	1
5/28/04	7	Pond	Upland Mixed Hardwoods/ Pine Forest	LABO	1
				LASE	1
7/23/04	8	Swamp	Bald Cypress Swamp	LABO	5
				NYHU	7
7/24/04 5/24/05 6/27/05 6/29/05	9	Creek	Bottomland Hardwood Forest	LABO	12
				LASE	2
				PISU	6
				CORA	6
				NYHU	17
				MYAU	3
9/21/04	3	Cutover	Cutover	LASE	1
9/22/04	11	Creek	Bottomland Hardwood Forest	NYHU	9
9/23/04	12	Creek	Mixed Hardwood Forest	LABO	1
				NYHU	4
				LASE	1
4/19/05	16	Creek	Mixed Hardwood Forest	LABO	4
				NYHU	2
				MYAU	1
				PISU	1
4/20/05 6/28/05	17	Creek	Mixed Hardwood Forest	LABO	11
				NYHU	10
5/25/05	20	Creek	Bottomland Hardwood Forest	LABO	2
				LASE	2
				NYHU	11
				CORA	1
8/8/05	23	Creek	Mixed Hardwood Forest	LASE	5
				NYHU	5
8/9/05	21	Pond	Bald Cypress Swamp	LASE	10
				NYHU	5

Table 9. Number of bats captured per species during mist net surveys conducted from 2004 – 2005 at Camp Shelby including date, site type and surrounding habitat type.

Note: LABO = red bat, LASE = Seminole bat, NYHU = evening bat, PISU = eastern pipistrelle, MYAU = southeastern myotis, CORA = Rafinesque's big-eared bat, LACI = Hoary bat.

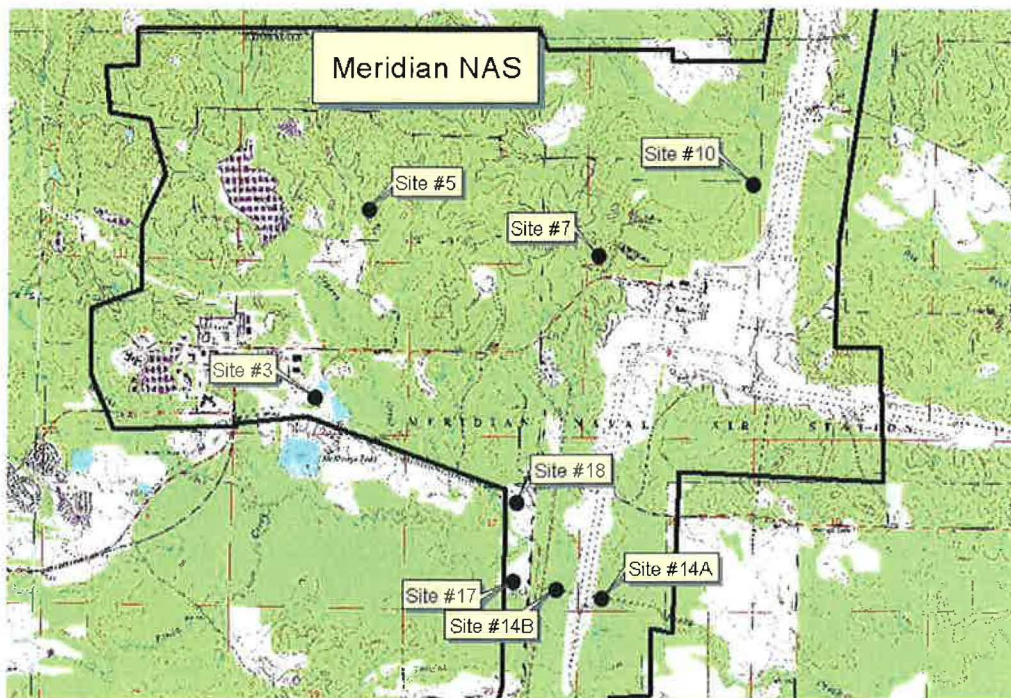


Figure 29. Eight sites chosen for mist net surveys conducted in 2005 at Meridian Naval Air Station.

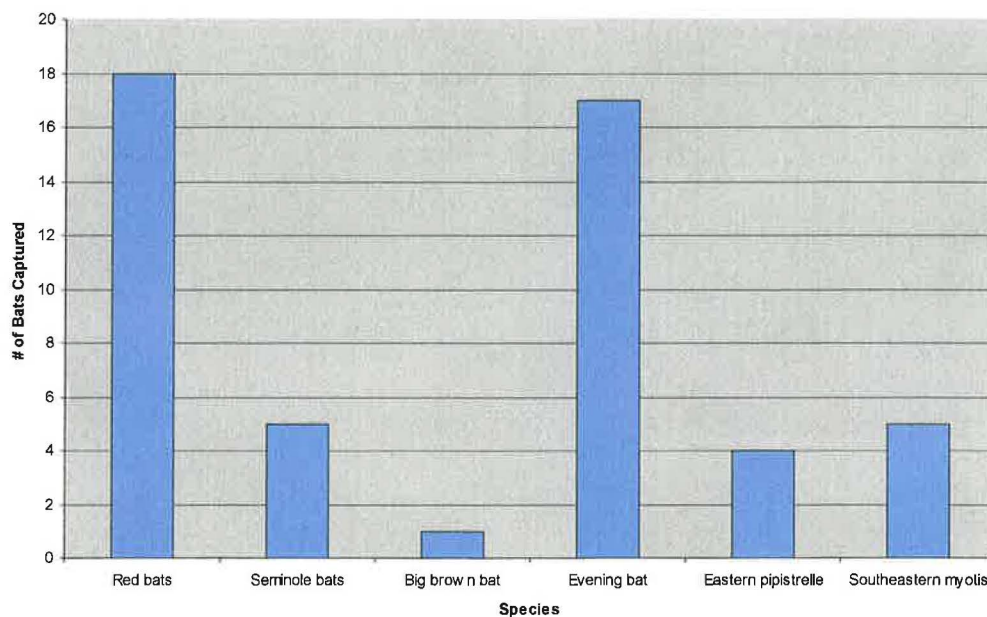


Figure 30. Number of bats captured per species during mist net surveys conducted in 2005 at Meridian Naval Air Station.

Date	Site #	Site Type	Habitat	Species Caught	# of Individuals
5/18/05	5	Small Pond	Mixed Hardwood Forest	NYHU	16
				LABO	4
				PISU	2
				LASE	3
5/19/05	17	Creek	Mixed Hardwood Forest	0	
5/20/05	7	Small Pond	Mixed Hardwood Forest	Rained Out	
6/13/05	3	Mud Hole	Mixed Hardwood Forest	MYAU	2
6/14/05	10	Creek	Mixed Hardwood Forest	LABO	1
7/20/05	14b	Creek	Mixed Hardwood Forest	LABO	1
				EPFU	1
				MYAU	1
				NYHU	1
7/27/05	5	Small Pond	Mixed Hardwood Forest	LABO	9
				LASE	2
				PISU	2
8/19/05	18	Small Creek Logging Road	Mixed Hardwood Forest	0	
8/20/05	7	Small Pond	Pine Forest	0	
11/11/05	14A	Creek	Mixed Hardwood Forest	MYAU	2

Table 10. Number of individuals captured per species during mist net surveys conducted in 2005 at Meridian Naval Air Station including date, site type and surrounding habitat type.

Note: MYAU = southeastern myotis, LABO = red bat, NYHU = evening bat, PISU = eastern pipistrelle, LASE = Seminole bat, EPFU = big brown bat.

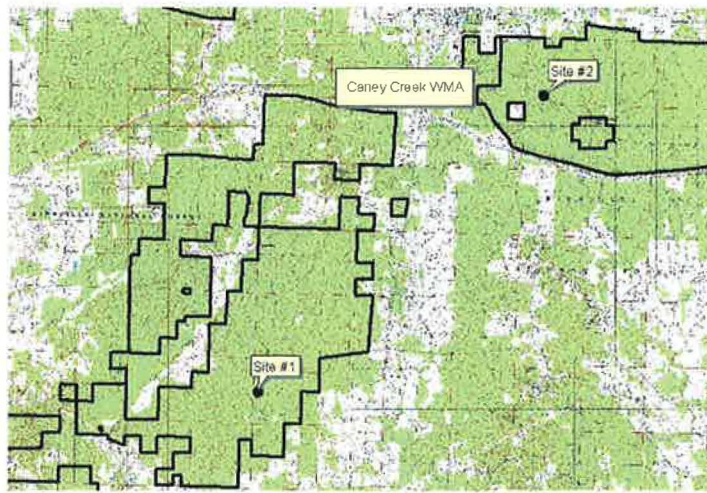


Figure 31. Two sites chosen for mist net surveys conducted in 2005 at Caney Creek Wildlife Management Area.

Date	Site #	Site Type	Habitat	Species Caught	# of Individuals
6/20/05	14	Small Creek	Upland Pine Forest	LABO	1
				NYHU	5
6/21/05	1	Slough	Bottomland Hardwoods	LABO	2
				NYHU	2
				MYAU	6

Table 11. Number of bats captured per species during mist net surveys conducted in 2005 at Caney Creek Wildlife Management Area including date, site type and surrounding habitat type.

Note: LABO = red bat, NYHU = evening bat, MYAU = southeastern myotis.

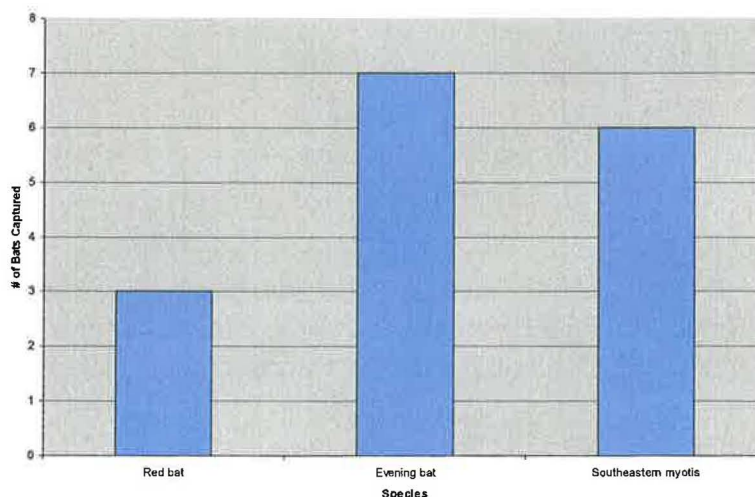


Figure 32. Number of bats captured per species during mist net surveys conducted in 2005 at Caney Creek Wildlife Management Area.

different locations over a two night period. The 4 research teams were led by myself, Lann Wilf, Chester Martin, and Austin Trousdale, University of Southern MS. Excluding the captures noted above, 1 evening bat and 1 eastern pipistrelle were captured at Caney Creek WMA. Eleven bats were captured at Tallahalla WMA, 7 of which were southeastern myotis representing 66% of total captures. Three evening bats and 1 red bat were also captured. The southeastern myotis captures occurred at 1 site which was a thin creek (~ 1-1.5 m wide and 0.25 – 1 m deep) located in a bottomland hardwood forest (Sherman 2005).

Divide Section WMA

Two mist net surveys were conducted at 1 site each on Divide Section and Canal Section WMAs in 2006 (Figure 33 and Table 12). No bats were captured at Canal Section WMA. Five bats were captured on Divide Section WMA, representing 2 species (Figure 34) including 3 red bats (60% of the total number of bats captured) and 2 eastern pipistrelles (40%).

Other Research

The mist net surveys above were conducted during the MBWG Third Annual Mist Net Event which occurred in Tishomingo County in 2006. During this event 5 research teams conducted mist net surveys at 10 different locations over a two night period. The 5 research teams were led by myself, Darren Miller, Monica Wolters, US Corp of Engineers, Joy O'Keefe, Clemson University, and Austin Trousdale. Excluding the captures noted above, 13 red bats, 4 Eastern pipistrelles, 1 evening bat and 1 hoary bat were captured. The hoary bat capture was the first county record for this species in Tishomingo County and 1 of only 5 records for this species in Mississippi (Sherman 2006).

Laurel Hill Plantation

Two mist net surveys were conducted at 2 sites at Laurel Hill Plantation in 2003 (Figure 35 and Table 13). Seven bats were captured, representing 2 species, with an average of 3.5 bats captured per net night (Figure 36). Six southeastern myotis were captured representing 86% of the total number of bats captured and 1 evening bat was captured (14%). The southeastern myotis captures occurred at 1 site which was a small pond (~ 10 X 6 m and 0.25 – 2 m deep) located in a bottomland hardwood forest.

Roost Surveys

Abandoned Buildings/Artificial Roosts

Thirteen of 14 structures (10 abandoned buildings and 4 artificial roosts) surveyed were being used by Rafinesque's big-eared bat, 4 of which were confirmed to be maternal colonies. The largest known maternal colony in Mississippi for Rafinesque's big-eared bat was found in an abandoned house owned by the Conservation Club and contained 62 individuals in May 2004. The second largest known maternal colony in Mississippi for this species was located in an abandoned house at St. Catherine Creek NWR and contained 50 individuals in May 2002. Six of the 14 buildings surveyed were also being used by southeastern myotis although none were confirmed to be maternal

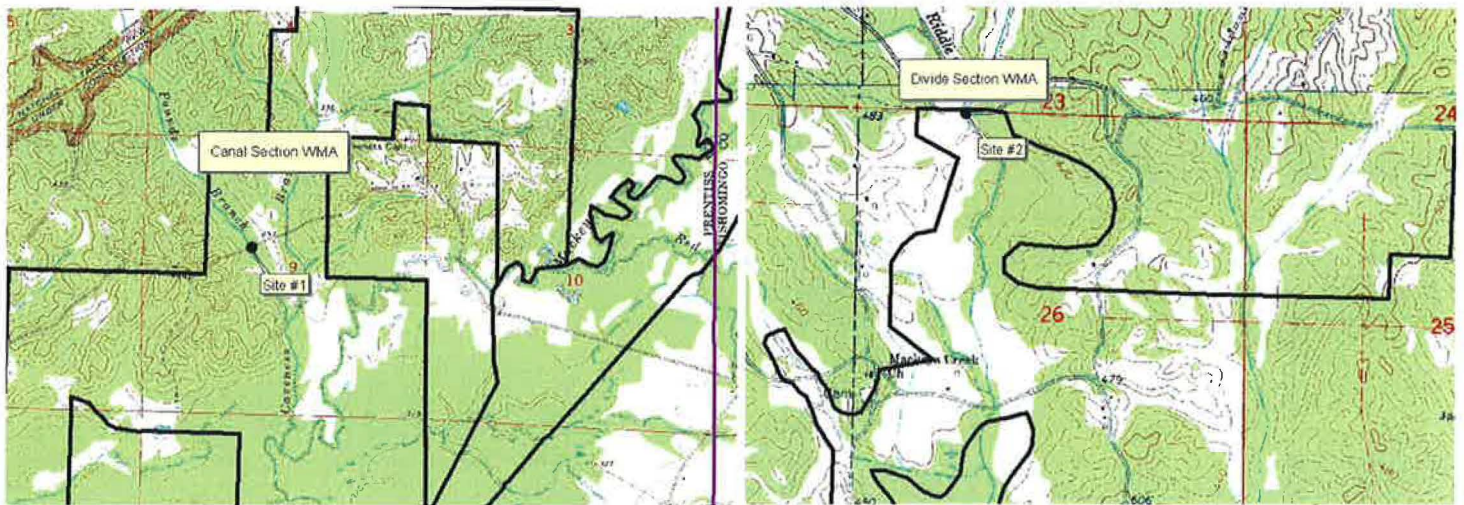


Figure 33. Two sites chosen for mist net surveys conducted in 2006 at Canal Section and Divide Section Wildlife Management Areas.

Date	Site #	Site Type	Habitat	Species Caught	# of Individuals
6/20/06	Divide Section WMA	Small Creek	Mixed Hardwood Forest	LABO PISU	3 2
6/21/06	Canal Section WMA	Small Creek	Mixed Hardwood Forest	0	

Table 12. Number of bats captured per species during mist net surveys conducted in 2006 at Divide Section and Canal Section Wildlife Management Areas including date, site type and surrounding habitat type.

Note: LABO = red bat, PISU = eastern pipistrelle.

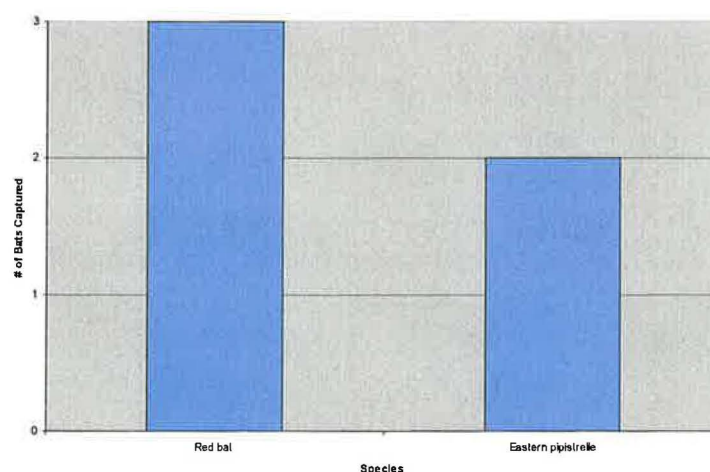


Figure 34. Number of bats captured per species during mist net surveys conducted in 2006 at Divide Section Wildlife Management Area.

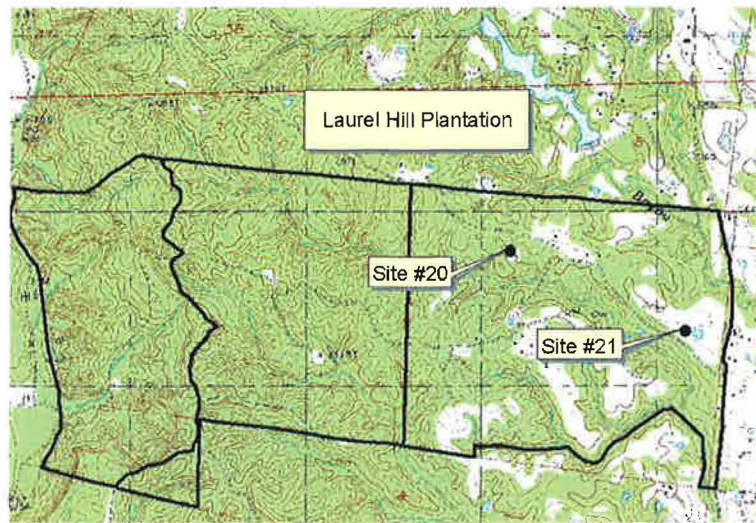


Figure 35. Two sites chosen for mist net surveys conducted in 2003 at Laurel Hill Plantation.

Date	Site #	Site Type	Habitat	Species Caught	# of Individuals
5/24/03	20	Small Pond	Mixed Upland Hardwood Forest	MYAU NYHU	6 1
5/24/03	21	Small Pond	Mixed Upland Hardwood Forest	0	

Table 13. Number of bats captured per species during mist net surveys conducted in 2003 at Laurel Hill Plantation including date, site type and surrounding habitat type.

Note: MYAU = southeastern myotis, NYHU = evening bat.

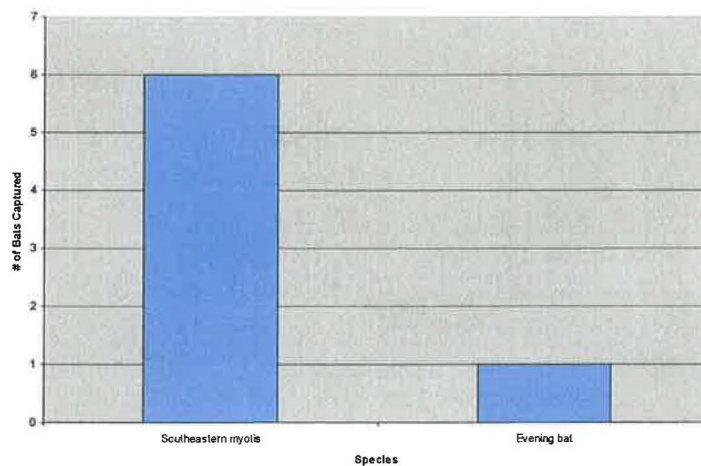


Figure 36. Number of bats captured per species during mist net surveys conducted in 2003 at Laurel Hill Plantation.

colonies. One of these roosts, located on property adjacent to St. Catherine Creek NWR, contained a maximum of 5 southeastern myotis in June 2003.

St. Catherine Creek NWR

Appendix A and B provide a list of survey dates and abundance of Rafinesque's big-eared bat and southeastern myotis in Roosts #1 – 11 at St. Catherine Creek NWR. Roost #1 was confirmed to be a maternal colony for Rafinesque's big-eared bat and contained 35 adult females on May 26, 2002 and 50 individuals on July 12, 2003 (Figure 37). This is the second largest known maternal colony for this species in Mississippi. Figure 37 shows a peak in the abundance of bats in late May, 2002 and 2003. This is the time of year that adult females form maternal colonies. A second peak for both years occurred in mid-June at which time both adult females and their pups were present. A dramatic decrease in the abundance of bats occurred in early to mid-June, 2002 and 2003.

Roost #2 was also confirmed to be a maternal colony for Rafinesque's big-eared bat and contained 0-10 individuals during the survey period (Figure 38). Similar to abundance trends in Roost #1, there was a peak in the number of individuals in Roost #2 in late May 2002 and 2003, with a decline in abundance in late June 2002 and 2003.

Roost #4 was discovered in March 2003 and was confirmed to be a maternal colony. There was a peak in the abundance of bats in mid March and mid July, with 25 individuals being recorded each, with a severe decline in abundance from April to the end of June (Figure 39).

Roost #3 was not confirmed to be a maternal colony and contained 0 - 4 individuals during the survey period. This roost consisted primarily of single adult males. Roosts #5 - 7 occasionally contained 1 individual each during the survey period (Appendix A).

Bats were not observed in Roost #8 (shed design artificial roost) during the survey period. Roost #9 (tree design artificial roost) contained 1 individual in April and July, 2005, February 2006, and March 2007. In May 2006, this roost contained 28 individuals, several of which had been banded in Roost #1 3 years previously. Roost #10 contained 1 individual in May 2006, 48 individuals in August 2006 and 20 individuals in March 2007. Roost # 11 contained 1 individual in April and July, 2005 and February 2006 and 2 individuals in May 2006 and March 2007 (Appendix A).

Six of the 7 abandoned houses on or adjacent to the refuge were also being used by southeastern myotis. One to two southeastern myotis individuals were observed on several occasions in Roosts #1 – 4 and Roost #6 (Appendix B). Roost # 5 contained a maximum of 5 individuals in June 2003. Big brown bats were also observed on several occasions in Roosts #1 - 2. Roost #2 was confirmed to be a maternal colony for big brown bats and contained 8 individuals in July 2003.

Noxubee NWR

Two Rafinesque's big-eared bat individuals were observed in 2 separate abandoned houses at Noxubee NWR in 2004. A master's research project is currently being conducted by Candy Stevenson, Mississippi State University, regarding tree roost availability and occupancy rates at Noxubee NWR. This project should provide valuable

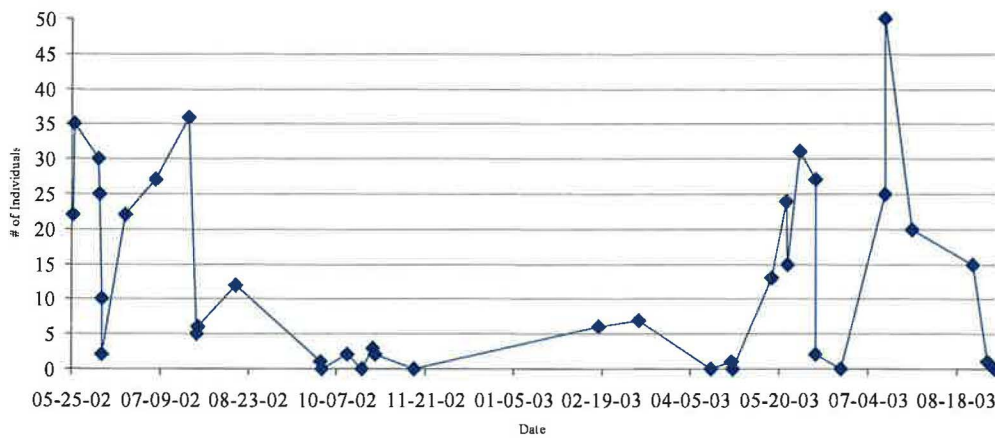


Figure 37. Number of Rafinesque's big-eared bat observed in Roost #1 during roost surveys conducted from 2002 – 2003 at St. Catherine Creek National Wildlife Refuge.

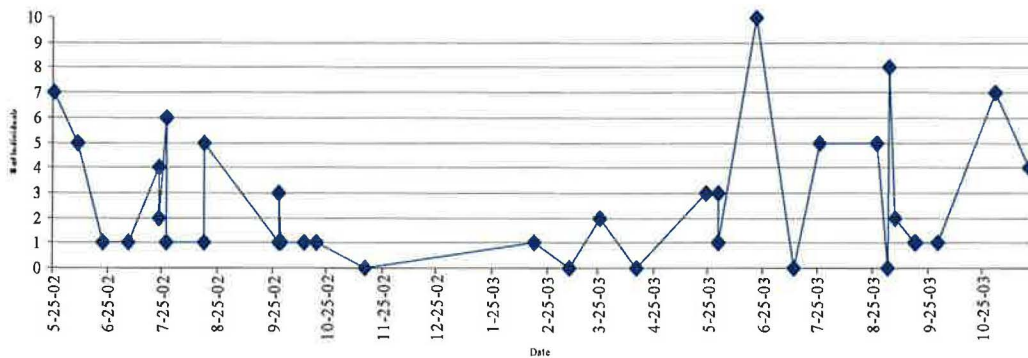


Figure 38. Number of Rafinesque's big-eared bats observed in Roost #2 during roost surveys conducted from 2002 – 2003 at St. Catherine Creek National Wildlife Refuge.

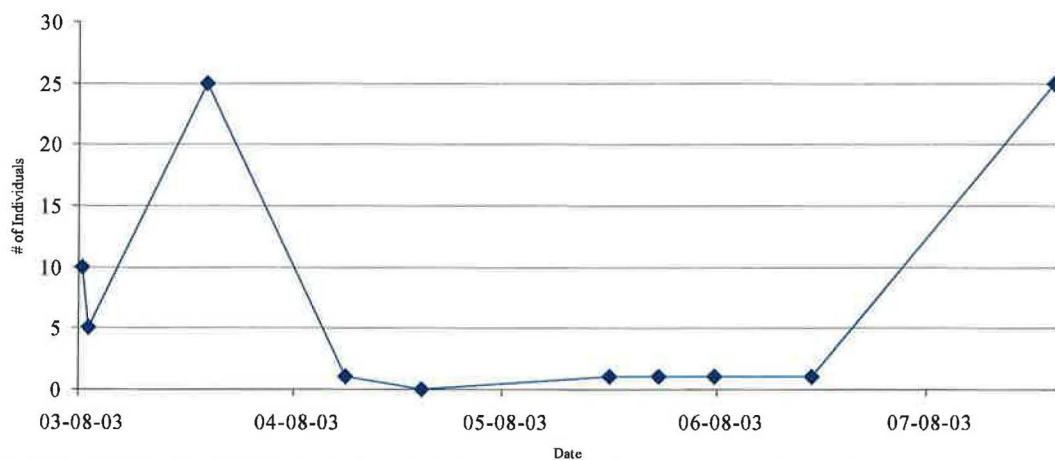


Figure 39. Number of Rafinesque's big-eared bats observed in Roost #4 during roost surveys conducted in 2003 at St. Catherine Creek National Wildlife Refuge.

data regarding relative abundance and roost preferences for this species.

The Conservation Club

An abandoned house located on property owned by the Conservation Club was confirmed to be a maternal roost for Rafinesque's big-eared bat and contained 62 individuals in May 2004 and 40 individuals in July 2004. This is the largest known maternal colony for this species in Mississippi.

Culverts

One Rafinesque's big-eared bat was observed in February 2003 and 5 southeastern myotis were observed in January 2005 in a culvert on Laurel Hill Plantation. Five Rafinesque's big-eared bats were observed in 1 culvert on Meridian NAS in 2002, but have not been observed since. These culverts were commonly used however, by southeastern myotis with 1 culvert being confirmed as a maternal colony. This culvert contained 584 individuals in September 2006. Culverts were also used by large numbers of eastern pipistrelles.

Laurel Hill Plantation

One Rafinesque's big-eared bat was observed in a culvert on Laurel Hill Plantation in February 2003 and 5 southeastern myotis were observed in January 2005. Eastern pipistrelles were also occasionally observed in this culvert during the winter months. No bats were observed using this culvert during the summer.

Meridian NAS

In 2002, 5 Rafinesque's big-eared bats were observed by Chester Martin in one of the culverts on the south end of the airstrip at Meridian NAS, but have not been observed since. Southeastern myotis were observed using the same culvert with 362 individuals recorded in August and 484 individuals recorded in October 2005 (Figure 40). This culvert was confirmed to be a maternal colony. In 2006, there was a peak in abundance in September and October with 584 and 245 individuals observed respectively. Single individuals were observed using the remaining 6 culverts.

Eastern pipistrelles were observed using the same 7 culverts in 2005 – 2006. Abundance was highest in the north culverts, although individuals were observed using all 7 culverts. There was a peak in the abundance of Eastern pipistrelles in December 2005 and February 2006 with 288 and 382 bats observed respectively (Figure 40). Abundance of individuals was highest in the winter months for eastern pipistrelles and highest in the summer months for southeastern myotis. Southeastern myotis were using the taller and wider culverts (south end of airstrip) as a maternal roost. Eastern pipistrelles were using the shorter and thinner culverts (north end) as a hibernaculum.

Cisterns

Three out of 10 cisterns surveyed were found to be occupied by southeastern myotis and were located on Laurel Hill Plantation and Hollywood Plantation. In August

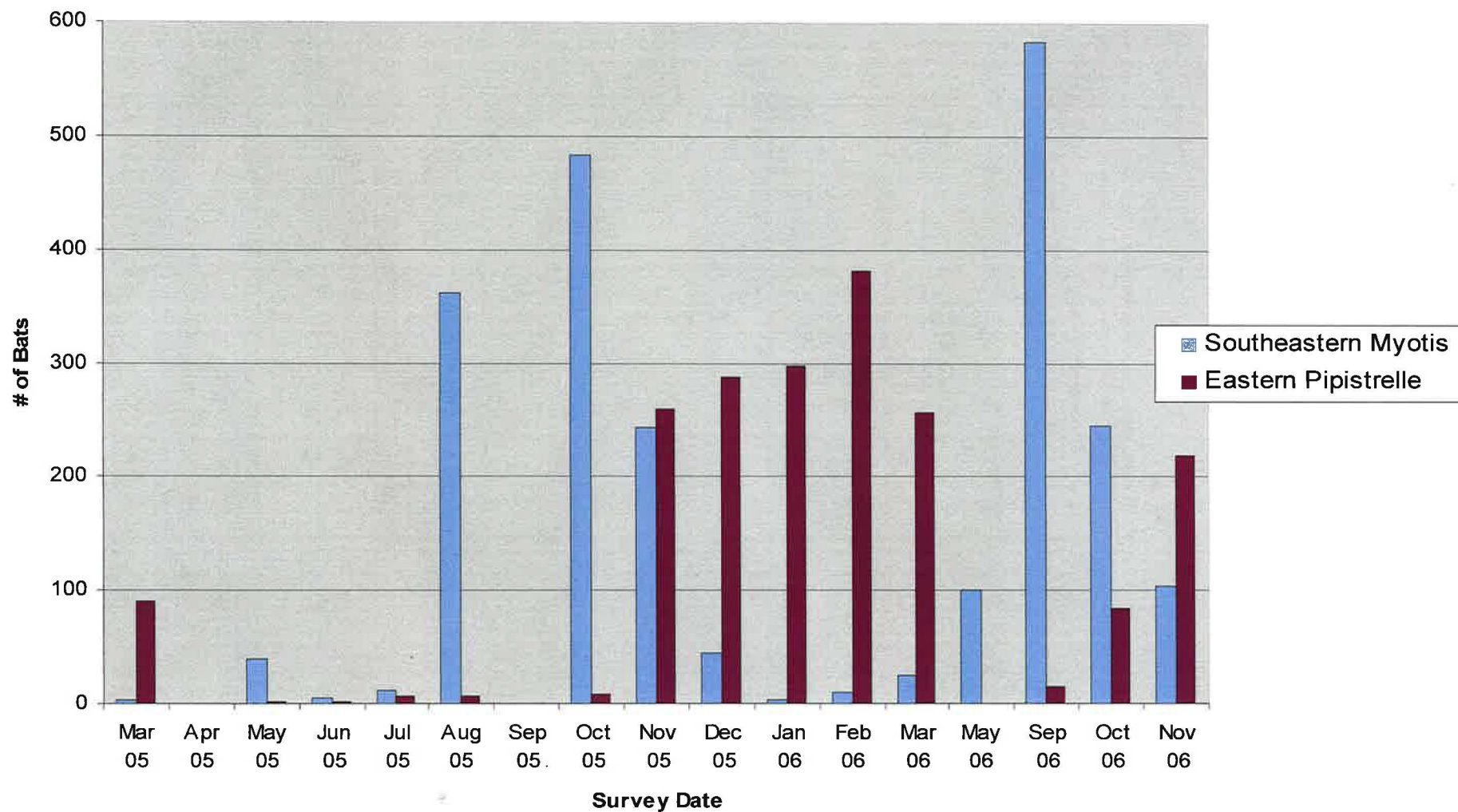


Figure 40. Number of southeastern myotis and eastern pipistrelles observed in culverts during roost surveys conducted from 2005 – 2006 at Meridian Naval Air Station.

2004, 5,479 southeastern myotis were recorded emerging from Cistern #2 at Laurel Hill Plantation. In 2004, 5,691 southeastern myotis were recorded emerging from Cistern #8 and 6,486 from Cistern #10 located on Hollywood Plantation. These are the largest known maternal colonies for this species in Mississippi and 3 of the largest known colonies in the entire Southeast. No other species were observed using these cisterns.

St. Catherine Creek NWR

Bats were not observed in Cistern #1 located at St. Catherine Creek NWR during the survey period. This cistern was located 1 m east of Roost #1 and was surrounded by heavy vegetation which covered the opening during most of the year.

Laurel Hill Plantation

Out of 3 cisterns surveyed on Laurel Hill Plantation, 1 was found to be occupied by bats (Cistern #2). This cistern was virtually identical in structure and dimensions to Cistern #1 but differed in surrounding vegetation. Mixed hardwood forests surrounded Cistern #2 with a 3 – 4 m clearing on three sides. Water, with a minimum depth of 1 m, was observed in this cistern every time it was surveyed. The other two cisterns on Laurel Hill Plantation (Cisterns #3 and 4), were identical in structure and dimensions to Cistern #2 but were located in less wooded areas, with one located right next to an inhabited house. Cisterns #3 and 4 occasionally held water.

Cistern #2 was found to be occupied year-round by both male and female southeastern myotis with no other species documented. Two-hundred and thirty-eight individuals were captured using a hand-net. The number of males captured was higher than the number of females for 8 of 11 months (Figure 41). This cistern was confirmed to be a maternal colony.

In August 2004, 5,479 bats were recorded emerging from this cistern (Figure 42). Over 1,500 individuals were recorded emerging in both December and May 2004 with 392 individuals documented in January 2005.

Hollywood Plantation

Two out of 3 cisterns located at Hollywood Plantation were found to be occupied by bats. The unoccupied cistern was similar in structure and design to Cisterns # 1 – 4 but was located in a heavily wooded area with very little clearing around the structure. One of the occupied cisterns (Cistern #8) was identical to the others in structure and dimensions with a 5 m clearing on three sides. This cistern was previously used as a trash dump site. A trash pile ~ 2 m deep was present at the bottom of the cistern with no water. The second occupied cistern (Cistern #10) was constructed out of brick and was ~ 5 m deep and 3 m in diameter. Half of the above ground portion of the cistern had caved in creating an opening with a diameter of 1 m. This cistern was surrounded by a mixed hardwood forest with a 1 m clearing surrounding the cistern.

Cisterns #8 and #10 were found to be occupied year-round by both male and female southeastern myotis, with no other species documented. These cisterns were confirmed maternal colonies.

In May 2004, 5,691 individuals were recorded emerging from Cistern #8. In

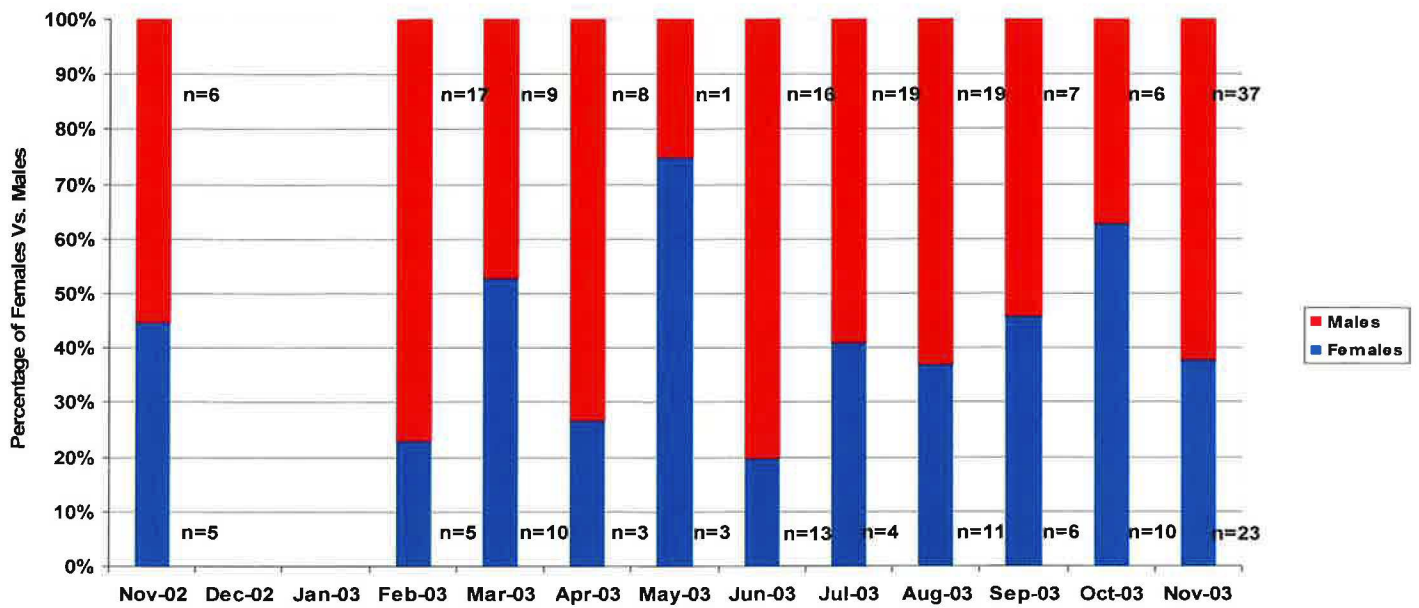


Figure 41. Percentage of male and female southeastern myotis captured emerging from a cistern at Laurel Hill Plantation, 2002 – 2003.

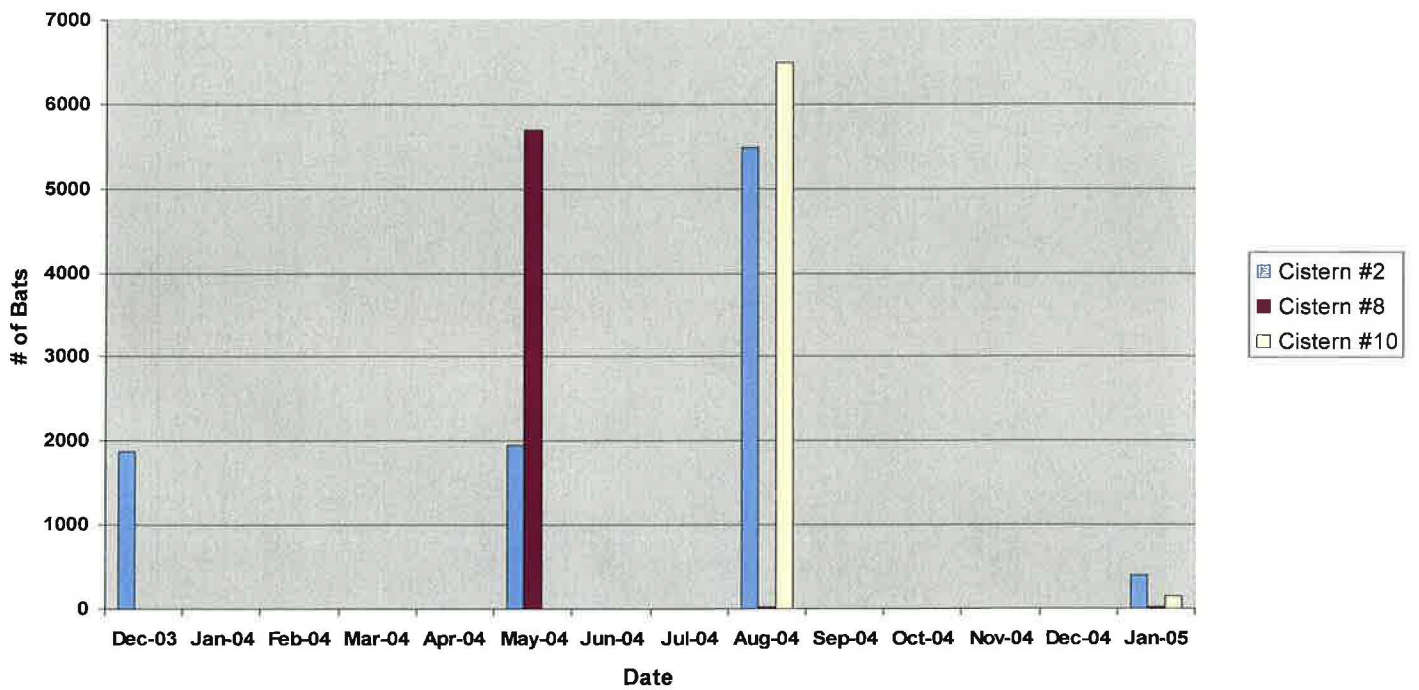


Figure 42. Number of southeastern myotis emerging from 3 cisterns on Laurel Hill and Hollywood Plantations, 2005 – 2006.

August 2004 and January 2005, 25 individuals were recorded each (Figure 42). In August 2004, 6,486 bats were recorded emerging from Cistern #10. These are the largest maternal colonies of southeastern myotis known in Mississippi and two of the largest in the entire Southeast.

Egypt Plantation

Out of 3 cisterns surveyed on Egypt Plantation (Cisterns #5 – 7), none were found to be occupied by bats. These cisterns did not have an above ground portion and instead were holes in the ground with a diameter of 0.75 m and were constructed from cement. Cisterns #5 – 6 had a depth of 10 m and diameter of 4.25 m with no water present. Cistern #7 was 3 m deep with a diameter of 3 m. This cistern was filled with water on the date surveyed.

Caves

Twenty-two caves were surveyed for occupancy by Rafinesque's big-eared bat and southeastern myotis in 11 counties in Mississippi from October 2005 – February 2007. Two caves were found to be under water due to damming projects and 2 had been filled in due to liability reasons. Bats were observed in 8 of the 22 caves on the survey date, representing three species including the southeastern myotis, eastern pipistrelle, and northern long-eared bat (*Myotis septentrionalis*).

Amite County

Randall's Cave located in Amite County was surveyed in February 2007. The cave opening was 3.5 m tall and 5 m wide (Table 4). The cave went straight back with a depth of 5 m and an average height of 1 m. Two eastern pipistrelles were observed on the survey date.

Benton County

Spider Lead Cave located in Benton County was surveyed in June 2006. The opening to this cave was approximately 1 m tall and 1 m wide with an immediate drop of 0.5 m into a small room (2 X 1.5 m and 1 m tall). According to Knight et. al. (1974), this cave contained 2 passages in 1970 with 1 being ~ 30 m long and the other ~ 6 m long. These passages are no longer present. No bats were found in this cave on the date surveyed.

Calhoun County

An attempt to survey Bounds Cave, Calhoun County, was made in July 2005. This cave was documented in the Mississippi Natural Heritage Program Database to be within Calhoun County WMA, but could not be located. The Manager of Calhoun County WMA confirmed in November 2005 that this cave was filled in several years ago due to liability reasons.

Franklin County

Calcote Branch Cave located in Franklin County was surveyed in February 2007.

This cave had an opening of 1 m in height and 2 m wide. The cave opened into a large room ~ 5 m in diameter with a height that ranged from 1.75 – 2.75 m. This cave contained a thin and shallow stream. Thirty-three eastern pipistrelles were observed on the survey date.

Jasper County

Roger's Hole located in Jasper County was surveyed in November 2005. This cave had an opening of 2 m tall and 1 m wide. It opened into a room with 4 passages going off of it. Approximately 10 m were surveyed before the passages became too small to traverse. Five eastern pipistrelles were observed.

Neshoba County

Nanah Wayah Cave located in Neshoba County was surveyed in November and December 2005. This cave was at the base of an Indian mound and located at Nanah Wayah State Park (which is currently closed). This cave had an opening of 0.75 m high and 1 m wide. From the entrance, the cave passageway sloped down for ~ 6 m until it ran into a large pool of water. At this point the cave ceiling was ~ 0.25 above the water surface. Two eastern pipistrelles were observed in November and 52 were observed in December.

Smith County

An attempt to visit Indian Cave was made in July 2005. Workers confirmed that this cave was filled in by the Smith County Lime Plant several years ago due to liability reasons.

Nearby Cat's Den Cave was located on property owned by The Nature Conservancy in Smith County and was surveyed in December 2005. The entrance to this cave was 0.75 m tall and 1 m wide. The cave was ~ 20 m with an average height of 0.75 m. Seven Eastern pipistrelles were observed on the survey date.

Waddell Cave, also located in Smith County, was surveyed in July and October 2005. This was a beautiful cave with a thin, shallow stream running through it. The entrance was ~ 1.25 m high and 1 m wide. Twenty m of this cave was surveyed. A large colony of over 1000 southeastern myotis was observed on each visit. This is the largest known colony of southeastern myotis in a Mississippi cave.

Tippah County

Muddy Ridge Cave located in Tippah County was surveyed in March 2006. This cave had 2 entrances both of which were ~ 0.75 m tall and 0.75 m wide and consisted of a winding passageway ~ 20 m long. Two Eastern pipistrelles were observed on the survey date.

Tishomingo County

Three caves and 1 abandoned chalk mine were visited in Tishomingo County. Attempts were made to find 2 additional caves but it's believed that they are under water. These caves were filled in with water from Pickwick Lake when this area was dammed in

the 1970's.

Tishomingo State Park Cave was surveyed on November 2003. This was a small cave (~3 m wide, 6 m long, and 1.5 m tall) which received a high amount of traffic due to location. No bats were observed on the survey date and it is probably unsuitable for bats.

Mingo Cave or Spring Cave located on the Natchez Trace Parkway was surveyed on November 2003, September 2005, and June 2006. This was a large cave by Mississippi standards and was ~ 16 m long, 16 m wide and 10 m tall. Half of the cave contained a large pool of water. No bats were observed.

Poole's cave was a dry cave with 2 entrances, both of which were ~ 1.5 m tall and 1 m wide. It contained a winding passage which opened into a large room (~ 3 m wide and 3.5 m long) before reaching the second entrance. No bats were observed in this cave on the date surveyed.

Tripoli Cave, an abandoned chalk mine located near Pickwick Lake, was surveyed in October 2004. The entrance was ~ 2 m tall and 1 m wide. There were several passageways with a total length of ~ 100 m, width of 65 m and ceiling height of 10 m. This is a historic roost site for the endangered gray bat (*Myotis grisescens*) and Indiana bat (*Myotis sodalis*). These species have not been observed in Tripoli Cave since 1967. The mine has been heavily vandalized with graffiti and evidence of fire. Fifteen Eastern pipistrelles and 1 Northern long-eared bat were observed on the survey date. The chalk mine is the only record for the northern long-eared bat in Mississippi. Before this survey date, the last known observation for this species was in 1967.

Union County

Two caves were surveyed in Union County on March 2006; Land of Caves #1 and Land of Caves #3. Land of Caves # 3 ranged in height from 0.25 – 2 m and was ~ 13 m long and 4 m wide. No bats were observed in this cave.

Land of Caves #1 was located ~ 30 m from Land of Caves #3. This cave ranged in height from 0.75 – 1.5 m and had a shallow stream running through it. Six Eastern pipistrelles were observed on the date surveyed.

Wayne County

Four caves were surveyed in Wayne County in October and November 2005. Pitt's Cave is the largest known cave in Mississippi. The entrance was ~ 3 m tall and 3 m wide with a total length of ~ 450 m surveyed. One southeastern myotis and 5 eastern pipistrelles were observed on the date surveyed. Excessive staining on the ceiling in places suggests that larger colonies once roosted here.

Triple H Cave is another large cave by Mississippi standards. The entrance to this cave was ~ 2.25 m tall and 1.5 m wide. According to Knight (1974) the passageway was approximately 100 m long and varies in height from 0.25 – 2.25 m. No bats were observed on the survey date however the entire cave was not surveyed.

Little H Cave is just east of Triple H Cave. The cave entrance was at the bottom of a 10 m pit so this cave was not surveyed.

The entrance to Graham Waterfall Cave is ~ 0.75 m high and 1.5 m wide. There was a stream running through this cave making it difficult to survey. No bats were

observed and this cave is probably unsuitable for bat occupancy.

CONCLUSIONS

Mist Net Surveys

Species Diversity and Abundance

Findings from this study were consistent with studies conducted by Miller (2004) which showed that species diversity and relative abundance of bats in an area can be considered indicators of overall forest health. Camp Shelby had both the highest relative abundance (averaging 9.21 bats captured per net night) and the highest species diversity (7 species) out of the 9 study areas surveyed. Camp Shelby was the largest study area surveyed during this project and contained some of the healthiest forests, with an abundance of non-fragmented mature mixed hardwoods. This was the only study area surveyed which contained 20 Natural Heritage Conservation Sites which shows that the area had a high number of unique and species rich habitats. Caney Creek had the second highest capture rate with an average of 8 individuals captured per net night. Although only 3 species were captured during the survey period, biases might be present due to small sample size (2 surveys). Caney Creek also contained rich habitats with an abundance of mature mixed hardwoods. Meridian NAS and Noxubee NWR had the third and fourth highest capture rates with an average of 5.59 and 5.6 bats captured per net night respectively and the third highest species diversity with 6 species captured at each. Both of these study areas contained high quality diverse forests. St. Catherine Creek NWR had a high species diversity (5 species) however a low capture average (1.33 bats captured per net night). These surveys were conducted in 2002 when I had very little experience conducting mist net surveys, possibly causing a sampling bias. St. Catherine Creek NWR contained healthy and diverse habitats with an abundance of mixed hardwoods including bottomland hardwoods and bald cypress swamps.

For 3 study areas, a large percentage of the total number of bats captured occurred at 1 mist net survey site. For example, 1 site at St. Catherine Creek yielded 80% of the total number of bats captured there, representing 5 species. One site at Noxubee NWR and 1 site at Meridian NAS yielded 66% of the total captures each, representing 5 and 4 species respectively. Only 1 – 2 mist net surveys were conducted at 4 of the study areas (Laurel Hill Plantation, Caney Creek, Divide Section, and Canal Section WMAs) so these areas were not considered for this analysis. The 3 survey sites located at St. Catherine Creek NWR, Noxubee NWR, and Meridian NAS, were small water bodies (2 ponds and 1 fairly dry creek with periodic pools) surrounded by mature mixed hardwood forests. Each of these 3 study areas contained both species rich areas as well as species poor areas (bottomland hardwoods and swamps as well as clear cuts, developed land, and pine plantations) which could possibly cause extreme highs and lows in abundance of bats at different locations of the same study area. Camp Shelby and Camp McCain were more homogeneous with Camp McCain having a high number of species poor habitats (pine plantations) and Camp Shelby having an abundance of species rich habitats (bottomland hardwoods and mixed hardwood forests).

During this survey, we captured all 7 of the species that we would expect to catch

in the study areas chosen including the: red bat, evening bat, eastern pipistrelle, big brown bat, Seminole bat, southeastern myotis and Rafinesque's big-eared bat. Five of these species have a high relative abundance in the southeastern United States (red bat, evening bat, eastern pipistrelle, big brown bat, and Seminole bat) (Harvey et. al. 1999) and are readily captured using mist net survey techniques (Cochran 1999, Trousdale and Beckett 2001). While Rafinesque's big-eared bat and southeastern myotis are special concern species, they are captured in low numbers throughout the Southeast, particularly in bald cypress swamps. Out of the 8 species captured during this survey effort, the hoary bat capture at Camp Shelby was probably the most significant. This capture represents 1 of only 5 records for this species in Mississippi (Mississippi Natural Heritage Program 2007). We did not capture any of the species that we would not expect to catch, including the: Brazilian free-tailed bat, gray bat, Indiana bat, northern long-eared bat, little brown bat, silver-haired bat, and yellow bat. The Brazilian free-tailed bat is common throughout its range but is rarely caught using mist net survey methods (Kalcounis-Ruppell 2006). We have very few records for the remaining 6 species contained on the Mississippi bat species list and I would not expect to capture them during mist net surveys within the state.

Rafinesque's Big-eared Bat and Southeastern Myotis

Rafinesque's big-eared bat was captured at 2 out of 9 study areas (Camp Shelby and St. Catherine Creek NWR). Both of these areas had an abundance of bottomland hardwood forests and cypress swamps. It is possible that this species was not captured at additional study areas due to sampling bias. Rafinesque's big-eared bat has been documented as being hard to capture using mist net survey methods. Surveys conducted by Trousdale and Beckett (2001) in southern Mississippi yielded no captures of Rafinesque's big-eared bat, although surveys took place in locations with known roost sites for this species. Lance and Garrett (1997) only had 1 capture for this species during extensive mist net surveys in Louisiana, and Rafinesque's big-eared bat accounted for only 12% (56 individuals out of 464 bats captured) of captures during mist net surveys conducted by Cochran (1999) in Arkansas. A study conducted by Candy Stevenson, Mississippi State University, has shown that there are numerous roost sites for Rafinesque's big-eared bat at Noxubee NWR, however this species has never been captured on the refuge using mist net survey techniques (Miller 2004, McCartney 2006). Rafinesque's big-eared bats are slow agile flyers with superior echolocation abilities (Harvey et. al. 1999). These factors might give this species the ability to easily avoid mist nets. It is possible that this species occurs in additional areas in Mississippi, particularly those with mature bottomland hardwoods forests and bald cypress swamps, but were not captured due to limitations of current survey techniques.

Southeastern myotis was captured at 6 study areas during the survey period (Camp Shelby, St. Catherine Creek NWR, Noxubee NWR, Meridian NAS, Caney Creek WMA, and Laurel Hill Plantation). These study areas contained more promising habitat for this species out of the 9 study areas surveyed due to the large amount of forested land in each and the amount of bottomland hardwood forests and cypress swamps. Southeastern myotis and Rafinesque's big-eared bat can often be found using the same

foraging and roosting habitats (National Biological Resources 1995, Clark 2000a). Therefore, it is possible that Rafinesque's big-eared bats are also using these study areas, even though they have not been captured. Additional mist net surveys should be conducted, particularly on Noxubee NWR and Caney Creek WMA, to determine usage by Rafinesque's big-eared bat. Chances of capture will be optimized if nets are placed near known roost sites.

Roost Surveys

Abandoned Buildings

Data compiled from this project is consistent with studies conducted by Barbour and Davis (1969) and Harvey et. al. (1999) which show that the majority of known maternal colonies for Rafinesque's big-eared bat are found in abandoned and decayed buildings. This species was found to occupy all 10 of the abandoned buildings surveyed during this project. The 2 largest known maternal colonies for Rafinesque's big-eared bat in Mississippi were found in abandoned buildings. Studies conducted by Harvey et. al. (1999) have shown that this species tends to prefer large, open, and well-lit areas for roosting, making abandoned houses ideal roost sites. Southeastern myotis was found occupying 6 of the same abandoned buildings as Rafinesque's big-eared bat. This is consistent with studies conducted by Clark (2000a) and National Biological Resources (1995), which have shown that Rafinesque's big-eared bat and southeastern myotis have similar geographic and ecological distributions and show a preference for comparable or identical foraging and roosting habitats.

The largest known maternal colony in Mississippi for Rafinesque's big eared bat contained 62 individuals in May 2004 and the second largest colony contained 50 individuals in May 2002. These numbers are consistent with other studies. Studies conducted by Saugey (2007) have shown that the average number of Rafinesque's big-eared bats in maternal colonies in abandoned buildings was 20 – 30 individuals in southern Arkansas. Studies conducted by Harvey et. al. (1999) show that maternal colonies in abandoned buildings usually consist of few to several dozen adults.

Artificial Roosts

Bat houses have become a successful management tool by providing artificial roosts for bats whose natural habitat is declining (Tuttle and Hensley 1993). Roost #1 on St. Catherine Creek NWR contained the second largest maternal colony known for Rafinesque's big-eared bat in Mississippi. Four artificial bat houses were constructed surrounding Roost #1, in an attempt to provide alternative roosting opportunities for that colony. Three bat houses surrounding Roost #1 were designed by Bat Conservation International (BCI) to simulate large hollowed out trees, which Rafinesque's big-eared bat and southeastern myotis tend to prefer as roost sites. All 3 of these bat houses were occupied by at least 1 Rafinesque's big-eared bat several times during the survey period. In May 2006, 1 of the roosts (Roost #9) contained 28 individuals, several of which had been banded in Roost #1 3 years previously. This shows that at least some individuals contained in the maternal colony originally found in Roost #1 had moved to the alternative roost, fulfilling the original objective of providing alternative roost sites for

bats whose natural roosts were declining. A second alternative roost (Roost #10) contained 48 individuals in August 2006. BCI has installed 22 artificial tree roosts in 6 southeastern states. The two alternative roosts at St. Catherine Creek NWR contained the highest numbers of Rafinesque's big-eared bats out of the 22 roosts installed.

The fourth artificial bat house was a shed design that was created by Laura Finn, Bat Conservation International, with specific attributes chosen in an attempt to attract Rafinesque's big-eared bats. The first shed bat house was installed in 1997 in the Disney Wilderness Preserve in Point St. John, Florida and has contained 1 - 12 Rafinesque's big-eared bats (Finn 2002). The shed design bat house at St. Catherine Creek has never been occupied by bats. One of the primary differences between the bat house at Disney Wilderness Preserve and the bat house at St. Catherine Creek NWR is that the bat house at the refuge is located in direct sunlight throughout the day and contains high concentrations of wasps. The bat house at Disney Wilderness Preserve is shaded by trees for most of the day. The high temperatures at the bat house on the refuge could make this structure unsuitable for this species.

Cisterns

Rafinesque's big-eared bats were not observed in any of the 10 cisterns surveyed. Cisterns have been used by this species however in other locations. Cistern studies conducted by Wolters (2006) documented 12 Rafinesque's big-eared bats in 2005 occupying a cistern near Port Gibson, Mississippi. Extensive cistern surveys conducted by Saugey (2007) in southern Arkansas documented several cisterns being used by Rafinesque's big-eared bats with 1 cistern containing 89 individuals in 1998. This species has been documented using cisterns for hibernaculums in the northern states within its range (Harvey et. al. 1999). Further cistern surveys are needed in Mississippi to document use by this species.

The largest known maternal colonies in Mississippi for southeastern myotis were found in cisterns. In 2004, 5,479 bats were recorded emerging from a cistern on Laurel Hill Plantation. Five-thousand six-hundred and ninety-one individuals were recorded emerging from 1 cistern and 6,486 were recorded from a second cistern on Hollywood Plantation. Excluding caves in Florida, these are 3 of the largest known colonies for this species in the entire Southeast. Few cistern surveys have occurred in other southeastern states and no other cisterns have been found to contain southeastern myotis. As a result, the large numbers of southeastern myotis found in cisterns in Mississippi during this study is a unique and substantial finding. It is also of great interest that all three of the occupied cisterns were maternal colonies being used year round by both males and females. To my knowledge, maternal colonies containing both males and females have never been documented for southeastern myotis in any roost type.

Culverts

Only 2 out of 8 culverts surveyed for this study were occupied by Rafinesque's big-eared bat individuals. It is of interest that 5 individuals were observed in a culvert at Meridian NAS in 2002, but have never been observed since. This species was also not documented at Meridian NAS using mist nets during extensive survey efforts in 2004 –

2005. Additional culvert surveys in Mississippi and other southeastern states are necessary to determine use in areas throughout its' range.

All 8 of the culverts surveyed were being used by southeastern myotis, with 1 confirmed as a maternal colony. Numbers were substantial for this species at Meridian NAS with 584 individuals observed in September 2006.

Caves

Rafinesque's big-eared bat has been documented to use caves as hibernaculums in the northern portions of its range. This species was not observed in any of the 22 caves surveyed in Mississippi. This species prefers large open roosts (Harvey et. al. 1999) so it is possible that Mississippi caves are not large enough to be attractive roost sites for this species.

Two of the 22 caves surveyed were being used by southeastern myotis, 1 of which was confirmed to be a maternal colony. Southeastern myotis are commonly found in caves in other states within its range. Gore and Hovis (1992) have documented 15 maternal colonies in Florida caves. Cave occupancy might be diminished in Mississippi due to the low number of large caves.

Distribution in Mississippi

Due to intensive survey efforts from this project and many others over the last 12 years, county records in the Mississippi Natural Heritage Database have increased from 6 to 22 records for Rafinesque's big-eared bat (Figure 43) and from 5 to 19 records for southeastern myotis (Figure 44). Twelve of these counties are occupied by both species. Large gaps exist, particularly in the middle of the state, where additional surveys are needed.

Rafinesque's big-eared bat and southeastern myotis are documented as preferring BLH forests for foraging and roosting habitat (Horner and Maxey 1998, Clark 2000b, Bat Conservation International 2001, Kentucky Bat Working Group 2003). Data obtained from this study shows that these species were found utilizing BLH and swamp forests as well as upland mixed hardwood forests and upland mixed hardwood pine forests. The 2 largest known maternal colonies for Rafinesque's big-eared bat in Mississippi are located in upland mixed hardwood pine forests. Recent studies conducted by Medlin (2007) have also shown Rafinesque's big-eared bat utilizing drier forests more frequently than previously believed. Medlin found this species to be using oak-hickory and pine forests as well as BLH forests. Further research needs to be conducted to ascertain habitat preferences more thoroughly for these species.

Conservation

Preservation of Known Roosts

The preservation of known roost sites is critical for conservation efforts to be effective for Rafinesque's big-eared bat and southeastern myotis. Bats spend over half of their time in roosts, which are considered a limiting factor for these two species (Clark 2000a). The largest known maternal colonies for Rafinesque's big-eared bat in Mississippi are located in abandoned buildings. These structures are unstable and in a



Figure 43. County records documented in the Mississippi Natural Heritage Database for Rafinesque's big-eared bat.



Figure 44. County records documented in the Mississippi Natural Heritage Database for southeastern myotis.

continuous state of decay. If stabilization of the buildings is not feasible, it is essential to provide artificial roosts nearby for these colonies to move to when the buildings are no longer suitable. This study has shown that artificial roosts constructed near known roosts can effectively provide alternative roost sites for this species.

Excluding cave sites in Florida, 3 of the largest known colonies for southeastern myotis in the Southeast were found in cisterns in Mississippi. It is essential that these sites be preserved. If something were to happen to these roost sites, there are few structures, either natural or man-made, in Mississippi of equal size that could provide these colonies an alternative roost. The property owners where these cisterns are located are very interested in preserving these colonies. The owner of Laurel Hill Plantation granted the Mississippi Department of Wildlife, Fisheries, and Parks a conservation easement in 1998. As a result, I think that these cisterns will be preserved.

Future Research

Additional mist net surveys, particularly in areas of the state that have not been surveyed before, are necessary to better determine distribution for Rafinesque's big-eared bat and southeastern myotis in Mississippi. Figure 45 shows the locations of bat surveys that have been conducted in Mississippi from 1990 – 2007. Large gaps exist in the middle of the state where surveys are greatly needed. Additional mist net surveys in all areas of the state will also help us to better determine foraging habitat preferences for these 2 species.

This study has shown that cisterns and culverts are important roost sites for southeastern myotis in Mississippi. Additional surveys are needed in cisterns and culverts through out the state to determine usage. Once occupied cisterns and culverts are located, data should be collected and analyzed regarding temperature and humidity, structure dimensions, and surrounding habitats in an attempt to determine why some cisterns and culverts are being used by southeastern myotis while others are not.

Twenty-two out of 65 known caves in Mississippi were surveyed during this project. The remaining caves need to be surveyed to determine additional use by Rafinesque's big-eared bat and southeastern myotis. Most of these cave surveys were conducted during the winter months. This survey has shown that some culverts are more commonly used by Eastern pipistrelles in the winter and southeastern myotis in the spring and summer. This could also be true for caves. Ideally, all caves should be surveyed 4 times a year (once per season) to more accurately determine usage. Caves that were documented to contain Eastern pipistrelles in the winter, in particular, should be surveyed in the summer to determine use by southeastern myotis. Additional survey work for Rafinesque's big-eared bat and southeastern myotis could greatly enhance conservation efforts for these special concern species in Mississippi.

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APPENDIX A: ABUNDANCE OF RAFINESQUE'S
BIG-EARED BAT IN 11 ROOSTS, 2002 - 2007

Date	House 1	House 2	House 3	House 4	House 5	House 6	House 7	Roost #8	Roost #9	Roost #10	Roost #11
6/21/2000	60+										
3/16/2002	1	7	2								
3/30/2002	1										
4/12/2002	5										
4/13/2002		2									
4/14/2002	8										
4/27/2002	2										
5/11/2002	0	9	2								
5/15/2002	0	6	1								
5/24/2002	15										
5/25/2002	22	7	1								
5/26/2002	35										
6/7/2002	30										
6/8/2002	20	5	2								
6/9/2002	11										
6/21/2002	22										
6/22/2002		1	2								
6/23/2002	18										
7/6/2002	27	4	1								
7/23/2002	32	5									
7/27/2002	5	7	2								
7/28/2002	6										
8/16/2002	12										
8/17/2002		6	1								
8/30/2002	3			12							
8/31/2002		3	1								
9/1/2002	0			3	1						
9/6/2002	0			8	0						
9/7/2002		7	1	3	0						
9/14/2002	0	5	1	15	0						
9/15/2002		5									
9/16/2002		1		32				Installed 9/02			
9/28/2002	1	4	4	25	0			0			
9/29/2002	0	1	1	12	0	1	1	0			
9/30/2002				4	1						
10/12/2002	2	1	3	13	0	0		0			
10/18/2002				2	0						
10/19/2002	0	2	3	1	0			0			
10/25/2002	3		4	1	0	0	0	0			
10/26/2002	2			0	0			0			
11/15/2002	0	0	2	1	0			0			
12/13/2002	0	1	0	0	0	0	0	0			
2/17/2003	6	1	0	0	0	Torn Down 1/03	Torn Down 1/03	0			
3/8/2003	7			8	0			0			
3/9/2003	0	0	2	5	0			0			

Date	House 1	House 2	House 3	House 4	House 5	House 6	House 7	Roost #8	Roost #9	Roost #10	Roost #11
3/26/2003		2	1	25							
4/15/2003	0	0	0	1	0			0			
4/25/2003	1							0			
4/26/2003	0	1	0	0	0			0			
5/16/2003	13	6	2	0	0			0			
5/23/2003	25			1	0			0			
5/24/2003	17	5	2					0			
5/30/2003	31							0			
5/31/2003		4	2	1	0						
6/7/2003	31			1				0			
6/20/2003	0	10	1	1	0			0			
6/21/2003	0							0			
7/12/2003	50	0	1	25	0			0			
7/26/2003	20	10	2	25	0			0			
8/22/2003	15			1	0			0			
8/23/2003	0			0	0			0			
8/27/2003	0	10	0	0	0			0			
9/2/2003	1	0	0					0			
9/3/2003		8		0	0						
9/6/2003	0	2	1					0			
9/17/2003	0	1	0	0	0			0			
9/18/2003		2									
11/1/2003	0	7	2	1	0			0			
11/20/2003	0	4	1					0			
3/15/2004	0							0			
4/23/2004	0	3						0			
5/22/2004	34							0			
5/23/2004	31			20	1			0			
8/31/2004	30			25	0			0	Installed 8/04	Installed 8/04	Installed 8/04
1/5/2005	26							0			
4/1/2005								0	1	0	1
7/1/2005								0	1	0	1
2/5/2006								0	1	0	1
5/25/2006								0	2	1	28
8/5/2006								0		48	0
3/4/2007								0	2	20	1
5/11/2007								0	3	34	8
5/24/2007								0	2	1	34

**APPENDIX B: ABUNDANCE OF SOUTHEASTERN
MYOTIS IN 5 ROOSTS, 2002 - 2007**

Date	House 1	House 2	House 3	House 4	Roost 5
3/16/2002	0	0	0		
3/30/2002	0				
4/12/2002	0				
4/13/2002		0			
4/14/2002	0				
4/27/2002	0				
5/11/2002	0	0	0		
5/15/2002	0	0	0		
5/24/2002	0				
5/25/2002	0	0	0		
5/26/2002	0				
6/7/2002	0				
6/8/2002	0	0	0		
6/9/2002	0				
6/21/2002	0				
6/22/2002		0	0		
6/23/2002	0				
7/6/2002	0	0	0		
7/23/2002	0	0			
7/27/2002	0	0	0		
7/28/2002	0				
8/16/2002	0				
8/17/2002		0	0		
8/30/2002	0			0	
8/31/2002		0	0		
9/1/2002	0			0	3
9/6/2002	0			0	0
9/7/2002		0	0	0	0
9/14/2002	0	0	0	0	1
9/15/2002		0			
9/16/2002		0		0	
9/28/2002	0	0	0	0	0
9/29/2002	0	0	0	0	0

Date	House 1	House 2	House 3	House 4	Roost 5
9/30/2002				0	0
10/12/2002	0	0	0	0	1
10/18/2002				0	0
10/19/2002	0	0	0	0	0
10/25/2002	0		0	0	0
10/26/2002	1			0	0
11/15/2002	0	0	0	0	0
12/13/2002	0	0	0	0	0
2/17/2003	0	0	0	0	0
3/8/2003	0			0	0
3/9/2003	0	0	1	0	0
3/26/2003		0	0	0	
4/15/2003	0	0	0	0	0
4/25/2003	0				
4/26/2003	0	0	1	0	0
5/16/2003	1	0	0	0	0
5/23/2003	0			0	0
5/24/2003	0	0	0		
5/30/2003	0				
5/31/2003		0	0	0	0
6/7/2003	0			0	3
6/20/2003	0	0	0	0	0
6/21/2003	0			1	5
7/12/2003	0	0	0	0	3
7/26/2003	0	0	0	0	0
8/22/2003	0			0	4
8/23/2003	0			0	1
8/27/2003	0	0	0	0	0
9/2/2003	0	2	0		
9/3/2003		0		0	1
9/6/2003	0	0	0		
9/17/2003	0	0	0	0	1
9/18/2003		0			

Date	House 1	House 2	House 3	House 4	Roost 5
11/1/2003	0	0	0	0	0
11/20/2003	0	0	0		
4/23/2004	0				
5/23/2004	0			0	
8/31/2004	0			0	4
1/5/2005	0				