

**Bat Inventories of Chattahoochee River National Recreation Area, Congaree
National Park, Fort Pulaski National Monument, Fort Sumter National Monument,
and Ocmulgee National Monument**

Final Report

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INTRODUCTION

The Southeast Coast Network consists of 17 park units in North Carolina, South Carolina, Georgia, Florida, and Alabama. This network is one of 32 Inventory and Monitoring Networks created by the National Park Service to implement the Natural Resource Challenge, a plan to determine the status of the parks' natural resources and to monitor the state of these resources over time. Although parks within the networks are grouped by similar geographic and biological characteristics, the 17 parks within the Southeast Coast Network vary considerably. For example, six major ecosystems are represented within these parks, ranging from upland hardwoods to barrier islands. The five Southeast Coast Network parks covered in this report cover a diverse array of ecosystems as well, including upland hardwoods, bottomland hardwoods, rivers and streams, and coastal wetlands.

The goal of the surveys reported here was documentation of 90% of the bat species occurring in five parks within the Southeast Coast Network: Chattahoochee National Recreation Area (CHAT), Congaree National Park (CONG), Fort Pulaski National Monument (FOPU), Fort Sumter National Monument including Charles Pinckney National Historic Site (FOSU), and Ocmulgee National Monument (OCMU). In general, complete species inventories have not been conducted in most of the nation's national parks, particularly the smaller parks (Stohlgren et al. 1995). Among the five parks covered in this report, CONG has received the greatest amount of research (Anonymous 1975) whereas surveys and biological research in the other parks have been limited. No previous bat surveys are known to have been conducted on any of the parks

except for CONG (Mary Bunch, South Carolina Department of Natural Resources, personal communication).

The primary objectives of the current survey were to: 1) develop a list of bat species expected to occur in each park, 2) verify and document the presence of 90% of the bat species within each park, and 3) prepare digital photographic vouchers of each species. Secondary objectives were to: 1) identify and map roost locations of bats within the park, 2) identify and describe foraging areas within the parks by area, and 3) delineate potential bat habitat within the park.

METHODS

A list of expected species was developed for each park. Each species was categorized as: 1) expected, 2) possible but unlikely or rare (e.g., vagrant), 3) not likely to occur, or 4) expected to occur in winter. These lists were based on records of occurrence in Menzel et al. (2000) for CHAT, OCMU, and FOPU; Menzel et al. (2003) for COSW, FOSU, and FOPU; and range maps developed by Bat Conservation International which are part of the National Atlas of the United States (<http://nationalatlas.gov>). For some species, Menzel et al. (2000, 2003) noted occasional or rare occurrences of species in counties adjacent to or near one of the parks. In these cases, species were classified as “possible but unlikely or rare”. In addition to range maps and records of occurrence, the types of habitats and the amounts of habitat types in each park were also considered in the final designations. Therefore, although some parks were within the general range of a species, the lack of specific habitat types in the park may have led to a species being designated as “P” (e.g., Rafinesque’s big-eared bat at FOSU).

Several methods were used to document species occurrence in each park. These included mist-netting, acoustic surveys with bat detectors, and inspection of bridges and buildings that might house bats. The relative use of each technique varied among parks and depended primarily on the availability of good netting sites. To effectively capture bats in mist-nets, nets should be set perpendicular to flyways (e.g., roads, trails, and streams) with over-hanging and side vegetation to funnel bats into the net (Kunz and Kurta 1988). Thus, netting at Fort Sumter and Fort Moultrie was virtually impossible and we relied on acoustic sampling at these sites. Further, it was difficult to set nets in many of the northern units of CHAT. A summary of netting efforts in each park is presented in Table 1.

Mist-nets were set across fly-ways in as many habitat types as possible in each park. Location of each net site was mapped with a Global Positioning System (GPS) and nets were checked every 15 minutes. Nets were usually opened for 3-5 hours depending on bat activity and weather. All captured bats were removed from the net and identified to species. We also recorded sex, age (adult or juvenile), weight, reproductive condition, and additional observations (e.g., unusual parasite load, injuries). Each bat was fitted with a uniquely numbered aluminum lipped band and released. Digital pictures were taken of each species encountered at each site. The majority of sampling occurred during the summers of 2004 and 2005. Some sampling occurred during the fall and late winter/early spring at CONG, FOPU, FOSU, and OCMU.

Radio-transmitters were placed on sensitive species when they were captured to locate their roost sites. Transmitters (0.45 g) were glued to the back of Rafinesque's big-eared bats (*Corynorhinus rafinesquii*) in CONG and OCMU and southeastern myotis

(*Myotis austroriparius*) in CONG. Bats were held for 15-30 minutes to ensure that the radio was securely attached before release. The bats were located in their roosts the following day using a receiver (Communication Specialists, Inc) and a 3-element handheld antenna. The roost was verified by visually locating the bat in the roost or conducting an emergence observation at dusk. We also attempted to locate roosts on as many subsequent days as possible. For each roost tree, we recorded the tree species, diameter at breast height (dbh), tree height, tree status (live or dead), and distance to the closest tree.

AnabatII bat detectors were used to record bats' ultrasonic echolocation calls. Recordings provided two important types of information: 1) species identity of bats using an area, and 2) a relative index of activity at a site. Bat detectors connected to laptop computers were deployed near each net site to record bats that were in the area but not captured in nets. These detectors were operated only during the duration of the netting session. We also used detectors connected to programmable interface modules with compact flash cards (CF-ZCAIMS) to survey bats in areas where netting was not possible. Detectors and CF-ZCAIMS were placed in waterproof containers with a 45° tube (O'Farrell 1998). The containers were attached to tripods set at approximately 1.3 m and oriented in the direction with the least clutter (Weller and Zabel 2002). Detectors were programmed to begin recording at sunset and end recording at sunrise but were not deployed when extended rain was predicted. Units were left at a site for 1-2 nights and the location of each unit was mapped with a GPS.

Analook (Version 4.9j, 2004) was used to analyze the bat calls. Two filters were used to assess bat habitat use: an identification filter and a use/activity filter. Both filters

were designed for bats in the eastern United States. The first filter selected call sequences for identification. This filter selected passes with at least 5 calls that, in general, were search-phase calls (Britzke and Murray 2000). Each file that passed through the identification filter was visually examined and those passes which did not contain search-phase calls were eliminated. Both quantitative and qualitative methods were used to identify the remaining passes to species. A discriminant function model based on a call library of over 23,000 calls was used to identify each call and pass to species (Britzke 2003). Each pass was also qualitatively examined (O'Farrell et al. 1999) to confirm or correct the quantitative identification. To assess bat activity in each habitat, a more liberal filter was used (see Britzke 2003). This filter required that each pass had ≥ 1 calls and allowed lower quality calls to pass the filter. These passes were not identified to species.

We interviewed park personnel, particularly maintenance personnel, regarding the presence of bats in buildings and other structures. We also searched buildings that appeared to be likely roost sites for the presence of bats and guano. Bridges in the parks as well as bridges on public roads near each park were also searched for the presence of bats and guano.

RESULTS AND DISCUSSION

The number of species expected to occur in the parks during summer ranged from four to eight (Table 2). Additional species were designated as possible species or likely winter inhabitants. Although some sampling occurred during fall and late winter/early spring, none of the possible winter migrants were documented. Specific results for each park are presented below.

Chattahoochee River National Recreation Area

The Chattahoochee River National Recreation Area consists of 14 land units along a 48-mile stretch of the Chattahoochee River in Fulton, Cobb, Gwinnett, and Forsyth Counties, Georgia. The park is in the upper Piedmont Physiographic Region and forest types found in the park are primarily hardwood or pine-hardwood. Dominant species are a variety of oaks (*Quercus* spp.), sweetgum (*Liquidambar styraciflua*), red maple (*Acer rubrum*), yellow poplar (*Liriodendron tulipifera*), hickories (*Carya* spp.), elm (*Ulmus* spp), dogwood (*Cornus florida*), loblolly pine (*Pinus taeda*), shortleaf pine (*P. echinata*), and Virginia pine (*P. virginiana*). Because the river follows the Brevard Fault, there are numerous rocky outcrops along the river, particularly in the southern land units (e.g., Vickery Creek and Palisades). The park units are intermixed with suburban areas in the north and more urban development in the south.

Mist-netting was conducted at nine sites in six of the land units (Table 3, Figs. 1-3). Acoustic sampling was conducted in 25 sites within all 14 land units (Table 4, Figs. 1-3). Four species of bats were captured in mist-nets (Table 3): big brown bats (*Eptesicus fuscus*), red bats (*Lasiurus borealis*), a little brown bat (*Myotis lucifugus*), and eastern pipistrelles (*Pipistrellus subflavus*). Big brown bats, red bats, and eastern pipistrelles were also recorded by the bat detectors (Table 4). Although we did not capture evening bats (*Nycticeius humeralis*) in our mist-nets, they were detected acoustically. However, little brown bats were not recorded by the detectors. All of the species captured or recorded were expected species in the park except for the little brown bat (a possible species), and all four of the expected species (big brown bat, red bat, evening bat, and eastern pipistrelle) were documented. The little brown bat was captured

in the northern portion of the Cochran Shoals unit. Although not common in the Piedmont, there is a previous record of little brown bats in Fulton County (Menzel et al. 2000). Sixteen bridges over the Chattahoochee River or its tributaries were inspected. None of these bridges housed bats and no guano was observed.

The bat community of CHAT was clearly dominated by big brown bats. Fifty-five of the 62 bats captured were big brown bats and they were captured at every site netted (Table 3). In addition, their calls were recorded at 21 of the 25 acoustic sampling locations and in all 14 land units. Big brown bats readily use human structures for roosting (Kurta and Baker 1990) and have very flexible foraging habits (Furlonger et al. 1987). They have adapted well to urban environments in the U.S. (Duchamp et al. 2004) and are the most common bat recorded in urban areas in southwestern Ontario (Furlonger et al. 1987). Our netting data suggest that there were several maternity colonies roosting in or near CHAT. For example, a maternity colony was likely roosting near the Jones Bridge Unit because eight of the 10 bats captured there in July 2004 were lactating females. Further, many post-lactating females were captured at Sope's Creek and other sites in the Cochran Shoals unit, and at the Palisades Overlook area in August 2004 and 2005.

Although red bats and eastern pipistrelles were rarely captured, they were commonly recorded by the bat detectors; both species were recorded in 12 of the 14 land units. Red bats roost in the foliage of large hardwood trees, primarily oaks, hickories, yellow poplars, beech (*Fagus* spp.) and sweetgum (Hutchinson and Lacki 2000, Leput 2004, Mager and Nelson 2001). Thus, it is likely that suitable roosting structures were available for red bats in the park as well as in some of the near-by residential areas.

Further, red bats commonly forage on insects that congregate near street lights (Furlonger et al. 1987; Whitaker and Hamilton 1998). Mager and Nelson (2001) suggested that wooded parks, residential areas and riparian corridors provide important roosting habitat for red bats in urban and agricultural settings.

Like the red bat, eastern pipistrelles roost in the foliage of large hardwoods (Leput 2004; Veilleux et al. 2003) although they also roost in buildings (Whitaker 1998). Oaks are the most common species used. Thus, roost trees are probably not limiting in the park or the surrounding area. Little is known about the effects of urbanization on eastern pipistrelles but it appears that they are fairly common throughout CHAT.

No evening bats were captured although they were an expected species. Because there are many records of evening bats in the area (Menzel et al. 2000), their absence in the capture records is notable. However, they were recorded acoustically in seven units, although they were more common in the northern portion of the park (Table 4). Thus, even though they were documented in CHAT, evening bats do not appear to be as common or ubiquitous as big brown bats or even red bats and pipistrelles. Evening bats are more sensitive to urbanization than big brown bats (Duchamp et al. 2004) and their low abundance in CHAT, particularly in the southern portion of the park, may be related to the intense urbanization surrounding CHAT.

Bat activity was recorded in all 14 land units but the level of activity varied considerably among units. The variation in activity did not appear to be related to particular habitats among land units; however, some of the variation appeared to be related to variation among habitats within land units. For example, the median number of bat passes/hour over the Chattahoochee River (3.82) was lower ($P = 0.07$) than over

fields in the same area (18.33 bat passes/hour). Temperatures over the river were often noticeably cooler over the river and fog was common. Both of these factors may have contributed to decreased bat activity over the river compared to other habitats.

In summary, all species expected to occur in CHAT during summer were captured or recorded and one species classified as “possible” was also captured. The park appears to provide suitable habitat for species such as big brown bats, red bats, and eastern pipistrelles. However, the status of evening bats in the area is questionable. All land units provide some foraging habitat for bats. Fields, ponds, and forested areas appear to provide better foraging habitat than the Chattahoochee River.

Congaree National Park

The 8,988 ha Congaree National Park is in the Upper Coastal Plain of South Carolina. The majority of the park consists of floodplain and bottomland hardwood forests and represents the largest remaining tract of old-growth bottomland hardwood forest in the U.S. Frequently flooded areas are dominated by water tupelo (*Nyssa aquatica*), swamp tupelo (*N. sylvatica*), and bald cypress (*Taxodium distichum*) whereas infrequently flooded areas are dominated by sweetgum, American holly (*Ilex opaca*), oaks, ash (*Fraxinus* spp.), red maple, elms, and hickories. The park also supports mixed upland hardwood stands as well as loblolly and longleaf (*P. palustris*) plantations in the drier bluffs in the northern portion of the park. Ninety-eight percent of the park is designated wilderness. Thus, there are few roads and access to many areas is limited.

Mist-netting was conducted at 6 sites (Fig. 4-5). Several of the sites were netted multiple times (Table 5). Thirty-two bats of six species were captured (Table 5). All six species were expected to occur in CONG. Two species, the Seminole bat (*L. seminolus*)

and the Brazilian free-tailed bat (*Tadarida brasiliensis*) were also expected to occur in CONG but were not captured. Seminole bats are commonly associated with pine stands (Carter et al. 2004; Menzel et al. 1998). Although netting was conducted in and near pine and mixed pine-hardwood stands, it was not possible to net near the most mature pine areas in the park. Further, it was not possible to distinguish between the echolocation calls of Seminole bats and red bats. Thus, Seminoles bats may have been in CONG but, due to methodological problems, we were not able to detect them. Mexican free-tailed bats are difficult to capture due to their propensity to fly very high (Wilkins 1989) rendering them out of the range of most mist-nets. We also did not record them acoustically although we were able to record them in FOPU, FOSU, and OCMU. Because Brazilian free-tailed bats in the southeast roost primarily in man-made structures (Wilkins 1989), roosting sites on CONG may be limited. Further, they are strong, fast flyers (Whitaker and Hamilton 1998) and often forage over large rivers and agricultural fields (Best and Geluso 2003, Lee and McCracken 2005). Therefore, they may prefer the open agricultural areas surrounding CONG and the Congaree River itself for foraging rather than the dense forests found in CONG.

Two of the species captured, Rafinesque's big-eared bat and the southeastern myotis, are sensitive species. Rafinesque's big-eared bats are listed as state-endangered and the southeastern myotis is listed as state-threatened. Evidence of breeding colonies was found for both species. All nine southeastern myotis captured in June 2004 and three of the seven adult females captured in June 2005 on the West Boundary Road were lactating, suggesting that there was a maternity colony nearby. Further, one of the southeastern myotis captured at the end of the Service Road was a juvenile. Two juvenile

Rafinesque's big-eared bats were also captured, one of which was radio-tagged and followed to a maternity roost (see below).

Twenty sites were surveyed with bat detectors (Table 6, Fig. 4-5). We attempted to place detectors in a variety of habitats, particularly those which we were not able to net. Activity at all sites was relatively low and there was no statistical difference in mean activity (passes/hour) among habitats ($P = 0.35$). However, activity appeared to be greatest in bottomland hardwood stands and lowest in sweetgum stands (Table 7). Four of the six species captured were also recorded by the bat detectors. Rafinesque's big-eared bats are "whispering bats" and produce low intensity calls (Fenton 1982). Thus, they are rarely picked up by bat detectors using passive sampling (Murray et al. 1999). However, it is surprising that we did not record southeastern myotis because these bats appear to be relatively common in CONG based on capture records.

Red bats and eastern pipistrelles appear to be fairly common on the CONG. They were recorded in a variety of habitats ranging from bottomland hardwoods to pine stands. In contrast, big brown bats and evening bats were surprisingly rare. Only one individual of each species was captured and they were only recorded in pine stands. Evening bats in the Coastal Plain usually roost in longleaf pines, bald cypress, or snags (Menzel et al. 1999, Menzel et al. 2001). Thus, there should be abundant suitable roosting habitat for them on CONG. Few data are available on big brown bat natural roosts in the South. In other parts of the country they use cavities in large trees in mature stands (Betts 1996, Cryan et al. 2001). Therefore, natural roosts should also be abundant for them in CONG. It is not clear why so few big brown bats and evening bats were captured or recorded.

Radio-telemetry was used to locate roosts of southeastern myotis and Rafinesque's big-eared bats. On June 2, 2004 we placed a radio-transmitter on an adult female southeastern myotis captured at the south end of the West Boundary Road. On June 3, the bat was located in a suspected roost tree in a mixed bottomland hardwood stand approximately 1 km away from the capture site (Fig. 6). Unfortunately, the bat was not observed leaving the tree it was thought to be in, and there was no evidence of a maternity colony in the area. Subsequent efforts to locate the bat and the colony failed. On July 6, 2004, an adult male Rafinesque's big-eared bat was captured, radio-tagged, and released near Wise Lake. On July 7 and 8, the bat was found roosting in a large tupelo just south of Cedar Creek and east of Wise Lake (Fig. 6). The roost was 90.5 m from the capture site. The tree was hollow with a basal opening as well as an opening at approximately 10.5 m. The bat was observed roosting at approximately 7.5 m from the ground or about 3 m from the upper opening. On July 13, the bat was located in another tupelo 73 m from the first roost site. A juvenile male Rafinesque's big-eared bat was captured along the entrance road near the after hours parking area on July 7, 2004. The bat was radio-tagged but not located until July 14. It was found in a large tupelo 1.12 km from its capture site near the muck swamp west of the boardwalk (Fig. 6). An emergence observation was conducted at dusk and 23 bats were seen leaving the roost indicating that this was likely a maternity colony roost. The characteristics of each roost are presented in Table 8 and pictures of each roost tree are included on the CD.

In summary, CONG supports a diverse bat community and most importantly, provides optimal habitat for two sensitive species. Both of these species are dependent

on old-growth bottomland hardwood forest in the Coastal Plain. Thus, CONG likely represents an important refuge for these species due to the loss of habitat in other areas.

Fort Pulaski National Monument

Fort Pulaski National Monument contains approximately 2,275 ha. Prior to human settlement, Cockspur and McQueens Islands were primarily salt marsh, although Cockspur Island probably supported some coastal hammock forest (Govus 1998). Since abandonment of the fort in the late 1800's, the upland portions of Cockspur Island have reverted to maritime forest. Currently this area (approximately 101 ha) supports maritime forest, maritime shrub communities, a planted slash pine (*P. elliotii*) stand and maintained grasslands. There are also about 138 ha of tidal marsh on Cockspur Island. The rest of FOPU (approximately 1,983 ha) is primarily salt marsh. The maritime forest is dominated by cabbage palmetto (*Sabal palmetto*), coastal red cedar (*Juniperus virginiana* var. *silicicola*) and sugarberry (*Celtis laevigata*) in the overstory and redbay (*Persea borbonia*) and laurel cherry (*Prunus caroliniana*) in the understory. The tidal marsh areas of Cockspur and McQueens Islands are dominated by *Spartina alterniflora*.

Mist-net surveys were conducted on Cockspur Island and acoustic surveys were conducted on Cockspur Island and McQueen's Island (Fig. 7). Mist net sites were limited even on Cockspur Island and we concentrated our efforts in one area which was fairly productive (Table 9). Eighteen bats representing five species were captured: red bat, Seminole bat, big brown bat, evening bat, and northern yellow bat (Table 9). All five species were expected to occur in FOPU (Table 2). Brazilian free-tailed bats and eastern pipistrelles were not captured although they were expected species. However, both of these species were recorded by the bat detectors (Table 10).

The tree-lined area along the dike appears to be a highly suitable area for bats. All seven species were either detected or captured there. While little bat activity was detected over the marsh south of Highway 80, there was greater activity in marsh areas that were close to wooded areas on Cockspur Island (Table 10). The marsh areas appear to be used primarily by big brown bats and Brazilian free-tailed bats, both of which are strong flyers that often prefer open areas.

The bridge on the entrance road to Cockspur Island and the two bridges on Highway 80 were inspected for the presence of bats in April 2004, July 2004, and March 2005. The bridge on the entrance road has a wood bottom with slats. No bats were observed under the bridge. This type of bridge is rarely used by bats (Lance et al. 2001, McDonnell 2001). Additionally, no bats were observed or heard in the two bridges on Highway 80. Both of these bridges were concrete T-beam girder bridges which are the most commonly used type of bridge in the Coastal Plain (Bennett 2004, Lance et al. 2001, McDonnell 2001). T-beam concrete bridges are preferred primarily because they trap warm air in the interstices between the concrete girders and have reduced light intensity (Ferrara and Leberg 2005). However, both the bridges on Highway 80 are very high and thus, very light and windy. Therefore, these bridges may not be suitable roost sites for bats. We also examined the fort and a few of the maintenance buildings for bats or their guano. No evidence of bats was found in any of these sites.

Despite the relatively small size of FOPU, particularly the forested areas, it supports a relatively diverse bat fauna. Seven species were documented either through capture or acoustic records. All of the species captured or recorded were expected. Although the northern yellow bat was listed as an expected species, its capture in FOPU

is noteworthy. The northern yellow bat is a species of conservation concern in Georgia and very little is known about its status, distribution, and ecology (Webster et al. 1980, Whitaker and Hamilton 1998). Only a few roost sites have been found and these include Spanish moss (*Tillandsia usneoides*) in an oak tree, corn stalk thatching, and palm groves (Baker and Dickerman 1956, Webster et al. 1980). Northern yellow bats are relatively high foragers and often use open or scrubby areas (Whitaker and Hamilton 1998). Thus, FOPU appears to provide suitable roosting and foraging habitat for this rare species.

Fort Sumter National Monument

The Fort Sumter National Monument complex includes three administrative units: Fort Sumter, Fort Moultrie, and Charles Pinckney National Historic Site (CHPI). Fort Sumter is located on a man-made island in the mouth of Charleston Harbor. There are no trees on the island although a dense ground layer covers much of the area not covered by the fort. Fort Moultrie is situated on Sullivan's Island. While there are few trees surrounding the fort, shrubs line the area, particularly on the ocean-side. Some trees also line the parking lot near the visitor's center. CHPI is located in Mount Pleasant. Many mature live oaks (*Q. virginiana*) line the parking lot and the road to the maintenance buildings and barn. Further, many large mature eastern red cedars are scattered around the property.

Both mist-netting and acoustic sampling were conducted at CHPI. Mist-nets were set along the entrance to the parking lot and on the service road, and bat detectors were set at five sites (Fig. 8). No mist-nets were set on Fort Moultrie or Fort Sumter due to the lack of suitable netting sites. However, bat detectors were set at three sites on Fort Moultrie (Fig. 9) and at three sites on Fort Sumter (Fig. 10).

Only one Seminole bat was captured along the service road at CHPI (Table 11). No bats were found in the buildings on site. However, five species or species groups were recorded on the property and there was a considerable amount of bat activity (Table 12). Species recorded at CHPI were the big brown bat, eastern pipistrelle, red or Seminole bat, evening bat, and Brazilian free-tailed bat. In the Coastal Plain, eastern pipistrelles and red bats roost in the foliage of live hardwoods whereas Seminole bats primarily roost in the foliage of live pine trees (Menzel et al. 1998, 1999). Thus, there is probably suitable roosting habitat for eastern pipistrelles and red bats on CHPI as well as in the surrounding area, and suitable roosting habitat in the surrounding area for Seminole bats. The relatively high activity suggests that this area provides good foraging habitat for bats in the area.

Three species or species groups of bats were recorded at Fort Moultrie: the big brown bat, red or Seminole bat, and Brazilian free-tailed bat (Table 12). Greater activity was recorded near the beach and fort than in the parking lot behind the Visitor's Center, even though the parking lot is bordered by more dense vegetation.

Although Fort Sumter has no wooded vegetation and is in the middle of Charleston Harbor, a surprising amount of bat activity was recorded (Table 12). Both of the detectors set on top of the fort recorded bats. Four species or species groups were recorded: the eastern pipistrelle, the red bat or Seminole bat, evening bat, and Brazilian free-tailed bat. Red bats, Seminole bats, and Brazilian free-tailed bats are strong flyers. Red bats make long distance seasonal migrations (Shump and Shump 1982) and have been caught in boat rigging > 65 miles from shore (Mackiewicz and Backus 1956). Seminole bats are thought to make limited north-south migrations (Whitaker and

Hamilton 1998). Although Brazilian free-tailed bats in the eastern U.S. do not make long distance seasonal migrations, they often make long nightly foraging movements of > 50 km (Wilkins 1989). Thus, it is not surprising that these bats were recorded foraging or commuting over Fort Sumter. In contrast, the eastern pipistrelle is a small bat with a low wing-aspect ratio (Farney and Fleharty 1969) suggesting that it is weak but agile flyer (Fenton 1990). Thus, its presence over the fort is somewhat surprising. The fort was inspected for evidence of bats but none were observed. Further, none of the personnel had any knowledge of bats using the fort for roosting.

In summary, Fort Sumter, Fort Moultrie, and Charles Pinckney Historic Site provided foraging and commuting habitat for at least five bat species. CHPI may also provide roosting habitat for red bats, Seminole bats, and eastern pipistrelles.

Ocmulgee National Monument

The 284 ha Ocmulgee National Monument is located on the Fall Line which is the juncture of the Piedmont and Coastal Plain Physiographic Regions. Forest types within the park are mixed pine-hardwood, upland hardwood, bottomland hardwood, and loblolly-shortleaf pine forest (Froeschauer 1989). Dominant species in the uplands include loblolly and shortleaf pine, blackjack oak (*Q. marilandica*), southern red oak (*Q. falcata*), white oak (*Q. alba*), hickories, sassafras (*Sassafras albidum*), hackberry (*C. tenuifolia*), hawthorn (*Crataegus* spp.), sweetgum, elm, red maple, southern magnolia (*Magnolia grandiflora*), black cherry (*P. serotina*), and dogwood. Dominant species in the bottomland hardwood forests include sweetgum, beech, water oak (*Q. nigra*), willow oak (*Q. phellos*), yellow poplar, Florida maple (*A. barbatum*), green ash (*F.*

pennsylvanica), hackberry, and sycamore (*Plantanus occidentalis*). In addition there are many open fields throughout the park and wetlands along the river.

Mist-netting was conducted at four sites and acoustic sampling was conducted at 18 sites (Fig. 11). Sixteen bats of five species were captured in mist nets (Table 13): the big brown bat, Rafinesque's big-eared bat, red bat, Seminole bat, and evening bat. Two additional species, the eastern pipistrelle and Brazilian free-tailed bat, were recorded by the bat detectors. Thus, all of the expected species were captured or recorded.

Rafinesque's big-eared bat was designated as a possible species. This is the first record of Rafinesque's big-eared bats in central Georgia (Menzel et al. 2000) although they have been found in similar habitats near the Fall Line in South Carolina (Bennett 2004, Menzel et al. 2003).

Bat activity was detected in all sites sampled. There was considerable variation among sites sampled but this did not appear to be related to habitat type. High activity was found in bottomland forest and fields surrounded by pine-hardwood, upland hardwood, and bottomland hardwood forests (Table 14). However, low activity was found in some of these same site types. Bat activity is highly variable in space and time (Hayes 1997) due to nightly variation in temperature and insect availability. Thus, the variation among habitats probably reflects the high spatial and temporal variability of bat activity.

Big brown bats were the most numerous species captured and they were recorded at 14 of the acoustic sampling sites. Red bats or Seminole bats were also commonly recorded (12 sites). Both big brown bats and red bats appear to have adapted well to urban environments (Duchamp et al. 2004, Mager and Nelson 2001). Eastern pipistrelles

and evening bats were not recorded as frequently as big brown bats and red/Seminole bats, but were still recorded in a diversity of habitats (Table 14). Brazilian free-tailed bats are primarily found in the Coastal Plains of Georgia (Menzel et al. 2000) although they are becoming increasingly common in the Piedmont. They have also adapted well to urban environments and roost almost exclusively in man-made structures in the south.

We radio-tagged one of the adult female Rafinesque's big-eared bats captured on March 21, 2005. The female was located the following day in a large yellow poplar (dbh = 1.05 m, height = 24.4 m) located in a mixed hardwood stand near a drain (Fig. 9). The tree had a small opening at the base and a cavity at approximately 12 m. Although we conducted an emergence observation at the tree the evening of March 22, we were not able to determine which cavity the bat was using or how many bats were roosting with it. However, we suspect that there was a maternity colony on OCMU because two adult females were captured in the net at the same time. Unfortunately, we were not able to locate the bat the next day or the following week.

In summary, OCMU harbors a diverse bat community despite its urban setting. Its location on the Fall Line may increase its diversity due to the presence of both Coastal Plain and Piedmont species. Further, the diversity of habitat types ranging from pine forests to bottomland hardwoods, provide roosting and foraging habitat for a variety of bat species. The presence of big-eared bats suggests that large hollow trees and the bottomland forest are important features for future management and conservation.

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Table 1. Summary of netting efforts in CHAT, CONG, FOPU, FOSU, and OCMU during spring, summer, and fall 2004-2005.

	CHAT	CONG	FOPU	FOSU	OCMU
Number of sites netted	9	6	2	1	4
Number of nights	13	10	5	3	7
Number of net nights	39	32	14	10	16

Table 2. List of possible and expected species in each park unit. Species are designated as expected to occur (E), possible but unlikely or rare (P), not expected to occur (N), expected to occur during winter (W). Bold-face letters indicate the species was documented in the park.

Species	CHAT	CONG	FOPU	FOSU	OCMU
Rafinesque's big-eared bat <i>Corynorhinus rafinesquii</i>	N	E	P	P	P
Big brown bat <i>Eptesicus fuscus</i>	E	E	E	E	E
Silver-haired bat <i>Lasionycteris noctivagans</i>	W	W	W	W	W
Red bat <i>Lasiurus borealis</i>	E	E	E	E	E
Hoary bat <i>Lasiurus cinereus</i>	W	W	W	W	W
Northern yellow bat <i>Lasiurus intermedius</i>	N	N	E	P	N
Seminole bat <i>Lasiurus seminolus</i>	P	E	E	E	P
Southeastern myotis <i>Myotis austroriparius</i>	P	E	P	P	P
Little brown bat <i>Myotis lucifugus</i>	P	N	N	N	N
Northern long-eared bat <i>Myotis septentrionalis</i>	P	N	N	N	N
Evening bat <i>Nycticeius humeralis</i>	E	E	E	E	E
Eastern pipistrelle <i>Pipistrellus subflavus</i>	E	E	E	E	E
Mexican free-tailed bat <i>Tadarida brasiliensis</i>	P	E	E	E	E

Table 3. Mist net sites, site description, and number of bats captured at each site on the Chattahoochee River National Recreation Area, June-August 2004 and July, 2005. Site numbers correspond to numbers on map (N1 – N9; Figs.1-3).

Land Unit	Site #	Site Name	Date	Habitat Type, and Description of Survey of Location	Big Brown Bat		Red Bat		Little Brown Bat		Eastern Pipistrelle		Total
					Bat	Bat	Bat	Bat	Bat	Bat	Bat	Bat	
Bowman's Island	1	Bowmans Island	6/16/04 6/22/04	Oak/hickory. Nets on both sides of field and along wooded road from hatchery.	1								1
Medlock Bridge	2	Medlock Bridge	6/17/04	Hardwood. Nets on entrance road, at junction of road & parking lot, and between parking lot & river.	2						1		3
Jones Bridge	3	Jones Bridge	6/23/04	Hardwood. Nets across parking lot, right of way, and on wooded road NW of parking lot.	10								10
Island Ford	4	Island Ford	8/3/04	Upland hardwood. Nets at end of road from HQ, across boat ramp, and at trail heads.	4					1			5
Cochran Shoals	5	Sope's Creek	8/4/04 7/20/05 7/21/05	Bottomland hardwood. Nets on trail from parking lot to pond and on trail on far side of pond.	23		3						26
Cochran Shoals	6	Cochran Shoals No.	8/5/04 7/19/05	Upland hardwood. Nets on walking trails from parking lot and across right-of-way.	4				1				5
Cochran Shoals	7	Cochran Shoals So.	8/9/04	Upland hardwood. Nets along walking trails and across small trail to river.	2		1						3
Palisades	8	Palisades Overlook	8/10/04	Upland hardwood. Nets along woods road to parking lot.	6								6
Palisades	9	Palisades West	8/11/04	Upland hardwood. Road leading to field, on road ½-way between field & parking lot, and on trail to river	3								3
Total					55		4		1		2		62

Table 4. Acoustic sampling sites, site descriptions, number of recording hours, total number of bat passes recorded, and species recorded using Anabat II bat detectors during bat surveys in Chattahoochee River National Recreation Area, June-August, 2004 and July 2005. Site numbers correspond to numbers on map (A1—A25; Figs. 1-3).

Land Unit	Site #	Site Name	Date	Habitat Type and Description of Survey Site	Total Recording Time (h)	Total bat passes	Big Brown Bat	Red Bat	Evening Bat	Eastern Pipistrelle
Bowmans Island	1	Bowmans Island North	7/20/05	Upland Hardwood; detector set in forest	9.75	213	+	+	+	+
Bowmans Island	2	Bowmans Island Field	6/16/04 6/22/04	Hardwood-pine; detector set in field	11.25	223	+			+
Bowmans Island	2	Bowmans Island River	6/16/04 6/22/04	Upland Hardwood-Pine; detector set adjacent to river;	4.25	10	+			
Settles Bridge	3	Wild Timber	7/27/05	Pine-hardwood; detector set in field	10.25	431	+	+		+
Settles Bridge	4	Settle's Bridge	7/20/05	Hardwood; detector set in right-of-way	9.83	107		+	+	+
McGinnis Ferry	5	Rivermoore	7/21/05	Hardwood; detector set in field	9.58	280	+	+	+	+
McGinnis Ferry	6	McGinnis Ferry	7/27/05	Pine-hardwood; detector set in forested area	10.17	212	+	+		+
Suwannee Creek	7	Suwannee Creek	7/21/05	Hardwood; detector set adjacent to River	9.83	59	+	+		+
Abbot's Bridge	8	Abbot's Brdg River	7/26/05	Hardwood; detector set adjacent to River	9.67	29	+	+		+

Table 4. con't

Land Unit	Site #	Site Name	Date	Habitat Type and Description of Survey Site	Total Recording Time (h)	Total bat passes	Big Brown Bat	Red Bat	Evening Bat	Eastern Pipistrelle
Abbots' Bridge	9	Abbot's Bridge Field	7/26/05	Hardwood; detector set in field	9.92	111	+	+	+	+
Medlock Bridge	10	Medlock Bridge	6/17/04	Hardwood; detector set in parking area;	3.00	63	+	+		+
Medlock Bridge	10	Medlock Bridge	6/17/04	Hardwood; detector set along River	3.00	123	+	+		+
Jones Bridge	11	JB Parking	6/23/04	Hardwood; detector set in parking lot	3.50	59	+	+		
Jones Bridge	11	Jones Bridge River	6/23/04	Hardwood; detector set adjacent to river.	3.50	13	+	+		+
Jones Bridge	12	Barnwell	7/27/05	Hardwood; detector set over pond	9.33	1164	+	+	+	
Holcomb Bridge	13	Holcomb Bridge	7/26/05	Pine-hardwood; detector set in opening near right-of-way	10.00	203	+	+		+
Island Ford	14	Island Ford Field	8/3/04	Hardwood; detector set in field at end of road from HQ to river	4.50	407	+	+	+	+
Island Ford	14	Island Ford River	8/3/04	Hardwood; detector set along River	4.50	150	+	+		

Table 4. con't.

Land Unit	Site #	Site Name	Date	Habitat Type and Description of Survey Site	Total Recording Time (h)	Total bat passes	Big Brown Bat	Red Bat	Evening Bat	Eastern Pipistrelle
Vickery Creek	15	Vickery Creek	7/19/05	Hardwood; detector set adjacent to River	9.25	146	+	+	+	+
Vickery Creek	16	Abbot's House	7/25/05	Hardwood; detector set in opening	9.33	354	+	+		+
Gold Branch	17	Gold Branch	7/25/05	Pine-hardwood; detector set in opening	9.75	166	+	+		+
Johnson Ferry	18	Johnson Ferry North River	7/19/05	Hardwood; detector set on River	9.17	36	+			
Johnson Ferry	19	Johnson Ferry North Field	7/19/05	Hardwood; detector set in fields 30-40 m from the River	9.75	54	+			
Cochran Shoals	20	Sope's Creek	8/4/04	One detector set adjacent to pond.	4.75	99	+	+		+
Cochran Shoals	21	Cochran Shoals North2	7/19/05	Hardwood; detector set in open area	4.00	86		+		
Cochran Shoals	22	Cochran Shoals North1	8/5/04 7/19/05	Hardwood; detector set adjacent to river.	8.25	35	+			+
Cochran Shoals	23	Cochran Shoals South	8/9/04	Hardwood; detector set adjacent to river.	4.75	19				

Table 4. con't.

Land Unit	Site #	Site Name	Date	Habitat Type and Description of Survey Site	Total Recording Time (h)	Total bat passes	Big Brown Bat	Red Bat	Evening Bat	Eastern Pipistrelle
Palisades	24	Overlook Parking Lot	8/10/04	Hardwood; detector set in parking lot	4.50	15	+	+		
Palisades	24	Overlook Field	8/10/04	Hardwood; detector set in field.	4.50	38	+			
Palisades	25	Palisades West	8/11/04	Hardwood; detector set in field	4.50	56	+			
Palisades	25	Palisades West	8/11/04	Hardwood; detector set in adjacent to River	4.50	15	+			

Table 5. Mist net sites, site description, and bats captured at each site on the Congaree National Park, June, July, and October 2004 and June 2005. Site numbers correspond to numbers on map (N1 – N6; Figure 4).

Site	Site #	Date	Habitat Type and Description of Survey of Location	Big Brown Bat	Rafinesque's Big-eared bat	Red Bat	South-eastern Myotis	Evening Bat	Eastern Pipistrelle	Total
Service Rd. near Weston Lake Trail	1	6/1/04 6/13/05	Bottomland Hardwood. Nets set across road north of boardwalk near cypress stand and at juncture of road and boardwalk	1				1		2
West Boundary Rd.	2	6/2/04 6/14/05 6/15/05	Mixed hardwood. Nets set at end of road. One net set at river access, other nets set across road slightly north of river.				17			17
Road behind Learning Center	3	6/2/04 10/1/04	Loblolly pine. Nets set across road through recently burned pine stand.			1				1
End of Service Road near Wise Lake	4	7/6/04 6/14/05	Bottomland hardwood. Nets set on Service Road and on trails leading out from wildlife opening to Wise Lake and Weston Lake Trail		2		4		1	7
After Hours Parking Lot	5	7/7/04 10/2/04	Nets set on road leading from After Hours Parking Lot to Entrance Road and across Entrance Road		1	2			1	4
Cedar Creek at S. Cedar Creek Rd.	6	7/8/04	Nets set across Cedar Creek just east of bridge			1				1
Total				1	3	4	21	1	2	32

Table 6. Acoustic sampling sites and species recorded by Anabat II bat detectors during bat surveys in Congaree National Park, June-July, 2004. Site numbers correspond to numbers on map (A1—A20; Fig. 4).

Site	Site #	Date	Habitat Type and Description of Survey Site	Total Recording Time (h)	Total bat passes	Big Brown Bat	Red Bat or Seminole Bat ¹	Evening Bat	Eastern Pipistrelle
Service Rd. near Boardwalk to Weston Lake	1	6/1/04	Bottomland hardwood; on Service RD north of boardwalk	1.25	7				
Far Boardwalk near Service Rd.	2	6/1/04	Bottomland hardwood; at bridge on Boardwalk just east of road	3.50	86		+		+
Longleaf pine stand at end of Garrick Rd.	3	7/8/04	Pine; set in center of stand	10.00	19	+	+		
Loblolly stand behind Learning Center	4	6/2/04	Pine; detector set within stand south of road	9.75	4				+
Wise Lake	5	7/6/04	Tupelo; set next to Wise Lake	4.75	123				+
End of Service Road near Wise Lake	6	7/6/04	Bottomland hardwood; detector set in field at end of service road.	4.75	16		+		+
After Hours Parking Lot	7	7/7/04	Nets set at entrance to After Hours Parking Lot and across Entrance Rd.	4.50	4				

¹Not able to distinguish calls of red bats and Seminole bats

Table 6. Con't.

Site	Site #	Date	Habitat Type and Description of Survey Site	Total Recording Time (h)	Total bat passes	Big Brown Bat	Red Bat or Seminole Bat ¹	Evening Bat	Eastern Pipistrelle
Cypress Stand on Boardwalk south of HQ	8	7/7/04	Set amongst mature cypress trees	10.00	37		+		+
COSW1	9	6/13/05	Tupelo stand	10.25	49				
COSW2	10	6/13/05	Tupelo stand	10.25	15		+		
COSW3	11	6/14/05 6/15/05	Bottomland Hardwood stand	20.50	40		+		+
COSW4	12	6/14/05 6/15/05	Pine stand	20.50	13				
COSW5	13	6/14/05 6/15/05	Upland mixed hardwood stand	20.50	69		+		
COSW6	14	8/9/05	Upland hardwood stand	10.25	0				
COSW7	15	8/9/05	Bottomland hardwood stand	10.25	3				
COSW8	16	8/9/05 8/10/05	Bald cypress stand	20.50	1				
COSW9	17	8/9/05 8/10/05	Bald cypress stand	20.50	37		+		
COSW10	18	8/10/05	Pine stand	10.25	68		+	+	+

¹Not able to distinguish calls of red bats and Seminole bats

Table 6. Con't.

Site	Site #	Date	Habitat Type and Description of Survey Site	Total Recording Time (h)	Total bat passes	Big Brown Bat	Red Bat or Seminole Bat ¹	Evening Bat	Eastern Pipistrelle
COSW11	19	8/11/05	Sweet gum stand	10.25	7		+		
COSW12	20	8/11/05	Sweet gum stand	10.25	2				

¹Not able to distinguish calls of red bats and Seminole bats

Table 7. Mean activity (passes/hour) in various habitat types on the Congaree National Park in June-July 2004 and June-August 2005.

Habitat Type	Number of Sites Sampled	Mean	S.E.
Cypress	5	1.50	0.67
Tupelo	2	3.12	1.66
Bottomland Hardwood	7	9.09	4.22
Sweet Gum	2	0.44	0.24
Upland Mixed Hardwood	3	2.24	1.36
Pine	5	2.04	1.18

Table 8. Characteristics of Rafinesque's big-eared bat roosts in the Congaree National Park, July 2004.

	Roost #1	Roost #2	Roost #3
Roost occupants	Solitary male	Solitary male	Maternity colony
Tree species	Tupelo	Tupelo	Tupelo
Tree Height	25.9 m	27.4	39.3 m
DBH (at 1.4 m)	0.92 m	3.63 m	3.58 m
Diameter where trunk narrows above basal opening	0.92 m	3.16 m	3.58 m
Number of basal openings	2	1	0
Height of main basal opening	1.1 m	1.9 m	
Height of upper opening or cavity	10.5 m	11.0	14.3

Table 9. Mist net sites, site description, and bats captured at each site on the Fort Pulaski National Monument, August 2004 and March 2005. Site numbers correspond to numbers on map (N1 – N2; Fig. 6).

Site	Site #	Date	Habitat Type and Description of Survey of Location	Big Brown Bat	Red Bat	Northern Yellow Bat	Seminole Bat	Evening Bat	Total
Dike west of Fort	1	7/20/04	Maritime forest. Nets set across dike	1	4	1	11	1	18
		7/22/04	and trail just north of Main Road and						
		3/23/05	South of Main Road across utility road						
		3/24/05	on 7/20; two nets set across dike north of Main Road and across trail to picnic area on 7/22.						
Fire Rd ¹	2	7/21/04	Maritime forest. Nets set along fire road in forested area east of Pilot's Station.						

¹No bats were captured at this site.

Table 10. Acoustic sampling sites and species recorded by Anabat II bat detectors during bat surveys in Fort Pulaski National Monument, July 2004 and March 2005. Site numbers correspond to numbers on map (A1 – A9; Fig. 6).

Site	Site #	Date	Site Description	Total Recording Time (h)	Total bat passes	Big Brown Bat	Eastern Pipistrelle	Red Bat/ Seminole Bat ¹	Evening Bat	Brazilian Free-tailed Bat
SW corner of dike	1	7/19/04 3/24/05	Marshy area adjacent southwest corner of dike	21.75	32	+				+
Fields along Fire Road	2	7/19/04	Open fields next to wooded area between fire road and trail to picnic area ¹	9.75	0					
Trail to Picnic Area	3	7/20/04 7/22/04 3/23/04 3/24/05	Intersection of dike road and nature trail	34.50	308	+	+	+	+	+
Marsh north of Fire Rd.	4	7/21/04	Open marshy area	3.75	27	+	+			+
Fields Btw HQ and Fire Rd.	5	7/21/04	Open fields	3.75	20	+		+		
Fresh water Pond	6	7/22/04	Fresh water pond between entrance road and utility line	5.75	67	+	+	+		
S. of Hwy 80 Site 1	7	7/21/04	Marsh	0						

¹ Not able to distinguish between calls of red bats and Seminole bats

Table 10. Con't.

Site	Site #	Date	Site Description	Total Recording Time (h)	Total bat passes	Big Brown Bat	Eastern Pipistrelle	Red Bat/ Seminole Bat ²	Evening Bat	Brazilian Free-tailed Bat
S. of Hwy 80 Site 2	8	7/22/04	Marsh	0						
S. of US 80 Site 3	9	3/24/05	Set facing open marsh ¹	12.00	16			+		

Table 11. Mist net sites, site description, and bats captured at each site on Charles Pinckney National Historic Site, August 2005.

Site	Date	Habitat Type and Description of Survey of Location	Seminole Bat
Service Road to sheds	8/2/05	Live Oak/palmetto. Nets set at each end of the Service Road	1
	8/3/05		
	8/4/05		

Table 12. Acoustic sampling sites and species recorded by Anabat II bat detectors during bat surveys in Fort Sumter National Monument including Fort Moultrie and Charles Pinckney National Historic Site, August 2005. Site numbers correspond to numbers on map (A1 – A11; Figs. 7-9).

Site	Site #	Date	Site Description	Total Recording Time (h)	Total bat passes	Big Brown Bat	Eastern Pipistrelle	Red Bat Seminole Bat ¹	Evening Bat	Brazilian Free-tailed Bat
CHPI Barn	1	3/28/05 8/4/05	Hardwood; detector set in field near barn at end of Service Road	22.0	135			+	+	+
CHPI Field	2	8/2/05	Hardwood; Field	9.75	154		+	+	+	+
CHPI House	3	8/4/05	Hardwood; detector set near main house	9.83	149	+		+	+	+
CHPI Parking Area	4	8/2/05	Hardwood; detector set in parking area	9.75	98	+		+		+
CHPI Road to Barn	5	3/28/05	Hardwood; detector set on service road to barn	12.33	16			+		
Fort Moultrie Beach	6	3/29/05 8/1/05	Hardwood; detector set on beach area	22.16	131			+		+
Fort Moultrie Parking Lot	7	3/29/05 8/3/05	Hardwood; detector set in parking lot behind Visitor's Center	22.43	33	+		+		
NE side of Fort Moultrie	8	3/29/05 8/1/05	Set in field on northeast side of the fort	22.08	101			+		+

¹ Not able to distinguish calls of red bats and Seminole bats

Table 12. Con't.

Site	Site #	Date	Site Description	Total Recording Time (h)	Total bat passes	Big Brown Bat	Eastern Pipistrelle	Red Bat Seminole Bat ¹	Evening Bat	Brazilian Free-tailed Bat
Fort Sumter Huger Roof	9	8/2/05 8/3/05 8/4/05	Set on roof of Fort.	30.75	127		+	+	+	+
Fort Sumter Morris Island Side	10	8/2/05 8/3/05 8/4/05	Set in open area	30.75	0					
Fort Sumter Officer's Barracks	11	8/2/05 8/3/05 8/4/05	Set on top of Officer's Barracks area	30.75	152			+		+

¹ Not able to distinguish calls of red bats and Seminole bats

Table 13. Mist net sites, site description, and bats captured at each site on the Ocmulgee National Monument, March, June and August 2005. Site numbers correspond to numbers on map (N1 – N4; Fig. 10).

Site	Site #	Date	Habitat Type and Description of Survey of Location	Big Brown Bat	Rafinesque's Big-eared Bat	Red Bat	Seminole Bat	Evening Bat	Total
Woods Road south of Manager's House.	1	3/21/05 6/27/05 8/15/05	Pine-hardwood. Nets set along woods road between house and main road and along flyway into field east of house.	6	2		1		9
Foot path from Visitor's Center	2	6/28/05	Pine-hardwood. Nets set along foot path. One net set near Visitor's Center, others set near fields.	1					1
Prehistoric Trench Site	3	6/29/05	Bottomland Hardwood/fields. Nets set along gravel trail to prehistoric trench and along trail that crosses the creek.						
Near Loop Trail	4	8/16/05 8/17/05	Bottomland hardwood and pine. One net set across road, other across trail	3		1	1	1	6
Total				10	2	1	2	1	16

Table 14. Acoustic sampling sites and species recorded by Anabat II bat detectors during bat surveys in Ocmulgee National Monument in March, June, and August 2005. Site numbers correspond to numbers on map (A1 – A18; Fig. 10).

Site	Site #	Date	Site Description	Total Recording Time (h)	Total bat passes	Big Brown Bat	Eastern Pipistrelle	Red Bat Seminole Bat ¹	Evening Bat	Brazilian Free-tailed Bat
OCMU1	1	8/15/05	Pine-hardwood; detector set in open field	10.75	150	+	+	+	+	+
OCMU2	2	8/15/05	Bottomland hardwood; detector set in forested area	10.75	137	+	+	+	+	+
OCMU3	3	8/15/05	Bottomland hardwood; detector set in forested area	10.75	68	+	+	+	+	
OCMU4	4	8/15/05	Upland hardwood; set in field with a few trees	10.25	7					
OCMU5	5	8/15/05	Hardwood; set in field surrounded by forest	10.25	83	+		+		
OCMU6	6	8/16/05	Hardwood; set in field near drain	10.25	23	+				
OCMU7	7	8/16/05	Hardwood; set in parking lot	10.25	41	+			+	
OCMU8	8	8/16/05	Bottomland hardwood; set in field near drain	10.25	88	+	+	+		+
OCMU9	9	8/16/05	Pine-hardwood; detector set near junction of power line and railroad crossing	10.75	41		+	+	+	

¹ Not able to distinguish calls of red bats and Seminole bats

Table 14. Con't.

Site	Site #	Date	Site Description	Total Recording Time (h)	Total bat passes	Big Brown Bat	Eastern Pipistrelle	Red Bat Seminole Bat ¹	Evening Bat	Brazilian Free-tailed Bat
OCMU10	10	8/16/05	Hardwood; detector set by road near loop trail	0.17	8					
OCMU11	11	8/17/05	Pine-hardwood; set near Work Center	10.25	35					
OCMU12	12	8/17/05	Pine-hardwood; detector set in forest	10.25	8	+				
OCMU13	13	8/17/05	Hardwood; detector set in drain near Visitor's Center	10.25	12	+	+	+		
OCMU14	14	8/17/05	Hardwood; detector set at crossing of railroad and Walnut Creek	10.25	114	+	+	+		
OCMU15	15	8/17/05	Detector set near Great Temple Mound	10.75	78	+	+	+		+
Field south of Super's house	16	3/21/05	Field between Superintendent's house, main road, and woods road	12.10	67	+		+		+
Trench Site	17	6/29/05	Open area; detector set near prehistoric trenches	4.50	40	+		+		
Visitor's Center	18	6/28/05	Hardwood; detector set on asphalt trail leading from Visitor's Center	3.50	26	+		+		

¹ Not able to distinguish calls of red bats and Seminole bats

Anabat and Netting Locations 2004-2005

Chattahoochee River National Recreation Area

(Northeast Section)

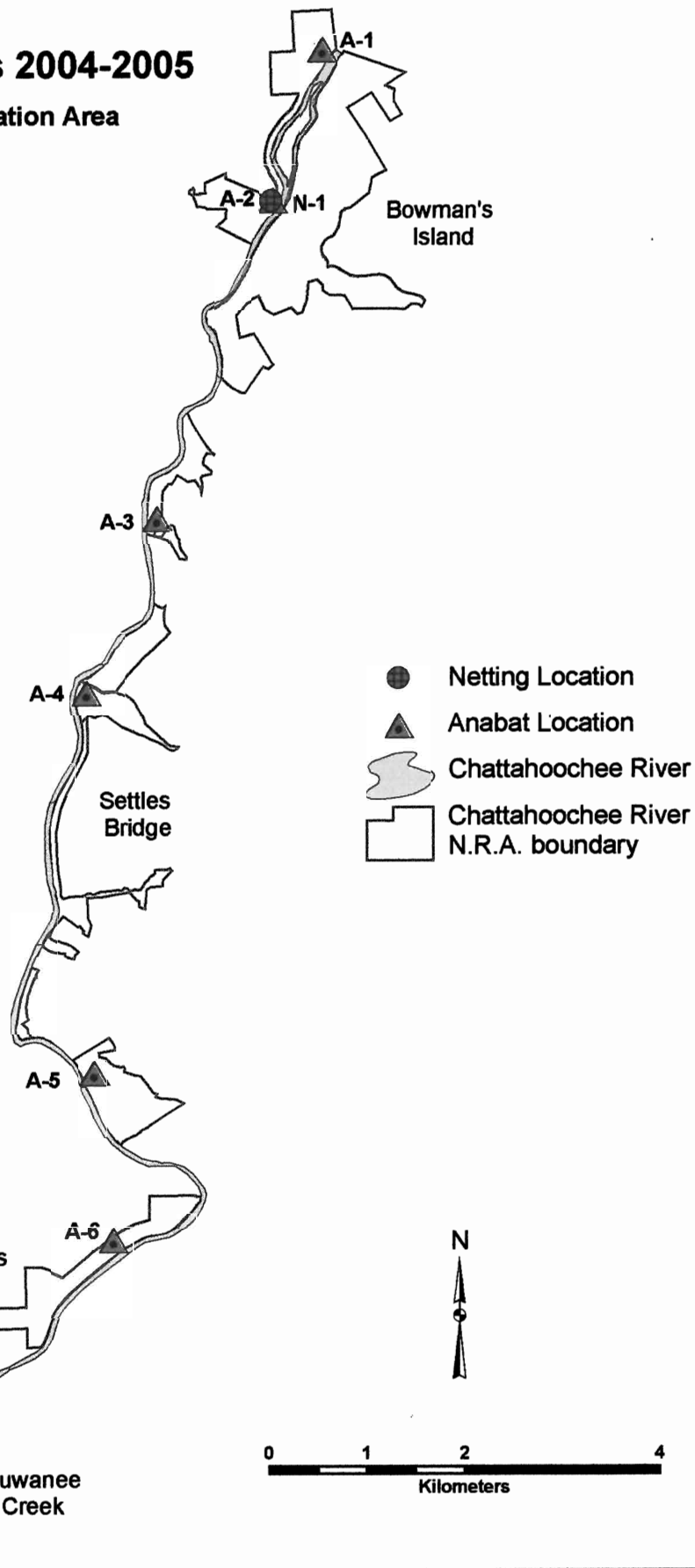
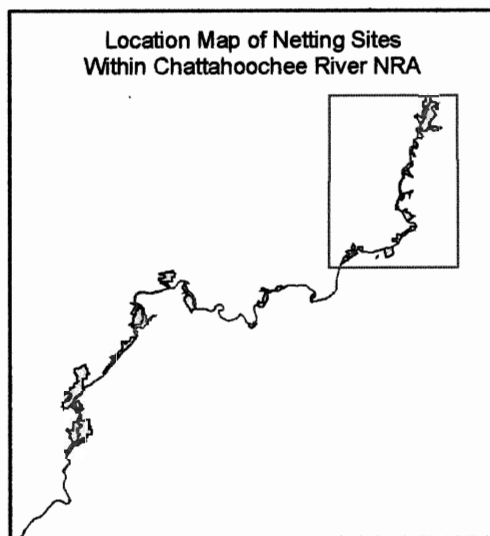


Fig. 1. Bat survey points in the northern section of the Chattahoochee River National Recreation Area June-August 2004-2005. See Tables 3 and 4 for a description of each site.

Anabat and Netting Locations 2004-2005

Chattahoochee River National Recreation Area

(Middle Section)

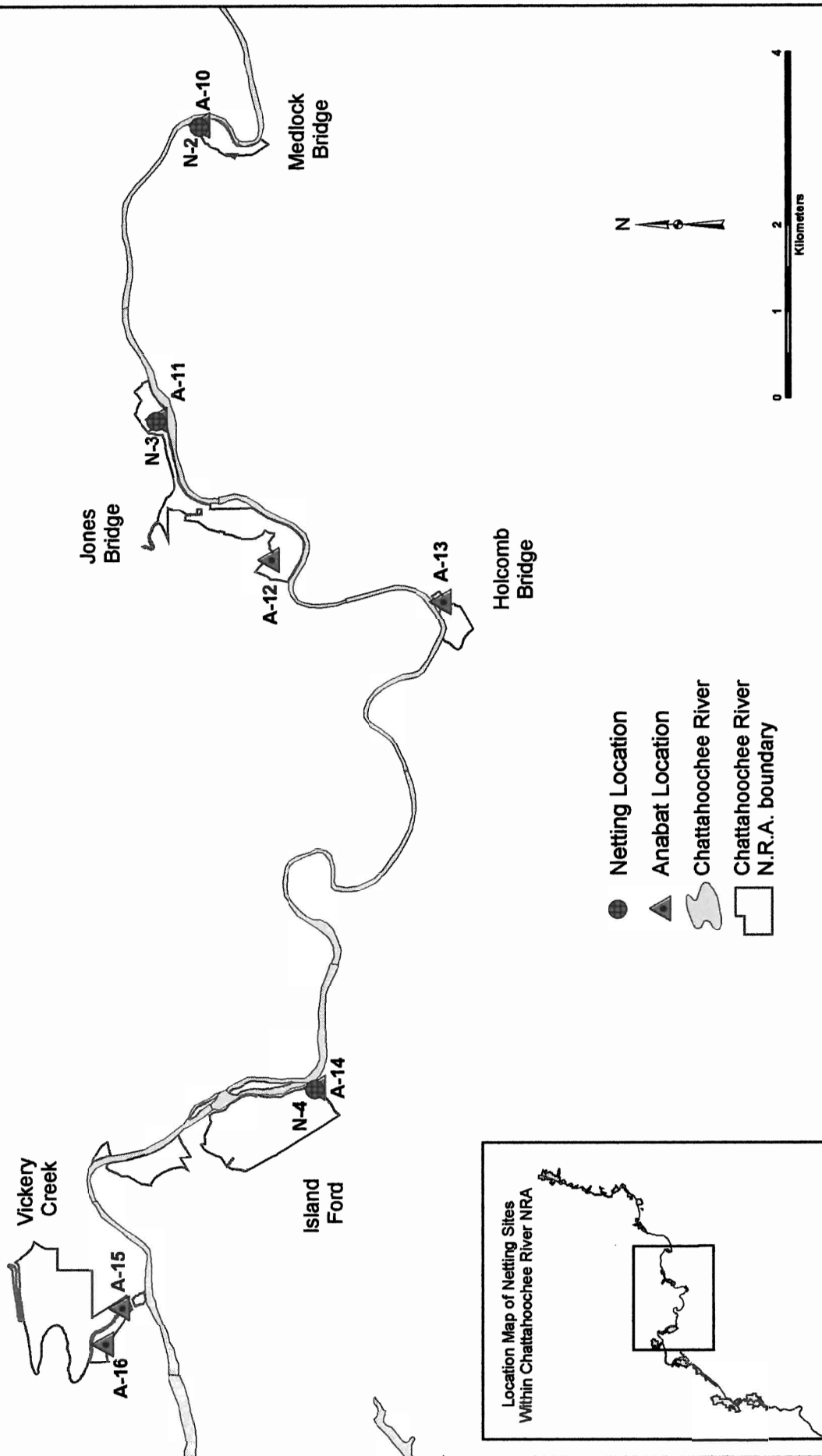


Fig. 2. Bat survey points in the middle section of the Chattahoochee River National Recreation Area June-August 2004-2005. See Tables 3 and 4 for a description of each site.

Anabat and Netting Locations 2004-2005

Chattahoochee River National Recreation Area

(Southwest section)

- Netting Location
- ▲ Anabat Location
- Chattahoochee River
- Chattahoochee River N.R.A. boundary

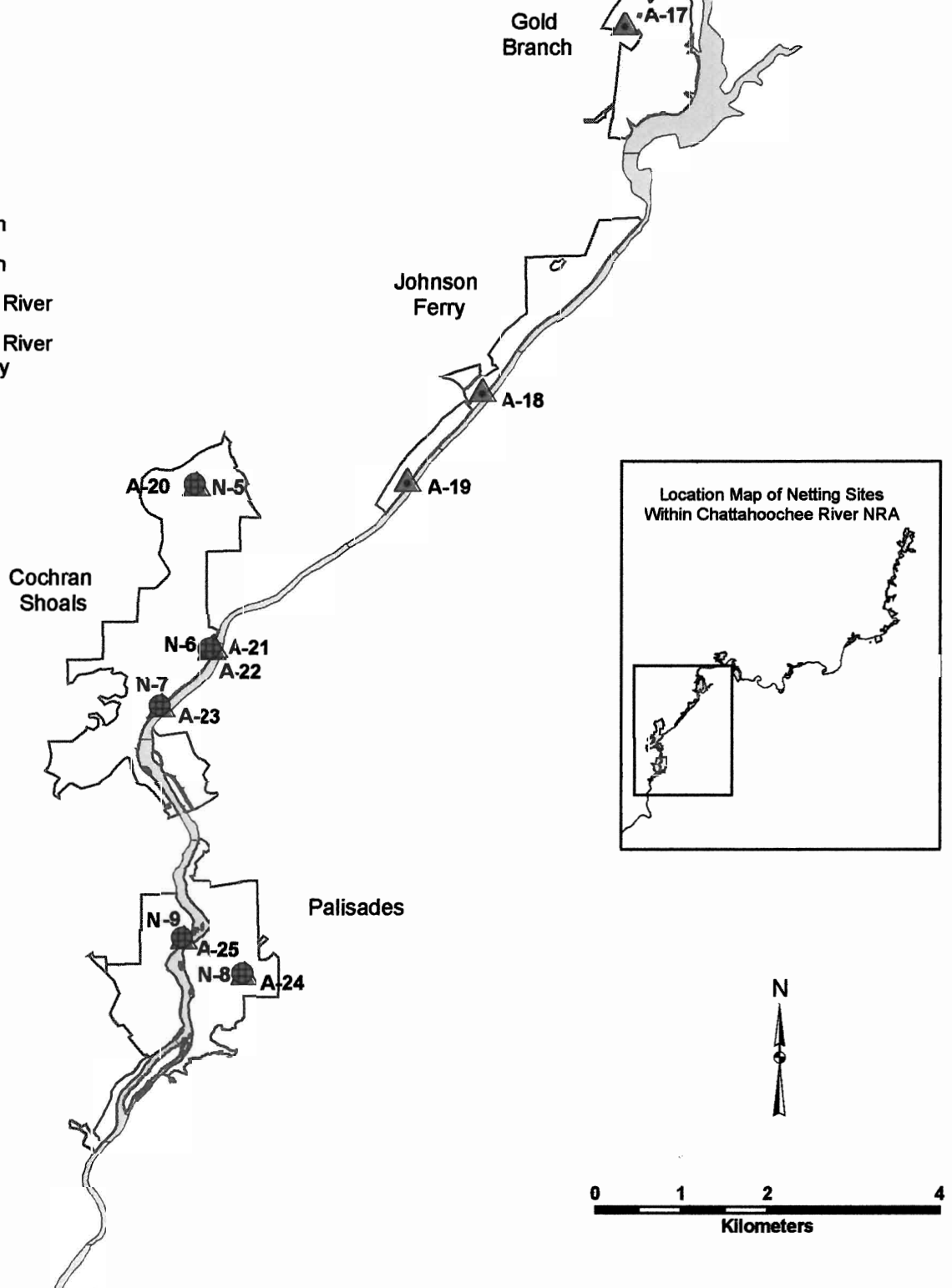


Fig. 3. Bat survey points in the southwestern section of the Chattahoochee River National Recreation Area June-August 2004-2005. See Tables 3 and 4 for a description of each site.

Anabat and Netting Locations 2004-2005

Congaree National Park

(in part - western section)

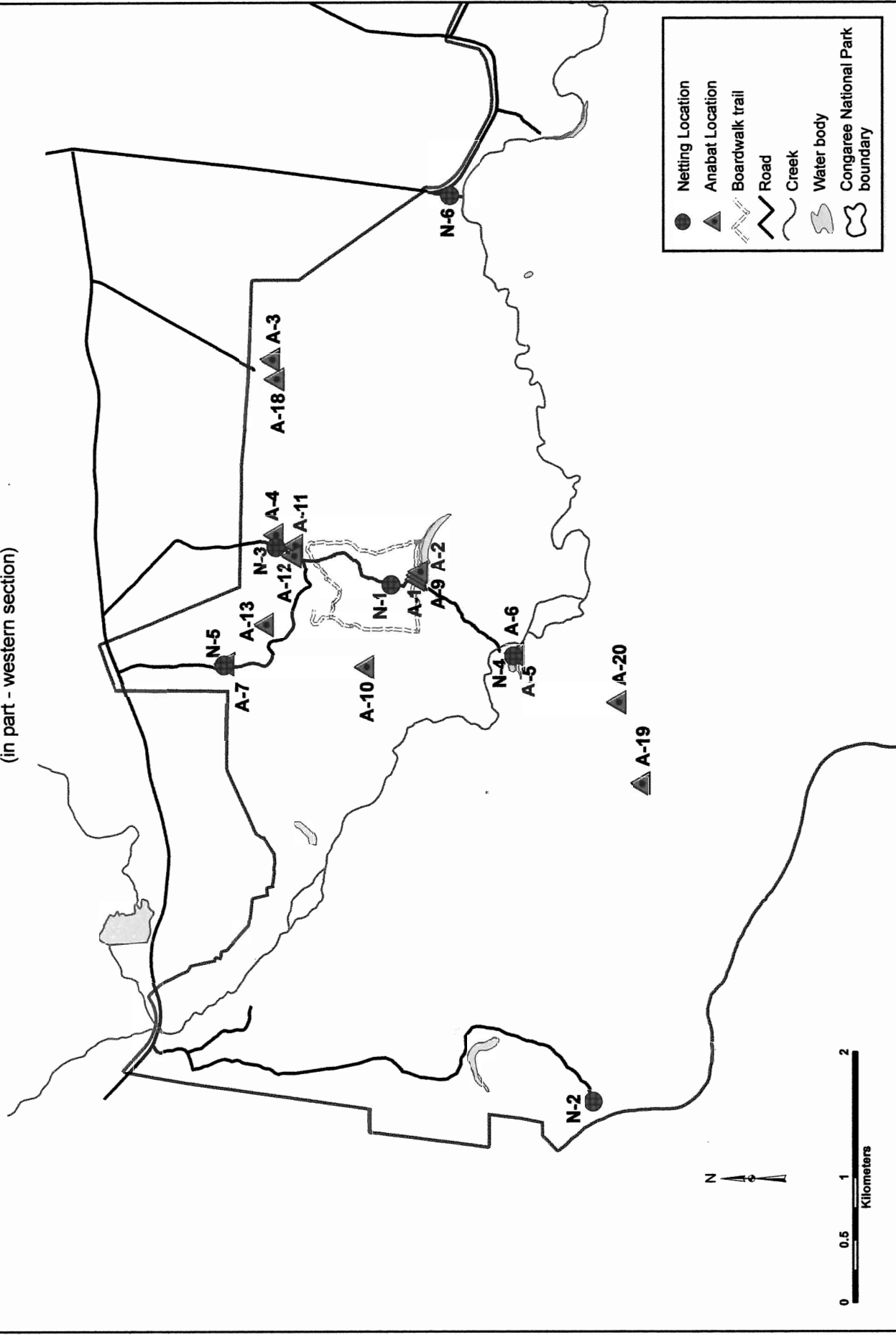


Fig. 4. Bat survey points in the western section of the Congaree National Park, summer and fall 2004-2005. See Tables 5 and 6 for a description of each site.

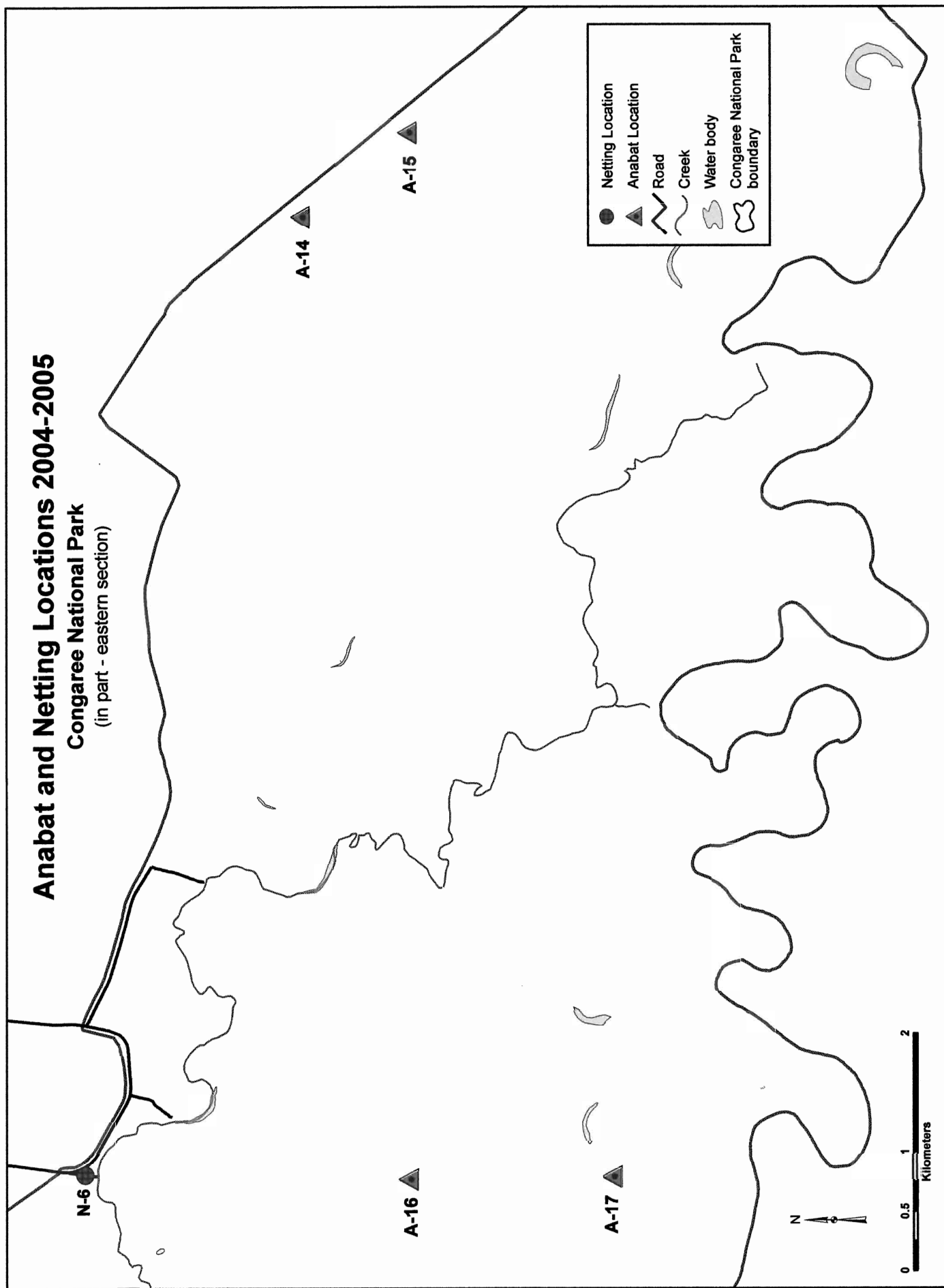


Fig. 5. Bat survey points in the eastern section of the Congaree National Park, summer and fall 2004-2005. See Tables 5 and 6 for a description of each site.

Roost Tree Locations 2004

Congaree National Park

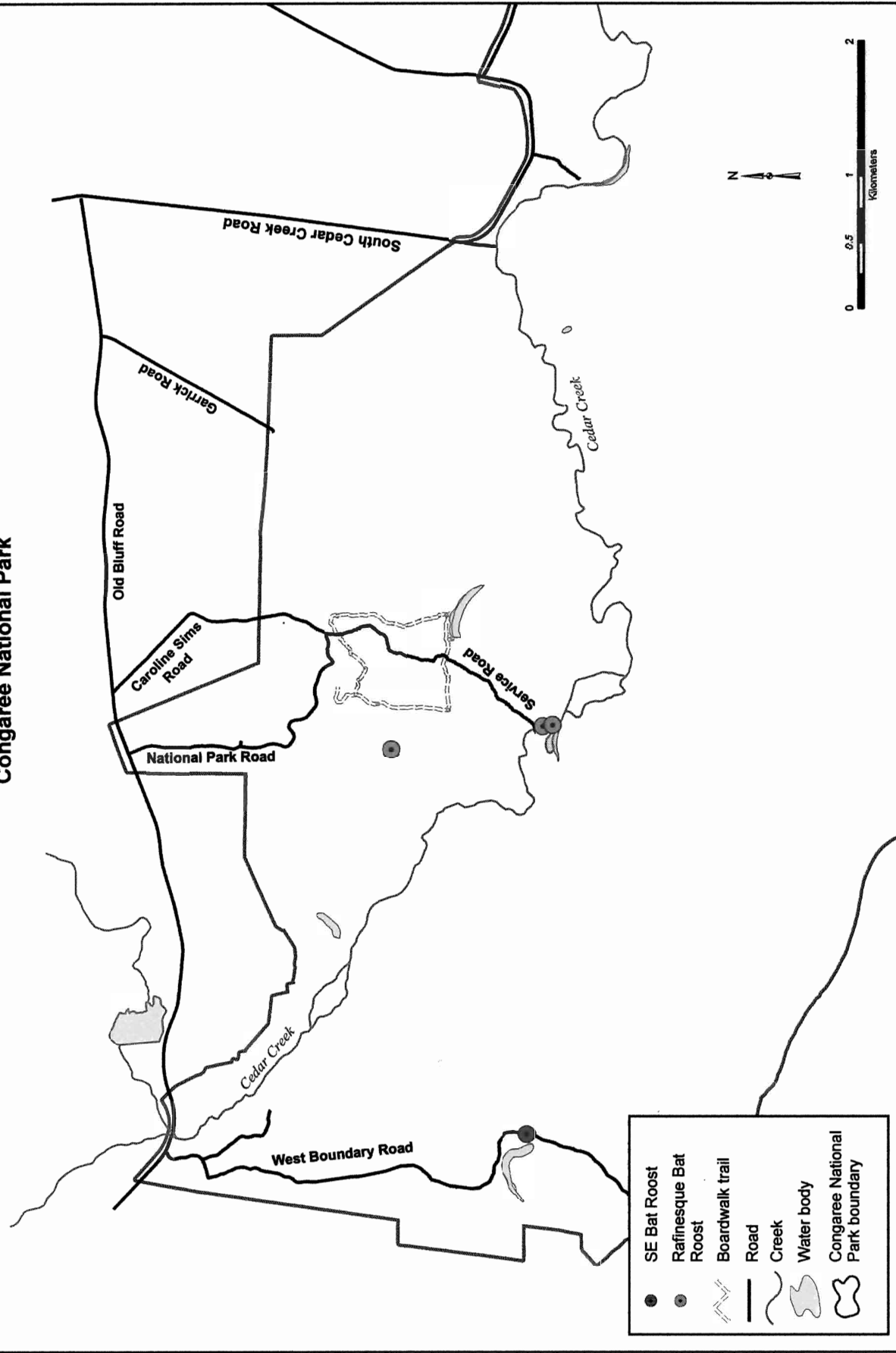


Fig. 6. Location of southeastern myotis and Rafinesque's big-eared bat roosts on COSW, June-July 2004.

Anabat and Netting Locations 2004-2005

Fort Pulaski National Monument

(in part)

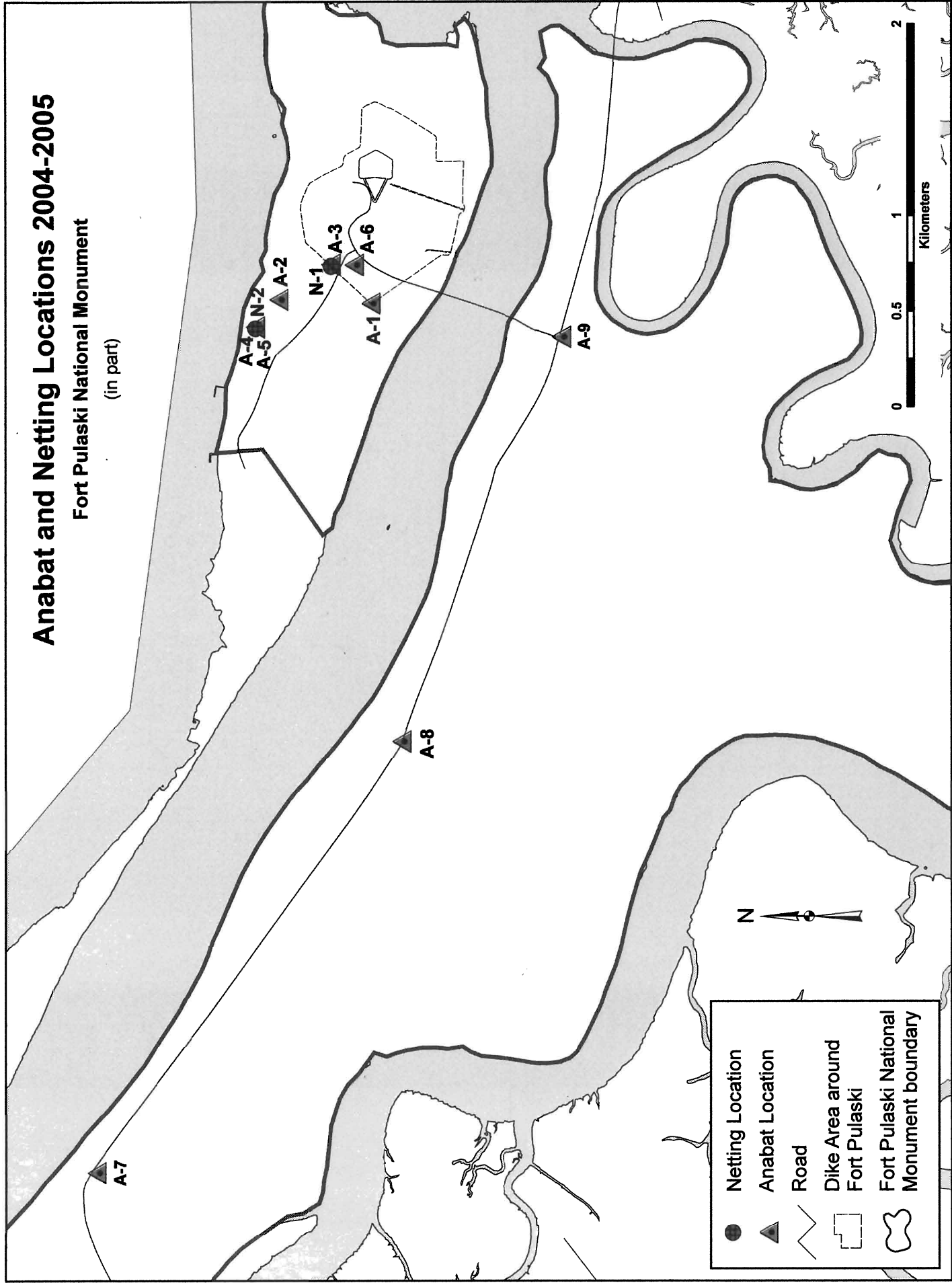


Fig. 7. Bat survey points on Fort Pulaski National Monument August 2004 and March 2005. See Tables 9 and 10 for a description of each site.

Anabat and Netting Locations 2005

Charles Pinckney National Historic Site

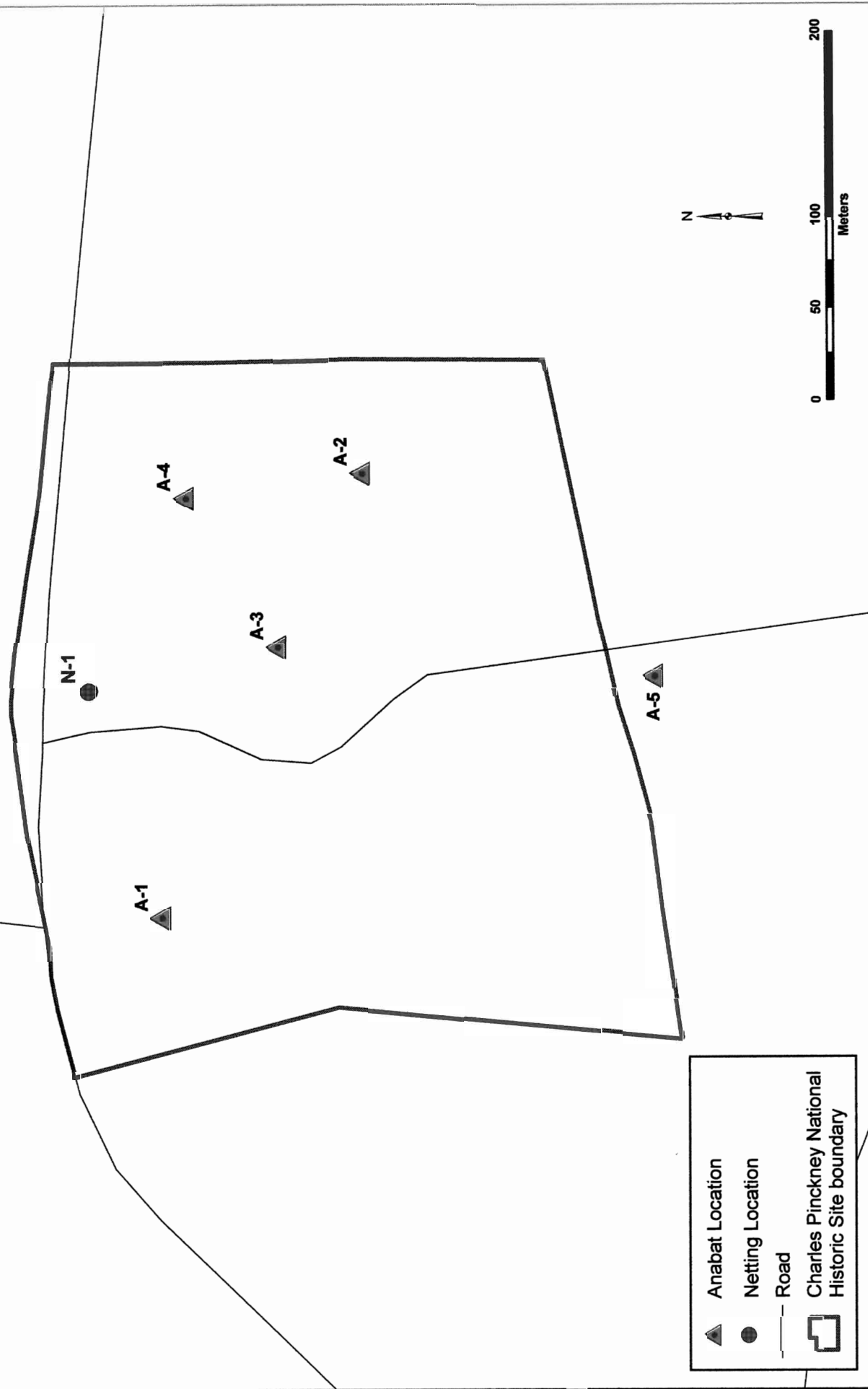


Fig. 8. Bat survey points on Charles Pinckney National Historic Site March and August 2005.
See Tables 11 and 12 for a description of each site.

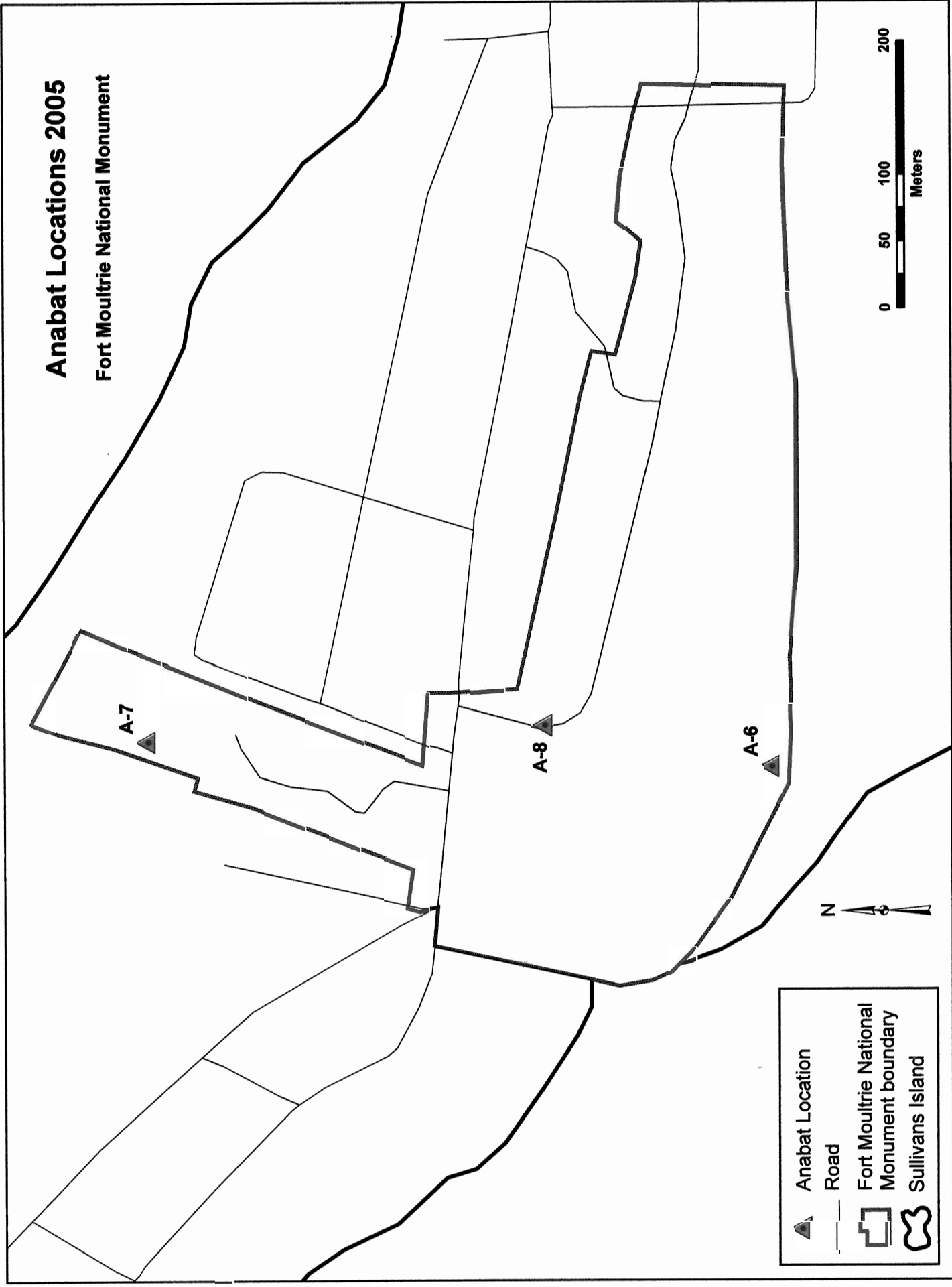


Fig. 9. Bat survey points on Fort Moultrie March and August 2005. See Table 12 for a description of each site.

Anabat Locations 2005

Fort Sumter National Monument

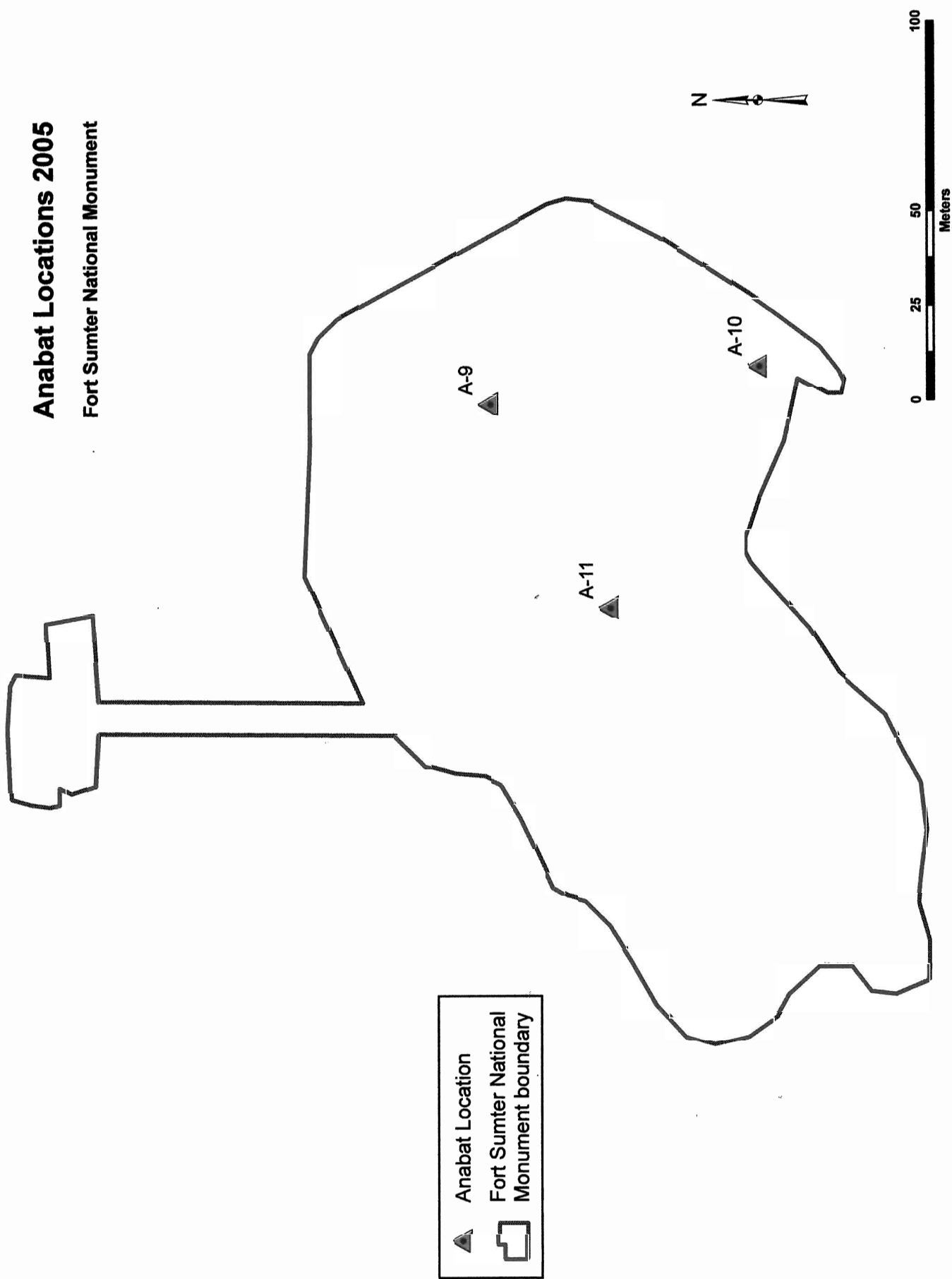


Fig. 10. Bat survey points on Fort Sumter August 2005. See Table 12 for a description of each site.

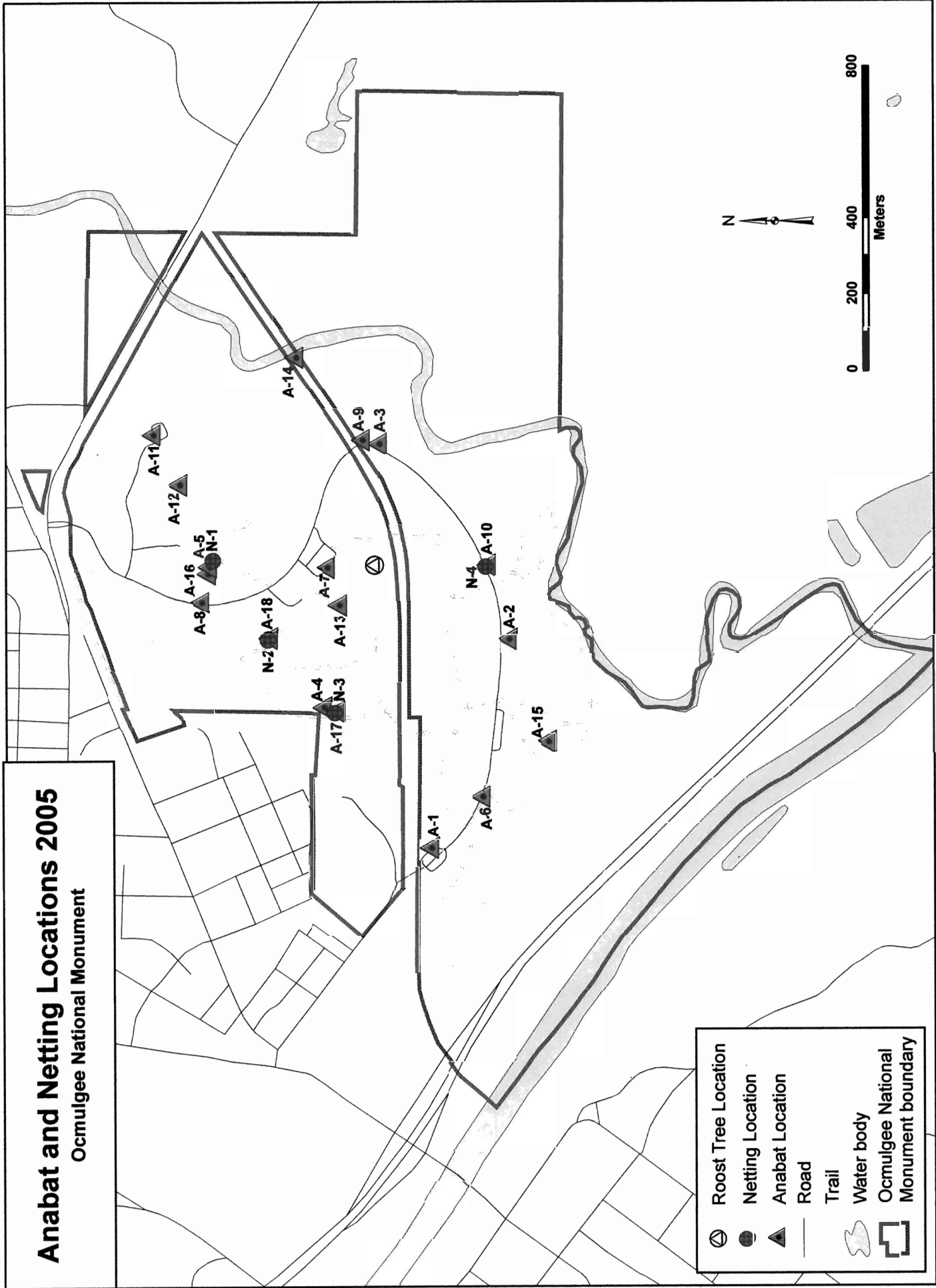


Fig. 11. Bat survey points and location of Rafinesque big-eared bat roost on Ocmulgee National Monument March, June, and August 2005. See Tables 13 and 14 for a description of each acoustic sampling and mist-net site.