

Final Report

Inventory of the Mammals of Jean Lafitte National Historical Park and Preserve,

Barataria Preserve and Chalmette Battlefield

(Cooperative Agreement H2115 03 0001)

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ABSTRACT

This report describes an inventory of mammal species occurring in the Barataria Preserve and Chalmette Battlefield units of Jean Lafitte National Historical Park and Preserve (JLNHPP) located in southeastern Louisiana, conducted from September 2003 to June 2006. Small and medium-sized mammals were observed using live trapping, motion-triggered cameras, study of owl pellets and field observations of tracks and sign. Large mammals were observed using motion-triggered cameras, study of National Park Service (NPS) trapping records, and field observations of tracks and sign. Bats were documented using mist nets and electronic bat detectors. Field work included 8,820 trap-nights (live trapping), 1,462 camera-days (motion-triggered cameras), 88 net-nights (bat netting), and 50 detector-nights (bat electronic detection).

*In the **Barataria Preserve**, 24 species of mammals were documented as occurring in the marsh, swamp, bottomland hardwood forests, and on the natural and man-made spoil banks of waterways (bayous and canals). The following were especially noteworthy findings: 1) first documentation of bats at the Barataria Preserve (7 species), including Rafinesque's big-eared bat (*Corynorhinus rafinesquii*) and the southeastern myotis (*Myotis austroriparius*) both of which are considered uncommon in southeast Louisiana, 2) discovery of a maternity colony of the evening bat (*Nycticeius humeralis*) using bridge supports at the intersection of Kenta Canal and Bayou Coquille, 3) documentation of a large population of resident coyotes (*Canis latrans*), and nine-banded armadillos (*Dasypus novemcinctus*) in all areas of the Barataria Preserve (both coyotes and nine-banded armadillos have only recently extended their range into southeast Louisiana), and 4) documentation of a large population of white-tailed deer (*Odocoileus virginianus*) that has the potential for presenting natural resource management concerns into the future.*

*In the **Chalmette Battlefield**, 11 species of mammals were documented as occurring in the herbaceous field (the battlefield site) and the wooded park boundaries (at fence lines). The natural habitat of the Chalmette Battlefield is so limited and tourist activity so strong that it is not surprising that only a few mammals would be documented or observed. The following noteworthy findings are: 1) first documentation of bats at the Chalmette Battlefield (4 species), 2) presence of the hispid cotton rat (*Sigmodon hispidus*), and 3) lack of resident rodents in the wooded areas at the boundaries of the park unit.*

INTRODUCTION

1. DESCRIPTION OF JLNHPP AND STATEMENT OF PROBLEM

The following is a brief description of the Barataria Preserve and Chalmette Battlefield of JLNHPP that will place the present study in an appropriate context to understand the problem addressed in the mammal inventory.

A. General Description.

Barataria Preserve. The Barataria Preserve of JLNHPP is a large and diverse natural area of approximately 7,500 hectares (18,500 acres) located a few miles south of New Orleans on the westbank of the Mississippi River (see map, **FIGURE 1**). The park unit is found within the Barataria Basin which historically derived its freshwater from the Mississippi River at its northern edge. Nearly 70% of this park unit is comprised of marsh habitats. The marshes of the region vary from highly productive freshwater and intermediate marsh systems to areas that are being severely degraded by saltwater intrusion and erosion. Lakes Cataouatche and Salvador are large, shallow freshwater systems that form the entire western boundary of this park unit. Additionally, over 30 miles of man-made canals, mostly dredged in the mid-1900s for oil and gas exploration, course through the area. The spoil banks of these canals support diverse plant and animal communities. Swamps dominated by bald cypress (*Taxodium distichum*), water tupelo (*Nyssa aquatica*), and dwarf palmettos (*Sabal minor*) are found bordering the marsh systems as one travels eastward towards the forested areas. Several natural bayous course through the area, supporting bottomland hardwood forest systems. The most heavily forested region of the unit is comprised of about 800 hectares (2,000 acres) east of Bayou des Familles (along LA Hwy 45).

This general description of the Barataria Preserve reveals that very diverse, complex, and productive ecosystems exist within this park unit. The marsh habitats include unique ecological assemblages, including flotant (floating) marshes. Swamp zones are found both west and east of Bayou des Familles. The bottomland hardwood forests of the more upland areas adjacent to and east of Bayou des Familles include some of the last remnant forests of the Barataria Basin south and west of New Orleans and the Mississippi River. Finally, a unique aspect of this park unit is that public hunting, trapping, and fishing are permitted and incorporated into the park management. The extensive marsh systems that comprise the western two-thirds of the Barataria Preserve support populations of waterfowl, furbearers, fish, and shellfish that can be accessed and harvested (under appropriate permits) by the public.

Chalmette Battlefield. The Chalmette Battlefield was the site of the Battle of New Orleans during the War of 1812. It is a very small area of about 58 hectares (143 acres) that is situated on the east bank of the Mississippi River only 6 miles from the city of New Orleans. Historically, the site was a natural levee forested region that supported a variety of spoil bank trees, including willows (*Salix* spp.) and oaks (*Quercus* spp). Extending away from the higher elevation of the natural levee to the east were swamps dominated by cypress-tupelo communities. By the mid-1800s, much of the area was transformed for farming and nearly all native vegetation was cleared. Today, the site is completely surrounded by residential and industrial development. Adjacent to the Chalmette Battlefield is a 7-hectare strip that is maintained as the Chalmette National Cemetery. Most of the remaining 51 hectares of the park

unit is the battlefield site, which is managed as a large field of herbaceous plant communities. The park personnel are actively managing this area to enhance its support of wildlife. The northern and western boundaries of the Chalmette Battlefield are wooded, however these are very narrow buffer zones (<40 meters in width).

B. Historical Studies, Previous (Non-Mammalian) Inventories and Current Projects.

Historical studies. Because JLNHPP was only established in 1978, limited NPS-sponsored studies have been conducted on the natural history of its park units. In 1991, Betsy Swanson published a history of the Barataria Preserve, with special emphasis on the forested (upland) areas adjacent to Bayou des Familles. The forests and swamps of the Barataria Preserve have been heavily used and modified by people of the region for over 2000 years, resulting in substantial changes in the physical landscape, as well as the historic flora and fauna. Native Americans, French, Canary Island, and American settlers successively occupied and farmed the forested higher grounds of the Barataria Preserve (Swanson 1991). However, during the past 100 years, these forested/agricultural areas have undergone secondary succession. In the absence of agriculture, logging and other land-use practices, the bottomland hardwood forests are returning to more natural forest systems.

The marsh habitats that comprise nearly 70% of the Barataria Preserve have experienced significant physical and biotic change, as well. Beginning in the mid-1900s, exploration for oil and gas deposits in the Barataria Preserve marshes resulted in the single most significant factor effecting coastal wetlands in Louisiana today – the dredging of canals for oil/gas exploration and navigation. Canal dredging has resulted in over 30 miles of canals coursing through the Barataria Preserve, as well as hundreds of miles of canals connecting this region to the Gulf of Mexico. These canals and their spoil banks have severely altered the natural hydrological systems, effectively subdividing large estuarine systems into fragmented habitat islands. They also provide access of saltwater from gulf coastal waters to intrude into freshwater and intermediate marsh areas. During the past 50 years, the combined effect of disrupting freshwater (and sediment) flow into Barataria Preserve marshes, together with saltwater intrusion, has caused significant degradation of the western boundary of the Barataria Preserve marshes and swamps.

Vascular plant inventories and surveys. The Statement of Work provided by the JLNHPP resource managers for this funded inventory project summarizes the previous inventories of the flora and fauna of the Barataria Preserve and Chalmette Battlefield. Because the state of knowledge of the plant communities is fundamental to assessing the status of the mammals in the park units, the following summary of previous plant inventories and ongoing studies is provided.

White et al. (1983) conducted a comprehensive survey of the vascular plants of the Barataria Preserve. Their study included multiple sites within the bottomland hardwood forests and swamps adjacent to Bayou des Familles, as well as a sampling of marsh habitats adjacent to Kenta Canal. They made an extensive collection of voucher specimens, housed at the Tulane University Herbarium. Later inventories addressed sampling of marshes (Michot 1984, Michot 1985, White 1988) and natural levees and canal spoil banks (Fry 1988, Shannin 1996). Most recently, Nolfo-Clements (2006 and *in press*) has published a paper on the wetland herbaceous plants of the Barataria Preserve marsh habitats.

Ongoing studies of plant community ecology. Beginning in the late-1990s and continuing to date, a number of important studies of plant community ecology have been conducted at the Barataria Preserve. In response to concerns about degradation of the freshwater marshes bordering Lake Salvador, United States Geological Survey (USGS) researchers from the National Wetlands Research Center (NWRC) began studies of the hydrology, productivity, and ecology of marsh vegetation (Doyle 1999, Muth et al. 2000). Dr. Tom Doyle has developed hydrological and plant productivity models for several marsh and forested areas of the Barataria Preserve that will contribute directly to monitoring the changes that are expected to occur once the Davis Pond Freshwater Diversion is fully operational.

Several sea-level rise studies have been conducted and continue in the bottomland hardwood forest habitats of the Barataria Preserve. Drs. Julie Denslow (United States Forest Service) and Loretta Battaglia (Louisiana State University, hereafter LSU) have been conducting a long-term study of the effect of sea-level rise and forest tree dynamics with a special emphasis on assessing the impact of the introduced Chinese tallow tree (*Triadica sebifera*) (Denslow and Battaglia 2002). On the same study site, Walisevich (2001) has just completed a Ph.D. dissertation evaluating the impact of hydroperiod on seed and seedling banks.

In summary, recent and ongoing studies of plant ecology in the Barataria Preserve, have established a foundation of data to support future studies of the flora and fauna of this park unit. The present mammal inventory will build on this foundation.

C. Mammal Inventories and Ongoing Mammal Studies.

Historical mammal inventories. No inventory of the mammals inhabiting the Chalmette Battlefield has been previously undertaken. Two mammal inventories have been conducted in the Barataria Preserve (Smalley 1982, Demastes and Rossman 1989) and both of these are considered incomplete. Smalley's (1982) study was part of a general survey of the fauna of the forested areas of the Barataria Preserve and did not undertake a collection protocol that would have documented mammal species with voucher specimens. Demastes and Rossman's (1989) study was a more systematic effort, which included study of Lowery's (1974) specimen and species distribution lists, as well as confirmation of specimens housed at the LSU Museum of Natural Science (LSUMNS). The survey did include some trapping and observational protocols, but yielded only a limited number of voucher specimens.

In Chapter 2 of Swanson's (1991) book, David Muth described the mammals known or that are thought to have occurred historically in the Barataria Preserve. He related historical accounts of large mammals now extirpated from the region including Louisiana black bear (*Ursus americanus luteolus*), red wolf (*Canis rufus*), Florida panther (*Felis concolor*); introduced and domesticated mammals such as the wild pigs (*Sus scrofa*), nine-banded armadillos, coyotes, dogs (*Canis familiaris*), cats (*Felis catus*); and mammals not recorded but expected in the area such as striped skunks (*Mephitis mephitis*). He also provided a list of mammal species, with relative abundances, thought to occur in major ecological communities of the Barataria Preserve based on the data available at the park through the early-1990s, which includes the previous inventories and unpublished park data.

The mammalian fauna of southeast Louisiana is rather poorly known. George Lowery's (1974) *Mammals of Louisiana and Adjacent Waters* remains the most comprehensive professional reference, although it is now over 30 years out of date. In 1994, Choate et al. published the *Handbook of Mammals of the South-Central States*, which provided an updated, but very general reference to the mammals of the south including Louisiana. This publication has distribution maps, but lacks voucher specimen lists or locality symbols to identify specific locations to document distribution and status of mammal species. Few distributional studies have been published since Lowery (1974), although several dissertations have focused on specific taxa {e.g., gray squirrels (*Sciurus carolinensis*), Moncrief 1993; bats, Lance 1999, Lance et al. 1996, Lance et al. 2001}. Additional recent publications on mammals of southeast Louisiana include studies of mammals that are deposited at the Tulane Museum of Natural History (TMNH), which are described further, below (Jones 1967, Jones, 1975, Suttkus and Jones 1991, Suttkus and Jones 1999).

Although not expected to be encountered, any records or observations of the Louisiana black bear or Florida panther, the two listed endangered species of mammals in Louisiana, would be remarkable. In addition to these native mammals, it is expected that introduced and domesticated mammals will be encountered and documented. The distribution and abundance of introduced rodents (especially *Rattus* spp.), wild pigs and feral dogs and cats are of special concern in JLNHPP.

Reference collections at Tulane Museum of Natural History (TMNH) and LSU Museum of Natural Science (LSUMNS). The major systematic collections housing mammals from southeast Louisiana, including the Barataria Basin, are found in the TMNH and the LSUMNS. Lowery (1974) provided detailed lists of the mammal holdings of both of these collections through about 1972. However, beginning in the mid-1980s, field collections of small mammals were undertaken by students and faculty of Tulane University, yielding over 4,000 mammal specimens from southeast Louisiana. Most of these specimens, including bats, are from bottomland hardwood and natural levee and spoil bank habitats in northern Plaquemines and Jefferson parishes, which are very similar to those found at both the Barataria Preserve and Chalmette Battlefield. Therefore, a large reference collection of rodents and bats from nearby localities was an important resource for the present mammal inventory project.

D. Ongoing Wetland Loss Projects [Coastal Wetland Planning, Protection, and Restoration Act (CWPPRA) and the Davis Pond Freshwater Diversion].

Ongoing wetland loss projects are described here, because they directly impact and will have very important consequences to the flora and fauna of the Barataria Preserve. Since 1990, CWPPRA, also known as the Breaux Act, has provided over \$389 million in funding to support wetland loss projects in coastal Louisiana and an additional \$400 million is committed to complete all ongoing projects. These projects are aimed at addressing loss of Louisiana coastal wetlands due to multiple factors, including canal dredging and construction of levees that has led to disruption of hydrological systems and saltwater intrusion (see Louisiana CWPPRA website, <http://www.lacoast.gov/cwppra>).

Studies to document the extent of wetland loss in Louisiana identified the Barataria Basin as the area undergoing the highest level of land loss (Barros et al. 1994). Federal and State funds (over

\$200 million to date) have supported numerous projects in the Barataria Basin and are ongoing (see the Barataria-Terrebonne National Estuary Program website, <http://mail.btnep.org>). One area undergoing serious degradation and wetland loss is the eastern shoreline of Lake Salvador that forms the entire western boundary of the Barataria Preserve. These impacts on the marsh habitats that comprise nearly 70% of the Barataria Preserve are one of the most serious management concerns to the park. The assessment of mammal species diversity in the Barataria Preserve marsh and neighboring swamp habitats is critical, because virtually nothing is known and a major wetland project, the Davis Pond Freshwater Diversion, began operation in March 2002.

Davis Pond Freshwater Diversion Project and its impact on the Barataria Preserve. In 1996, funding for the Davis Pond Freshwater Diversion Project was approved. This is the most ambitious CWPPRA project to date, and directly effects the Barataria Preserve (Louisiana CWPPRA URL: <http://www.lacoast.gov/programs/DavisPond/index.htm>). This \$110 million project will mimic the historic spring flows of Mississippi River water into the upper Barataria Basin through control structures that will bring both freshwater and sediment to the entire basin. The hydrology of the entire upper Barataria Basin is expected to be shifted back to a condition that will support the freshwater and intermediate marshes from Lake Cataouatche to Barataria Bay in the Gulf of Mexico. The diversion control structure opened in March 2002 and its impacts will be evaluated over the next 50 years.

The Barataria Preserve is directly in the path of the diversion and will be significantly impacted by the expected hydrological changes resulting in its operation. The importance of this impact has been the basis for ongoing cooperative projects between the USGS and NPS personnel at JLNHPP to understand and collect pre-diversion data on these areas.

E. Statement of Problem.

The present mammal inventory provides baseline data on the status and relative abundance of mammals in the Barataria Preserve and Chalmette Battlefield of JLNHPP.

As described in the Statement of Work provided by the JLNHPP resource managers, the present state of the mammal species list and status is incomplete and largely unconfirmed in the case of the Barataria Preserve and entirely unknown at Chalmette Battlefield. The status of bat species in both units is especially poorly documented and is of special concern, as is the status of carnivores. Additionally, previous mammal studies have not adequately sampled the extensive marsh and swamp habitats of the Barataria Preserve, which comprise nearly 70% of the unit's area.

The following outlines the specific tasks conducted in this mammal inventory project that provide the needed baseline data and accommodate the Basic Inventory Standards and the Statement of Work for JLNHPP.

To address the JLNHPP Statement of Work, this mammal species inventory included:

- documentation and status of bats
- documentation and status of small/medium mammals (rodents, lagomorphs, Virginia opossums, nine-banded armadillos)

- documentation of large mammals (carnivores, ungulates)
- collection of voucher specimens and associated data for representatives of all taxa

Existing species lists and collections reviews:

- search of historical and recent literature
- search and confirmation of JLNHPP voucher specimens at TMNH and LSUMNS
- search/review of reference specimens from nearby localities housed at TMNH and LSUMNS

Sampling protocols used included:

- mist netting and electronic monitoring of bats
- live-trapping of small and medium-sized mammals
- photographic / observational methods for large mammals
- non-invasive marking (passive integrated transponder; hereafter PIT, tags) of all captured mammals
- global positioning systems (GPS) data collected for all encountered mammals

Sampling design to address diverse habitats in JLNHPP units included:

- sampling of marsh and spoil bank habitats (Barataria Preserve) -- extensive boat travel
- sampling of swamp habitats (Barataria Preserve)
- sampling of forest and upland habitats (Barataria Preserve and Chalmette Battlefield)
- use of seasonal collection protocols (esp. important for bats)
- use of GPS data and PIT tags to document occurrence and relative abundance in habitats

Scientific identification included:

- current mammalian nomenclature to species level
- identification by comparison of voucher specimens to reference collections

2. RESEARCH DESIGN AND PROTOCOLS

This section describes the specific research design and protocols.

A. Existing Species Lists and Collections

Historical and recent literature on mammals recorded from the Barataria Preserve and Chalmette Battlefield adjacent areas were reviewed. Major general references include Lowery (1974) and Choate et al. (1994). Recent relevant literature reporting data on mammals of southeast Louisiana were consulted, especially for nearby study sites. The mammal collections of TMNH and LSUMNS were surveyed for significant “off-site” specimens of mammals that will serve as reference material for newly collected voucher specimens.

Examination of existing voucher specimens from the Barataria Preserve. Previous inventory reports by Smalley (1982) and Demastes and Rossman (1989) were reviewed and their species lists and data assessed. The general study by Smalley (1982) did not collect any mammal voucher specimens. The mammal inventory portion of the Demastes and Rossman (1989) study included very limited field work for mammals – only 8 voucher specimens representing 5 species were collected. Visits to LSUMNS were made to locate and confirm identification of all voucher specimens reported in Demastes and Rossman (1989). Of these specimens, two were misidentified (specimens were wrongly associated with their data) and another was identified only to genus. Therefore, prior to the present study, verified voucher specimens existed for the following species only:

<i>Canis latrans</i>	coyote
<i>Sciurus carolinensis</i>	gray squirrel
<i>Peromyscus leucopus</i>	white-footed mouse
<i>Oryzomys palustris</i>	rice rat
<i>Mus musculus</i>	house mouse (introduced)

B. Sampling Designs and Protocols

Overall sampling design. Mammals were documented using capture techniques (live-traps, kill-traps, capture by hand, and mist nets), though observational methods including electronic detection of bats and motion-activated still cameras, and through examination of mammal sign (tracks, scat). Logistical challenges in the Barataria Preserve and Chalmette Battlefield (and in southeast Louisiana, generally) are very substantial and include, a) difficulty in accessing habitats in wet terrain (especially in inundated forests and swamps), b) extreme heat during the summer which limits mammal activity and poses health risks to investigators, c) seasonal migratory habits of some taxa (especially several species of bats), and d) access to most areas of the park by the general public. The sampling of marsh habitats that comprise nearly 70% of the Barataria Preserve required extensive use of boat travel and fieldwork within marsh vegetation.

Documentation of the occurrence and status (relative abundance) of bats, small/medium mammals, and large mammals inhabiting the diverse habitats and ecological associations of the Barataria Preserve and Chalmette Battlefield required specific sampling protocols that address the biology of each of these groups of taxa. The sections below describe the specific protocols, references, and adaptation to the present project.

Documenting bat species. Although bats can be observed flying at dusk or on moonlit nights, documenting occurrence and abundance of species requires capture and observational methods (Jones et al. 1996, Kunz et al. 1996, ASM 1998, Kunz and Kurta 1988). Bats are typically mist-netted as they leave diurnal roost sites or as they forage during the evening (Kunz and Kurta 1988). There are no caves and few other natural structures that allow roosting of very large colonies of bats in Louisiana (Lowery 1974). Most bats occurring in the region roost in small to medium-sized colonies (*Nycticeus humeralis*), in small groups (*Corynothinus rafinesquii*), or singly (*Pipistrellus subflavus* and lasiurines). Thus, mist-netting and electronic detection focused on foraging sites and required an intensive field effort.

Electronic detection of bats as a method for identification of species to document their occurrence and relative abundance has developed rapidly in recent years (for reviews see Anderson and Miller 1977, Fenton 1988, Kunz et al. 1996). These methods record the ultrasonic echolocation calls of bats and, provided that call libraries exist for the species encountered at the study site, the calls can be identified by their quantitative bioacoustic signature pattern. A large literature of field and laboratory studies has demonstrated the utility and limitations of electronic detection for species identification of bats (O'Farrell and Gannon 1999, O'Farrell et al. 1999, Robbins et al. 1999, Parsons et al. 2000). The principle benefits of using electronic detection is the ability to identify individuals that cannot be captured with mist-nets due to the height or style of their flight. Additionally, species identification without handling during capture promises to reduce stress or damage to rare or endangered species. Use of electronic detection in inventory and monitoring programs has become widespread (Lance et al. 1996, Britzke et al. 1999, Murray et al. 1999). However, the studies cited have demonstrated that it is critical to develop a high quality, local call library and to include mist-netting to confirm occurrence of species at a given locality. Most studies have demonstrated that electronic detection records some taxa that mist-netting misses, but it also can fail to record some taxa that are captured by mist nets. Electronic detection proved very useful and powerful tool to document occurrence and abundance of bats in concert with mist-netting in the present mammal inventory.

Specific localities and sampling effort for bats at JLNHPP. – Maps illustrating the sites for documentation of bats and photos of field methods are shown in **FIGURES 2-4, 15.**

The **Chalmette Battlefield** includes two general areas of different habitat structure – 1) the battlefield site with herbaceous cover in the center of approximately 51 hectares, and 2) narrow strips of secondary hardwood forest of the northern and eastern boundaries of the unit.

Electronic monitoring of bat calls at the Chalmette Battlefield and Barataria Preserve were coordinated with mist-netting to establish call libraries and to maximize efficiency of effort. Two to three ANABAT II bat detectors and field crews were used simultaneously in different areas at a field site to allow data to be collected in different areas of the park. Captured bats were recorded, GPS data collected, PIT tagged (see

below), and calls recorded (for call library if needed). In addition to development of call libraries from bats collected on site, call libraries were constructed from bats collected from nearby locations.

The **Barataria Preserve** includes diverse habitats that are divided for the purposes of this description into three major areas – 1) the bottomland hardwood forests east of Bayou des Familles (LA Hwy 45) at the extreme eastern boundary of the park, 2) the swamp and forest habitats west of Bayou des Familles (LA Hwy 45), and 3) the marsh habitats encompassing the western two-thirds of the unit. Mist netting and electronic detection sampling sites were established within the bottomland hardwood forest sites east of Bayou des Familles, at sites along Bayou Coquille that include swamp habitats transitioning to marsh, and at sites along natural levees and spoil banks of the marsh habitats in the western two-thirds of the unit. Standard 3 by 10-meter nylon mist nets (2-10) were deployed at each site each night.

Documenting small and medium-sized mammals. Small to medium-sized non-volant mammals include insectivores, rodents, lagomorphs, Virginia opossums (*Didelphis virginiana*), and small carnivores {e.g., weasels (*Mustela* spp.)}. Standard methods for documenting specific species are effected by their natural history; however, generally live-trapping methods are required (Jones et al. 1996). Observational methods included visual sightings during the day and crepuscular periods and identification of sign (tracks, feeding activity, scat).

Specify localities and sampling effort for small/medium mammals at JLNHPP. – Maps illustrating the sites for documentation of small/medium sized mammals and photos of field methods are shown in **FIGURES 5-6, 15**.

Rodents (including native and introduced mice, rats, squirrels), lagomorphs, Virginia opossums, and small carnivores were documented by live-trapping and observation (identification of sign, visual observation, road-killed specimens, use of motion-activated still cameras). Live-trapping transects were established in the two areas previously described in Chalmette Battlefield and major habitats within the Barataria Preserve. Sherman live traps (small rodents), Havahart #1 traps (squirrels, small carnivores), Havahart #2 traps (squirrels to opossums), and Havahart #3 traps {opossums to raccoons (*Procyon lotor*)} were set and monitored. Live traps were monitored nightly and closed or removed when not attended. GPS location data, environmental data, habitat description and field identification of species were made at each capture. All captured mammals were PIT-tagged for identification. Selected captured individuals were sacrificed and saved as voucher specimens (with all data, including GPS location data).

Documenting large mammals. Large mammals present challenges to collection and observation. Typically they are much less abundant and move greater distances on a daily basis than smaller mammals. Live-trapping and handling large mammals is difficult (Jones et al. 1996). Standard techniques for documenting large mammals include observational protocols, focused live-trapping for specific species, and observation of sign (tracks, scat) and road-killed animals (Rudran et al. 1996, Wemmer et al. 1996).

Specify localities and sampling effort for large mammals at JLNHPP. –

Maps illustrating the sites for documentation of small/medium sized mammals using motion-activated still cameras and sign are shown in **FIGURES 7-9**.

Large mammals in the Barataria Preserve and Chalmette Battlefield potentially included white-tailed deer (*Odocoileus virginianus*), feral pigs, native and domesticated canids and felids, raccoons, and nine-banded armadillos. Some of these taxa were observed visually during daylight hours or at dawn and dusk, which varies seasonally. Others are nocturnal. Species were documented by observation (identification of sign, visual observation, road kill specimens, and use of remote still cameras). The walking trails and roads that course through the bottomland hardwood forest habitats are major routes of movement for these mammals, as are the natural levee and spoil banks found throughout the swamp and marsh habitats in the Barataria Preserve. Wildlife monitors (motion-activated still cameras) were placed in major habitats within the Barataria Preserve.

Most voucher documentation for large mammals, especially white-tailed deer and carnivores, consisted of road-killed specimens, sign, and photographic records.

Marking captured mammals with PIT tags. To document the occurrence and relative abundance of mammals at JLNHPP without sacrificing every captured individual, all live-captured mammals were marked for identification. Mark/recapture protocols allow multiple observations of individuals and also allow for estimates of species richness, distribution, and abundance by application of established sampling and statistical designs (for general reference, see, Nichols and Conroy 1996). The inventory project is not designed to provide data on population size or density, seasonal variation in abundance, home range or dispersal. However, the mark/recapture data allowed for relative abundance estimates that are preferable to collection without recapture.

Rudran and Kunz (1996) summarized a diversity of marking methods, which have a wide range of characteristics in permanence, reliability, and behavioral or physiological stress on the animals. Among newer methods of marking animals that allows outstanding permanence, reliability, and minimal stress is PIT technology (Camper and Dixon 1988, Ball et al. 1991, Germano and Williams 1993). PIT tags are tiny microchips that respond to electromagnetic fields generated by a reading device, responding with a unique numeric code. The tags have been used extensively in fisheries research and management and more recently have been increasing used by mammalogists and wildlife managers (Fagerstone and Johns 1987, Thomas et al. 1987, Schooley et al. 1993, Williams et al. 1997). PIT tag technology requires an initial capture of individuals and subcutaneous insertion of the tag in a stable location (typically the nape of neck), followed by subsequent recapture of individuals and recording of the tag via the reader/scanner. Tags are considered permanent and continue to respond for over 20 years, well beyond the lifespan of most mammals that would be encountered at JLNHPP.

Wherever possible, every mammal captured was implanted with a PIT tag and a GPS location recorded at the place of capture. This permanently marks (identifies) the individual and records its place of first capture. Subsequent captures (recaptures) will be recorded with GPS locator data. These data will allow detailed records of the occurrence of mammals and also provide a

means to estimate relative abundance. Although the study of movement and dispersal are not goals of the inventory project, those data can be extracted from the database. Although monitoring is not a goal of this inventory project, the use of PIT tags also provides a means to permanently mark individual mammals for future monitoring studies at JLNHPP.

Recording GPS and environmental data. The Basic Standard for all inventory projects requires collection of spatial, environmental, and specimen data that will be integrated into the NPS Gulf Coast Inventory and Monitoring Network Geographic Information System (GIS) database. GPS locator data, environmental (weather), habitat description, and specimen data were recorded at every trap location, mist-net and remote still camera location used in this inventory project. As described above, capture data will include field identification of species, recording or insertion of PIT tag information, and voucher information (if the specimen is sacrificed for voucher).

C. Voucher Specimens

Traditional voucher specimens are essential for positive identification and documentation of status. Representative specimens encountered during live-trapping and mist-netting (bats) will be sacrificed and prepared as standard museum study specimens (Jones et al. 1996). This includes preparation and preservation of the skin, skull and post-cranial skeleton, as well as all associated location, habitat, and environmental data. PIT tag numbers, photographic records, and echolocation records will be associated with all specimens, as well. Maintenance of all of this data will be associated with the physical specimen. Voucher specimens will be deposited in the Mammal Collections of the TMNH.

RESULTS FOR BARATARIA UNIT

1. SPECIES LISTS

The following are checklists of the mammal species documented in this study at the Barataria Preserve of JLNHPP.

A. Species List of Documented Recent Mammals – Barataria Preserve

A total of **24 mammal species** were documented as occurring within the Barataria Preserve in the present study. Species with asterisk (*) are introduced or domesticated.

ORDER MARSUPIALIA—Marsupials

Family Didelphidae (opossums)

Didelphis virginiana (Virginia opossum)

ORDER CHIROPTERA—Bats

Family Vespertilionidae (vespertilionid bats)

Myotis austroriparius (southeastern myotis)

Pipistrellus subflavus (eastern pipistrelle)

Lasiurus borealis (eastern red bat)

Lasiurus intermedius (yellow bat)

Nycticeius humeralis (evening bat)

Corynorhinus rafinesquii (Rafinesque's big-eared bat)

Family Molossidae (free-tailed bats)

Tadarida brasiliensis (Brazilian free-tailed bat)

ORDER XENARTHRA—Edentates

Family Dasypodidae (armadillos)

Dasypus novemcinctus (nine-banded armadillo)

ORDER LAGOMORPHA—Lagomorphs

Family Leporidae (hares and rabbits)

Sylvilagus aquaticus (swamp rabbit)

ORDER RODENTIA—Rodents

Family Sciuridae (squirrels and allies)

Sciurus carolinensis (eastern gray squirrel)

Family Cricetidae (native mice and rats)

Oryzomys palustris (marsh rice rat)

Peromyscus leucopus (white-footed mouse)
Sigmodon hispidus (hispid cotton rat)
Ondatra zibethicus (common muskrat)

*Family Muridae (Old World rats and mice)

**Rattus rattus* (black rat)
 **Mus musculus* (house mouse)

*Family Myocastoridae (myocastorids)

**Myocastor coypus* (nutria)

ORDER CARNIVORA—Carnivores

Family Canidae (canids)

Canis latrans (coyote)

Family Procyonidae (procyonids)

Procyon lotor (Northern raccoon)

Family Mustelidae (mustelids)

Mustela vison (mink)
Lutra canadensis (Nearctic river otter)

Family Felidae (cats)

Felis rufus (bobcat)

ORDER ARTIODACTYLA— Even-toed ungulates

Family Cervidae (cervids)

Odocoileus virginianus (white-tailed deer)

B. Species Reported but Undocumented or No Longer Present – Barataria Preserve

The following species have been reported (in previous NPS inventories, public hunting and trapping records, naturalist reports), or have been observed by NPS staff as occurring within the Barataria Preserve in the past (before 1990). Species with asterisk (*) are introduced or domesticated.

ORDER RODENTIA—Rodents

Family Sciuridae (squirrels and allies)

Glaucomys volans (southern flying squirrel)

Family Castoridae (beavers)

Castor canadensis (American beaver)

Family Cricetidae (native mice and rats)

Neotoma floridana (eastern woodrat)

ORDER CARNIVORA—Carnivores

Family Canidae (canids)

Vulpes vulpes (red fox)
Urocyon cinereoargenteus (gray fox)

ORDER ARTIODACTYLA— Even-toed ungulates

*Family Suidae (pigs)

**Sus scrofa* (wild pig)

2. RESULTS FOR BATS – MIST-NETTING

The following is a summary of the results of documenting bats occurring within the Barataria Preserve. **FIGURE 2** illustrates a map of mist net site localities. A total of 8 site localities, 20 nights of observation using mist nets, and 88 net-nights resulted in capture of 37 individuals representing 5 species of bats. These included *Nycticeius humeralis*, *Pipistrellus subflavus*, *Corynorhinus rafinesquii*, *Myotis austroriparius*, and *Tadarida brasiliensis*. A maternity colony of *Nycticeius humeralis* was discovered in the bridge supports of the Kenta Canal / Bayou Coquille bridge (Site 8, **FIG. 10**). Overall netting success was very low and of 37 individuals captured none were recaptured. A summary of mist netting effort and results follows:

Summary of **Mist-netting** Results: (Sites 1-8)

Site 1 (N. Plantation trail) 2 net-nights
 no captures

Site 2 (Wood Duck trail) 8 net-nights,
 1 *Corynorhinus rafinesquii* (marked/released)

Site 3 (N. Old Barataria trail) 8 net-nights,
 1 *Corynorhinus rafinesquii* (voucher)
 1 *Myotis austroriparius* (voucher)

Site 4 (S. Old Barataria trail) 8 net-nights,
 no captures

Site 5 (Main road) 8 net-nights,
 no captures

Site 6 (Canoe launch) 8 net-nights,
 no captures

Site 7 (Bayou des Familles bridge) 8 net-nights,
 2 *Pipistrellus subflavus* (1 voucher, 2 marked/released)

Site 8 (Kenta Canal/Bayou Coquille bridge) 8 net-nights,

- 25 *Nycticeius humeralis* (1 voucher, 24 marked/released)
 1 *Corynorhinus rafinesquii* (marked/released)
 1 *Myotis austroriparius* (marked/released)
 1 *Pipistrellus subflavus* (marked/released)
 3 *Tadarida brasiliensis* (1 voucher, others marked/released)

[Note that 20 *Nycticeius humeralis* were captured and marked/released from bridge support at the netting locality]

3. RESULTS FOR BATS – ELECTRONIC DETECTION

The following is a summary of the results of electronic detection of bats occurring within the Barataria Preserve. **FIGURE 3** illustrates a map of electronic detection site localities. The use of electronic bat detectors at 9 site localities for 44 detector nights resulted in the documentation of 1,624 bat pass sequences and 46,745 bat calls for the 5 mist-net captured species, as well as for 2 additional species that were not captured in mist nets: *Lasiurus borealis* (eastern red bat) and *Lasiurus intermedius* (yellow bat). Of the 1,624 bat pass sequences recorded, 74% were positively identified as one of the 7 species (**FIGURES 11-12**). The remaining 26% were documented as bat calls but were unidentifiable. The most frequent species encountered was *P. subflavus*, which comprised nearly 50% of the bat pass sequences, while the fewest recordings (less than 1%) were documented for *L. intermedius*. A summary of electronic detecting effort and results follows:

Summary of **Electronic Detection** Results – **by Species** (see **FIGURES 11-12**)

Species	Number of Sequences	Number of Calls	Frequency Min.
<i>Pipistrellus subflavus</i>	567	18,650	42-44
<i>Nycticeius humeralis</i>	300	6,526	35-37
<i>Myotis austroriparius</i>	123	3,465	45-47
<i>Corynorhinus rafinesquii</i>	33	458	47
<i>Tadarida brasiliensis</i>	21	409	27
<i>Lasiurus borealis</i>	153	4,785	40
<i>Lasiurus intermedius</i>	3	33	26
Multiple	154	9,112	--
Unidentified	270	3,307	--
Total	1,624	46,745	--

4. TRAPPING RESULTS FOR SMALL/MEDIUM-SIZED MAMMALS

The following is a summary of the results of trapping for documenting mammals occurring within the Barataria Preserve. **FIGURE 5** illustrates a map of trapping site localities. A total of 8 site localities, 19 traplines, and 7,304 trap-nights resulted in capture of 100 mammals (many of which were recaptures) representing 7 species – *Didelphis virginiana*, *Sciurus carolinensis*, *Oryzomys palustris*, *Peromyscus leucopus*, *Sigmodon hispidus*, *Rattus rattus*, and *Mus musculus*. A summary of trapping effort and results follows:

A. Marsh and Adjacent Natural Levee Bank and Spoil Bank (Sites 1-3, see **FIGURE 5**)

At each of these sites, several traplines were placed on the natural levee bank or canal spoil bank and 100-200 meters into the adjacent marsh. A total of 3 sites, 9 traplines, and 1,640 trap-nights resulted in capturing 60 individuals of rodents and an opossum. Only the single opossum was captured on the banks. Two rodent species were captured in the marsh – *Oryzomys palustris* and *Sigmodon hispidus*. With the high number of recaptures (66%) in the immediately adjacent marsh yet no captures of any rodents on the banks, it seems unlikely that rodents are resident on natural levees or canal spoil banks or use the banks regularly.

Summary of Site Trapping Results:

Site 1 (Bayou Segnette Waterway) – 2 traplines, 260 trap-nights

1 *Didelphis virginiana* (and no recaptures)

Site 2 (Oak Chenier) – 4 traplines, 1,110 trap-nights

37 *Oryzomys palustris* (and 19 recaptures)

Site 3 (Tarpaper Canal) – 3 traplines, 684 trap-nights

23 *Oryzomys palustris* (and 21 recaptures)

B. Bottomland Hardwood Forest and Swamps (Sites 4-8, see **FIGURE 5**)

At each of these sites, several traplines were placed. A total of 5 sites, 10 traplines, and 5,260 trap-nights resulted in capturing 39 individuals of 3 rodent species – *Peromyscus leucopus*, *Rattus rattus*, and *Mus musculus*. With 25 recaptures there was a total of 64 captures.

Summary of Site Trapping Results:

Site 4 (Oak hardwoods, E. Plantation trail) – 2 traplines, 1,596 trap-nights

7 *Peromyscus leucopus* (and 11 recaptures)

Site 5 (Oak hardwoods, N. Old Barataria trail) – 2 traplines, 896 trap-nights

12 *Peromyscus leucopus* (and 7 recaptures)

Site 6 (Oak hardwoods, S. Old Barataria trail) – 3 traplines, 1,590 trap-nights

5 *Peromyscus leucopus* (and 6 recaptures)

Site 7 (Hardwood/Swamp, NE Twin Canals) – 2 traplines, 1,175 trap-nights

10 *Peromyscus leucopus* (and no recaptures)

1 *Mus musculus* (and no recaptures)

1 *Rattus rattus* (and no recaptures)

1 *Sciurus carolinensis* (and no recaptures)

Site 8 (Bayou des Familles, W. Education Center) – 1 trapline, 3 trap-nights

2 *Didelphis virginiana* (and 1 recapture)

5. MOTION-ACTIVATED CAMERA RESULTS FOR LARGE MAMMALS

The following is a summary of the results of motion-activated cameras for documenting mammals occurring within the Barataria Preserve. **FIGURE 7** illustrates a map of camera site localities. A total of 11 site localities and 1,462 camera-days resulted in 438 photographs of mammals (with some repeated photographs of individuals) representing 9 species – *Didelphis virginiana*, *Dasypus novemcinctus*, *Sylvilagus aquaticus*, *Sciurus carolinensis*, *Myocastor coypus*, *Canis latrans*, *Procyon lotor*, *Felis catus*, *Odocoileus virginianus*. A summary of results by site and by species follows:

A. Marsh and Adjacent Natural Levee Bank and Spoil Bank (Sites 1-6, see **FIGURE. 7**)

At each of these sites, 1-2 cameras were placed on the natural levee bank or canal spoil bank or within the adjacent marsh. Marsh and adjacent banks captured many photographs of medium-sized and large mammals, especially white-tailed deer and coyotes. Judging by individual markings, many of photographs appear to be of different individuals, documenting a substantial population of these large mammals in a habitat that are not considered optimal for them (the sites are embedded in large areas of floating marsh). A great deal of sign (tracks, scat, digging) was evident at all sites. It is noteworthy that sign (tracks, digging) was also very commonly observed on all natural levee and canal spoil banks for nine-banded armadillos and that photographs of nine-banded armadillos were taken at Site 1.

Summary of Marsh/natural levee/spoil bank Camera Results – **by Site**

Site 1 (Bayou Segnette Waterway) – 2 cameras, 78 camera-days

3 *Didelphis virginiana*

5 *Dasypus novemcinctus*

2 *Sylvilagus aquaticus*

2 *Sciurus carolinensis*

36 *Canis latrans*

7 *Procyon lotor*

5 *Odocoileus virginianus*

Site 2 (Oak Chenier) – 2 cameras, 284 camera-days

- 3 *Sylvilagus aquaticus*
- 37 *Canis latrans*
- 20 *Procyon lotor*
- 1 *Odocoileus virginianus*

Site 3 (Wreck Keyhole, E. spoil bank) – 2 cameras, 45 camera-days

- 3 *Procyon lotor*
- 7 *Odocoileus virginianus*

Site 4 (Powerline, W. spoil bank,) – 1 camera, 75 camera-days

- 2 *Sylvilagus aquaticus*
- 1 *Procyon lotor*
- 3 *Myocastor coypus*

Site 5 (Wax myrtle marsh) – 1 cameras, 99 camera-days

- 5 *Sylvilagus aquaticus*
- 1 *Sciurus carolinensis*
- 11 *Canis latrans*
- 31 *Odocoileus virginianus*

Site 6 (Tarpaper Canal, SW. spoil bank) – 2 cameras, 60 camera-days

- 2 *Dasyus novemcinctus*
- 5 *Sylvilagus aquaticus*
- 2 *Sciurus carolinensis*
- 4 *Procyon lotor*
- 20 *Odocoileus virginianus*

Summary of Marsh/natural levee/spoil bank Camera Results – **by Species**

<i>Didelphis virginiana</i>	3
<i>Dasyus novemcinctus</i>	7
<i>Sylvilagus aquaticus</i>	17
<i>Sciurus carolinensis</i>	4
<i>Myocastor coypus</i>	3
<i>Canis latrans</i>	84
<i>Procyon lotor</i>	35
<i>Odocoileus virginianus</i>	54

B. Bottomland Hardwood Forests and Swamps (Sites 7-11, see **FIGURE 7**)

At each of these sites, 1-2 cameras were placed on within the forest or swamp. Many photographs were captured of medium-sized and large mammals, especially white-tailed deer, coyotes and nine-banded armadillos. Excepting for nine-banded armadillos, many of photographs appear to be of different individuals, documenting a substantial population of these large mammals. Nine-banded armadillos do not appear to leave the area when a photograph is taken (and camera flash goes off), therefore the numbers of photographs greatly over-estimate

population numbers. However, they are frequently observed at both day and night throughout the forested areas.

Summary of Bottomland Hardwood Forest/Swamp Camera Results – **by Site**

Site 7 (NW Twin Canals) – 1 cameras, 101 camera-days

22 *Odocoileus virginianus*

Site 8 (Bayou des Familles, bank/swamp) – 1 cameras, 60 camera-days

5 *Dasyopus novemcinctus*

6 *Sciurus carolinensis*

1 *Canis latrans*

5 *Odocoileus virginianus*

Site 9 (NE Plantation trail) – 1 cameras, 180 camera-days

2 *Dasyopus novemcinctus*

3 *Sciurus carolinensis*

0 *Canis latrans*

2 *Procyon lotor*

2 *Odocoileus virginianus*

Site 10 (S Old Barataria trail) – 1 cameras, 168 camera-days

6 *Didelphis virginiana*

33 *Dasyopus novemcinctus*

1 *Sylvilagus aquaticus*

15 *Sciurus carolinensis*

2 *Canis latrans*

1 *Procyon lotor*

15 *Odocoileus virginianus*

Site 11 (N Old Barataria trail) – 2 cameras, 292 camera-days

49 *Dasyopus novemcinctus*

2 *Sylvilagus aquaticus*

5 *Canis latrans*

1 *Procyon lotor*

44 *Odocoileus virginianus*

Summary of Bottomland Hardwood Forest/swamp Camera Results – **by Species**

Didelphis virginiana 6

Dasyopus novemcinctus 84

Sylvilagus aquaticus 3

Sciurus carolinensis 25

Canis latrans 8

Procyon lotor 2

Odocoileus virginianus 100

6. SPECIES ACCOUNTS

The following accounts provide assignments of a) park status, b) abundance, c) residency, d) voucher/observation status, and e) additional comments of the mammal species documented in this study at the Barataria Preserve of JLNHPP.

ORDER MARSUPIALIA—Marsupials Family Didelphidae

Didelphis virginiana (Virginia opossum)

PARK STATUS: Present. Occurs in swamp, bottomland hardwood forest, natural levees/canal spoilbanks, and marshes throughout the Barataria Preserve.

ABUNDANCE: Common.

RESIDENCY: Resident and Breeder. Native.

VOUCHER / OBSERVATIONS: Voucher photographs of live captured specimens, numerous photographic and personal observations of tracks and live individuals.

COMMENTS: Although secretive, Virginia opossums were observed in all major habitats of the Barataria Preserve with motion-activated cameras, live-trapping, and observations of sign. A native of wetland habitats of southeast Louisiana, they are an expected resident species of the Barataria Preserve. JLNHPP hunting records dating back to the mid 1980s record Virginia opossums being occasionally taken as “by-catch” to nutria-trapping in swamp and marsh habitats.

ORDER CHIROPTERA—Bats Family Vespertilionidae (vespertilionid bats)

Myotis austroriparius (southeastern myotis)

PARK STATUS: Present. Occurs in swamps, bottomland hardwood forests, and along waterways.

ABUNDANCE: Uncommon. May be locally common in bottomland hardwood forests and swamps, but population size is likely low.

RESIDENCY: Resident and likely Breeder. Native.

VOUCHER / OBSERVATIONS: Voucher specimens, photographs of live captured specimens, and electronic detection of calls from the bottomland hardwood forests east of Bayou des Familles and in swamps and along waterways adjacent to the Coquille trail (paralleling Bayou Coquille) and Kenta Canal.

COMMENTS: Southeastern myotis are uncommonly and rarely encountered throughout their range in the southern United States. In southeast Louisiana and along the Mississippi Gulf Coast, they have been most commonly found inhabiting bridges and occasionally roosting in hollow trees of oaks, hickories (*Carya* spp.), tupelos. The live-trapping of one individual and the frequent electronic recording of the species at the study localities throughout the evening hours suggest that the species is resident in the Barataria Preserve and is likely using the bottomland hardwood forest (and swamp) trees as roost sites. The population status of this species should be studied further at the Barataria Preserve, especially their use of roost tree species. The Louisiana Natural Heritage Program does not list southeastern myotis as a species of concern, but does recommend the need for study to understand its status in the state. Other states and some National Wildlife Refuges list it as a species of concern.

Pipistrellus subflavus (eastern pipistrelle)

PARK STATUS: Present. Occurs in swamps, bottomland hardwood forests, and along waterways.

ABUNDANCE: Common.

RESIDENCY: Resident and likely Breeder. Native.

VOUCHER / OBSERVATIONS: Voucher specimens, photographs of live captured specimens, and electronic detection of calls from the hardwood forests east of Bayou des Familles and in swamps and along waterways adjacent to the Coquille trail (paralleling Bayou Coquille) and Kenta Canal.

COMMENTS: Eastern pipistrelles are one of the most commonly encountered bat species at the Barataria Preserve. They are commonly encountered throughout their range in the southern United States. In southeast Louisiana and along the Mississippi Gulf Coast, they have been most commonly found inhabiting man-made structures, buildings, and occasionally roosting in trees (hardwoods and pines). The live capture of 3 individual and the frequent electronic recording of the species at all study localities throughout the evening hours seasons suggest that the species is resident in the Barataria Preserve and is likely using the bottomland hardwood forest (and swamp) trees as roost sites. As has been found in other studies of eastern pipistrelle, this species was found to be first species to emerge in the very early evening hours. The documentation of eastern pipistrelles as being resident throughout the year is a new finding. In previous studies (see Jones and Pagels 1968, Jones and Suttikus 1973), eastern pipistrelles from southeast Louisiana migrate north during the winter/spring to establish maternity colonies. The population status of this species should be studied further at the Barataria Preserve, especially their use of roost tree species.

Lasiurus borealis (eastern red bat)

PARK STATUS: Present. Occurs in swamps, bottomland hardwood forests, and along waterways.

ABUNDANCE: Uncommon. May be locally common (in bottomland hardwood forests and swamps), but population size is likely low.

RESIDENCY: Unknown, possible Resident or Migrant. Native

VOUCHER / OBSERVATIONS: The only vouchers are voucher electronic recordings of echolocation calls from the hardwood forests east of Bayou des Familles and in swamps and along waterways adjacent to the Coquille trail (paralleling Bayou Coquille) and Kenta Canal. No red bats were captured in mist nets.

COMMENTS: Eastern red bat are commonly encountered throughout its range in the eastern United States. In southeast Louisiana and along the Mississippi Gulf Coast, they have been most commonly found roosting among Spanish moss-covered hardwoods, in swamps, and in coastal marshes. Based on distributional records in southeast Louisiana, eastern red bat was expected to be a commonly encountered bat species at the Barataria Preserve. However, mist netting did not capture any individuals. The electronic recording of calls identified as eastern red bat is presented as documentation evidencing their occurrence at the Barataria Preserve. The calls of red bats are considered readily identified compared with other bat species with a characteristic frequency sweep that terminates at 40 kHz (see **FIGURE 12**). The echolocation calls of the seminole bat (*L. seminolis*), is the only other lasiurine bat species that could overlap with red bats. The population status of this species should be studied further at the Barataria Preserve, especially their use of roost tree species.

Lasiurus intermedius (yellow bat)

PARK STATUS: Present. Occurs in swamps, bottomland hardwood forests, and along waterways.

ABUNDANCE: Uncommon. May be locally common (in hardwood forests and swamps), but population size is likely low.

RESIDENCY: Unknown, possible Resident or Migrant. Native.

VOUCHER / OBSERVATIONS: The only vouchers are voucher electronic recordings of echolocation calls from the bottomland hardwood forests east of Bayou des Familles and in swamps and along waterways adjacent to the Coquille trail (paralleling Bayou Coquille) and Kenta Canal. No yellow bats were captured in mist nets.

COMMENTS: Yellow bat is uncommonly encountered throughout their range in the eastern United States. In southeast Louisiana and along the Mississippi Gulf Coast, they have been most often found roosting among Spanish moss-covered hardwoods and in association with palmettos. Based on distributional records, yellow bat could possibly be encountered at the Barataria Preserve. However, mist netting did not capture any individuals. The electronic recording of calls identified as yellow bat is presented as documentation evidencing their occurrence at the Barataria Preserve. The calls of yellow bats are considered readily identified compared with other bat species with a characteristic frequency sweep that terminates at about 25 kHz. No other bats in our area have calls that have echolocation characteristics that overlap

with yellow bats. The population status of this species should be studied further at the Barataria Preserve, especially their use of roost tree species.

Nycticeius humeralis (evening bat)

PARK STATUS: Present. Occurs in swamps, bottomland hardwood forests, and along waterways.

ABUNDANCE: Uncommon. May be locally common (in bottomland hardwood forests and swamps), but population size is likely low.

RESIDENCY: Resident and Breeder. Native.

VOUCHER / OBSERVATIONS: Voucher specimens, photographs of live captured specimens, and electronic detection of calls from the bottomland hardwood forests east of Bayou des Familles and in swamps and along waterways adjacent to the Coquille trail (paralleling Bayou Coquille) and Kenta Canal.

COMMENTS: Evening bats are commonly encountered throughout their range in the eastern United States. In southeast Louisiana and along the Mississippi Gulf Coast, they have been most often found roosting in buildings, other man-made structures, and in hollow trees (hardwoods and pines) in uplands and swamps. The live capture of 25 individuals, the discovery of a maternity colony at the bridge supports at Kenta Canal/Bayou Coquille, and the frequent electronic recording of the species at all study localities throughout the evening hours and seasons document that the species is resident and maintains a breeding population at the Barataria Preserve (**FIGURE 10**). Evening bats are likely using the bottomland hardwood forest (and swamp) trees as roost sites, in addition to man-made structures. Given the discovery of a maternity colony location, the population status and breeding biology of this species should be studied further at the Barataria Preserve.

Corynorhinus rafinesquii (Rafinesque's big-eared bat)

PARK STATUS: Present. Occurs in swamps, bottomland hardwood forests, and along waterways.

ABUNDANCE: Uncommon. May be locally common (in bottomland hardwood forests and swamps), but population size is likely low.

RESIDENCY: Resident and likely Breeder. Native.

VOUCHER / OBSERVATIONS: Voucher specimens, photographs of live captured specimens, and electronic detection of calls from the hardwood forests east of Bayou des Familles, and in swamps and along waterways adjacent to the Coquille trail (paralleling Bayou Coquille) and Kenta Canal.

COMMENTS: Rafinesque's big-eared bats are uncommonly and rarely encountered throughout their range in the southern United States. In southeast Louisiana and along the Mississippi Gulf Coast, they have been most often found in maternity or mixed sex colonies inhabiting bridges, buildings, and occasionally roosting in hollow trees (hardwoods). The live capture of two individuals and the electronic recording of the species at the study localities early in the evening suggests that the species is resident in the Barataria Preserve and is likely using the bottomland hardwood forest trees as roost sites. The population status of this species should be studied further at the Barataria Preserve, especially their use of roost tree species. The Louisiana Natural Heritage Program does not list Rafinesque's big-eared bats as a species of concern, but does recommend the need for study to understand its status in the state. Other states and some National Wildlife Refuges list it as a species of concern.

Family Molossidae (free-tailed bats)

Tadarida brasiliensis (Brazilian free-tailed bat)

PARK STATUS: Present. Occurs in swamps, bottomland hardwood forests, and along waterways.

ABUNDANCE: Uncommon. May be locally common (in bottomland hardwood forests and swamps), but population size is likely low.

RESIDENCY: Unknown, possible Resident, but likely Migrant. Native.

VOUCHER / OBSERVATIONS: Voucher specimens, photographs of live captured specimens, and electronic detection of calls from the hardwood forests east of Bayou des Familles, and in swamps and along waterways adjacent to the Coquille trail (paralleling Bayou Coquille) and Kenta Canal.

COMMENTS: Free-tailed bats are commonly encountered throughout its range in North America. Along the Mississippi Gulf Coast they have been most often found roosting in buildings and other man-made structures. Free-tailed bats form very large colonies (1,000s of individuals), usually occupying large cave systems or abandoned buildings. Based on their natural history and distributional records in southeast Louisiana, free-tailed bats was expected to be encountered at the Barataria Preserve as a non-resident bat, foraging at the park from nearby urban areas. The live capture of 4 individuals and the electronic recording of the species at the Kenta Canal and Bayou des Familles late in the evening suggests that the species is not a resident in Barataria and is likely foraging in the park habitats. The status of this species should be studied further at the Barataria Preserve, especially to establish their residency, population status, and use of the park.

ORDER XENARTHRA—Edentates **Family Dasypodidae (armadillos)**

Dasypus novemcinctus (nine-banded armadillo)

PARK STATUS: Present. Occurs in swamp, bottomland hardwood forest, natural levees/canal spoilbanks, and marshes.

ABUNDANCE: Common.

RESIDENCY: Resident and Breeder. Non-native. (to southeast Louisiana and Barataria)

VOUCHER / OBSERVATIONS: Voucher specimen, photographs of live captured specimens, photographic and personal observations of burrows, tracks and live individuals.

COMMENTS: Nine-banded armadillos were observed in all major habitats of the Barataria Preserve with motion-activated cameras, and observations of sign. They are non-native to Louisiana and to the Barataria Preserve, having extended their range from northern Mexico into western Louisiana in the 1920s. The occurrence of nine-banded armadillos in southeast Louisiana and in the vicinity of the Barataria Preserve is as recent as the 1970s. Today they are among the most common mammals sighted in daylight and early evening hours in the bottomland hardwood forests and swamps east of Bayou des Familles and along all public trails of the park. The activity of nine-banded armadillos (digging for food and constructing burrows) in the bottomland hardwood forests and swamps are likely to be contributing various ecological services to the forest floor ecosystem. It is noteworthy that sign (tracks, digging) was also very commonly observed on all natural levee and canal spoil banks throughout the park, including spoil banks extending far into the marsh. The ability of nine-banded armadillos to traverse waterways to become distributed on all spoil banks of the park is remarkable.

ORDER LAGOMORPHA—Lagomorphs
Family Leporidae (hares and rabbits)

Sylvilagus aquaticus (swamp rabbit)

PARK STATUS: Present. Occurs in swamp, hardwood forest, natural levees/canal spoilbanks, and marshes.

ABUNDANCE: Common.

RESIDENCY: Resident and Breeder. Native.

VOUCHER / OBSERVATIONS: Voucher photographs of live captured specimens, photographic and personal observations of tracks, scat and live individuals.

COMMENTS: Swamp rabbits were observed in all major habitats of the Barataria Preserve with motion-activated cameras, live-trapping, observations of sign (scat, tracks) and live individuals. In southeast Louisiana and along the Mississippi Gulf Coast, they are one of the most common mammals of coastal wetlands, including both marsh and swamp habitats. Swamp rabbits are usually active and sighted in early morning and early evening hours in the bottomland hardwood forests and swamps east of Bayou des Familles, along public trails of the park, on natural levees and canal spoil banks, and especially in marsh habitats. Examination of owl pellets collected

from barn owls (*Tyto alba*) and barred owls (*Striz varia*) on spoil banks adjacent to marsh habitats contain fragments of swamp rabbit bones. Coyote scats examined throughout the park have swamp rabbit fur and bones. Thus, swamp rabbits represent a major food resource for the raptors and carnivores inhabiting the Barataria Preserve. JLNHPP hunting and trapping records dating back to the late 1980s record swamp rabbits being regularly taken as “by-catch” to nutria-trapping in swamp and marsh habitats.

ORDER RODENTIA—Rodents
Family Sciuridae (squirrels and allies)

Sciurus carolinensis (Eastern gray squirrel)

PARK STATUS: Present. Occurs in swamps, bottomland hardwood forests, and natural levees/canal spoilbanks .

ABUNDANCE: Common. Occurs in forested (non-marsh) habitats

RESIDENCY: Resident and Breeder. Native.

VOUCHER / OBSERVATIONS: Voucher specimen, photographs of live captured specimens, photographic and personal observations of tracks, scat and live individuals.

COMMENTS: Eastern gray squirrels were observed in all major habitats of the Barataria Preserve, except for marshes, with motion-activated cameras, live-trapping, and observations of sign (scat, tracks) and live individuals. In southeast Louisiana and along the Mississippi Gulf Coast, they are a common squirrel of wooded areas, especially near cities and towns. Eastern gray squirrels are usually active and sighted in daylight hours in the bottomland hardwood forests and swamps east of Bayou des Familles, along public trails of the park, on natural levees and canal spoil banks. Owl pellets collected from barred owls on spoil banks adjacent to marsh habitats can contain fragments of eastern gray squirrel bones. Coyote scats examined throughout the park can include gray squirrel fur and bones. Thus, eastern gray squirrels represent a food resource for the raptors and carnivores inhabiting the Barataria Preserve. JLNHPP hunting and trapping records dating back to the mid 1980s record eastern gray squirrels as being taken regularly during the fall hunting season. During the 2002-2004 hunting seasons, several hundred were taken by hunters annually (pers. comm., Leigh Zahm, NPS Law Enforcement officer). Enforcement officers and park naturalists report that in reviewing hunting takes of squirrels, all were eastern gray squirrels, as opposed to fox squirrels (*Sciurus niger*).

Family Cricetidae (native mice and rats)

Oryzomys palustris (marsh rice rat)

PARK STATUS: Present. Occurs in marsh and swamp habitats.

ABUNDANCE: Common. Occurs in marsh habitats.

RESIDENCY: Resident and Breeder. Native.

VOUCHER / OBSERVATIONS: Voucher specimens, photographs of live captured specimens, photographic and personal observations of live individuals.

COMMENTS: Marsh rice rat is the most common rodent inhabiting marsh habitats in the Barataria Preserve. Seventy individuals were live-trapped within marsh and an additional 40 recaptures were made. However, of over 400 trap-nights on spoil banks adjacent to marsh habitats, no marsh rice rats were captured. This suggests that they do not frequently use spoil bank habitats. Additionally, of over 5,000 trap nights in bottomland hardwood forests and swamps, no rice rats were captured. Examination of owl pellets collected from barn owls and barred owls on spoil banks adjacent to marsh habitats predominately contain fragments of marsh rice rat bones. Thus, marsh rice rats represent a major food resource for the raptors inhabiting the Barataria Preserve.

Peromyscus leucopus (white-footed mouse)

PARK STATUS: Present. Occurs in bottomland hardwood forest and swamp habitats.

ABUNDANCE: Common. Occurs in suitable bottomland hardwood forest and swamp habitats.

RESIDENCY: Resident and Breeder. Native.

VOUCHER / OBSERVATIONS: Voucher specimens, photographs of live captured specimens, photographic and personal observations of live individuals.

COMMENTS: The white-footed mouse is one of the common rodents inhabiting forested areas and riparian habitats in the eastern United States. Given distributional and previous voucher records, it was not surprising that it is the most common rodent inhabiting forested habitats in the Barataria Preserve. Twenty-nine individuals were live-trapped within hardwood forests and swamps and an additional 18 recaptures were made. However, of over 400 trap-nights on spoil banks adjacent to marsh habitats, no white-footed mice were captured. Likewise, owl pellets collected from barn owls and barred owls on spoil banks adjacent to marsh habitats did not contain any fragments of white-footed mice bones. This suggests that they do not frequently use spoil bank habitats deep within the marsh. In southeast Louisiana and the Mississippi Gulf Coast, white-footed mice can be found sympatrically with a congener, cotton mouse (*Peromyscus gossypinus*). To date, the cotton mouse had not been documented to occur in the Barataria Preserve.

Sigmodon hispidus (hispid cotton rat)

PARK STATUS: Present. Only recorded from marsh habitats.

ABUNDANCE: Uncommon. May be locally common (in marsh and swamp habitats), but population size is likely low.

RESIDENCY: Resident and Breeder. Native.

VOUCHER / OBSERVATIONS: No voucher specimens, but two individuals were live captured and marked/released.

COMMENTS: The hispid cotton rat is a common rodent inhabiting many grassland, wetland, forest and riparian habitats, as well as agricultural land in the United States, including Louisiana. Given its distributional records, hispid cotton rats were expected to be found in some or all of the habitats in the Barataria Preserve. Only 3 individuals were live-trapped and both of these were captured (and multiply re-captured) within a *Sagittaria*-dominated marsh. These individuals were marked and released and no others captured thereafter, thus the lack of a voucher specimen. Over 400 trap-nights on spoil banks adjacent to marsh habitats did not result in any captures. None of the owl pellets collected from barn owls and barred owls on spoil banks adjacent to marsh habitats contained fragments of cotton rat bones. Hispid cotton rats were not captured in over 5,000 trap-nights of collecting in forests and swamps. Despite the lack of additional captures or observations, the documentation of cotton rats within a marsh site far from other habitats suggests that there is a resident population at the Barataria Preserve. The status of this species should be studied further at the Barataria Preserve, especially to establish their residency, population status, and use of the park

Ondatra zibethicus (muskrat)

PARK STATUS: Present. Occurs in marsh habitats

ABUNDANCE: Uncommon. May be locally common (in marsh habitats), but population size is likely low.

RESIDENCY: Resident and Breeder. Native.

VOUCHER / OBSERVATIONS: Voucher specimen (skull) and photographs of an active muskrat mound (**FIG. 13**) and personal observations of tracks and scat.

COMMENTS: Historically, muskrats were the most important fur-bearing mammal in coastal Louisiana. However, significant declines in muskrat populations have been noted during the past several decades. Some resource managers attribute this to population expansion by nutria. Apparently, muskrats have not been abundant in Barataria for many decades. Today they appear to be restricted to *Scirpus* spp.-dominated marsh habitats, which are uncommon and patchy in Barataria. Exploring several patches of *Scirpus* (currently known as *Schoenoplectus*) within the marsh provided observations of active mounds, tracks, and scat. JLNHPP hunting and trapping records dating back to the mid 1980s record muskrats being rarely taken as “by-catch” to nutria-

trapping in swamp and marsh habitats. Given the historical and cultural significance of muskrats to the region, the population status of this species should be studied further at the Barataria Preserve, especially to increase knowledge of their residency and population status. Study of the ecological relationship between muskrats and nutria (which are highly abundant) is another potentially important area of future research.

***Family Muridae (Old World rats and mice)**

****Rattus rattus*** (black rat)

PARK STATUS: Present. Occurs in near NPS buildings, public facilities, and in nearby forested areas.

ABUNDANCE: Uncommon. May be locally common (near NPS buildings, public facilities), but population size is likely low.

RESIDENCY: Resident and Breeder. Non-native.

VOUCHER / OBSERVATIONS: Voucher specimen and personal observations of live individuals.

COMMENTS: The black rat is an introduced species commonly associated with buildings and urban areas. At the Barataria Preserve, they are pests that occasionally occupy NPS buildings and public facilities. Only 1 individual was captured in trapping and that was at the Twin Canals forest trapping locality that was within 200 meters of the Twin Canals public boat launch. With no other specimens captured in over 7,500 trap-nights of effort it is likely that black rats do not occur in natural habitats of the park. An effort should be made to control the population of black rats that live near NPS facilities to ensure that their populations do not grow and expand into natural areas.

****Mus musculus*** (house mouse)

PARK STATUS: Present. Occurs in near NPS buildings, public facilities, and in nearby forested areas.

ABUNDANCE: Uncommon. May be locally common (near NPS buildings, public facilities), but population size is likely low.

RESIDENCY: Resident and Breeder. Non-native.

VOUCHER / OBSERVATIONS: Voucher specimen and personal observations of live individuals.

COMMENTS: The house mouse is an introduced species commonly associated with buildings and urban areas. At the Barataria Preserve, they are pests that occasionally occupy NPS buildings and public facilities. Only 1 individual was captured in trapping and that was at the Twin Canals forest trapping locality that was within 200 meters of the Twin Canals public boat launch. With no other specimens captured in over 7,500 trap-nights of effort it is likely that house mice do not occur in most natural habitats of the park. As in the account of the black rat,

an effort should be made to control their populations at NPS facilities so that their populations do not grow and expand into natural areas.

***Family Myocastoridae (myocastorids)**

****Myocastor coypus* (nutria)**

PARK STATUS: Present. Occurs in marsh and swamp habitats

ABUNDANCE: Common.

RESIDENCY: Resident and Breeder. Non-native.

VOUCHER / OBSERVATIONS: Voucher photographs and personal observations of live individuals.

COMMENTS: Nutria are an introduced species that became established in Louisiana in the 1920s and dramatically expanded their distributional range and population numbers. Numbers of nutria within the marshes of the Barataria Preserve are so great that active management programs have been in place for many years. Several important recent studies concerning population biology have been conducted in the park during the past few years. Nolfo-Clements (2006) documents their fine scaled habitat use (to plant species) and movement in the float marsh. Nutria are usually active and can be sighted in early morning and early evening hours in swamps, along public trails of the park, on natural levees and canal spoil banks, and especially in marsh habitats. They can be seen on trails within the forests east of Bayou des Familles, but are less common there. Given the historical and cultural significance of trapping to the region, the status of this species should be studied further at the Barataria Preserve, especially to develop management strategies [their residency and population status is well established]. A study of the ecological relationship between muskrats and nutria is another potentially important area of future research.

ORDER CARNIVORA—Carnivores
Family Canidae (canids)

***Canis latrans* (coyote)**

PARK STATUS: Present. Occurs in swamp, bottomland hardwood forest, natural levees / canal spoil banks, and marshes.

ABUNDANCE: Common. Occurs in all habitats.

RESIDENCY: Resident and Breeder. Non-native. (Native to North America, but non-native to southeast Louisiana and the Barataria Preserve)

VOUCHER / OBSERVATIONS: Voucher photographs, numerous additional photographic and personal observations of tracks, scat, and live individuals.

COMMENTS: Coyotes were observed in all major habitats of the Barataria Preserve with motion-activated cameras, and observations of sign. They are non-native to Louisiana and to the Barataria Preserve, having extended their range from the western United States into western Louisiana in the 1940s. The first occurrence of coyotes in southeast Louisiana and in the vicinity of the Barataria Preserve is as recent as the 1950s. The first confirmed observational record of a coyote at the Barataria Preserve was in 1987 (naturalist record). Today, coyotes are among the most common large mammals in all habitats of the park. Motion-activated cameras captured more than 90 photographs of coyotes, many of which appear to be different individuals. Coyote sign (scat, tracks, digging) was commonly observed on natural levees and canal spoil banks throughout the park. The sound of howling (groups of ~ 5-6 individuals) can be heard in the early evenings from the Marsh Overlook platform on the Bayou Coquille trail. Scats include hair and bone fragments of swamp rabbits and gray squirrels. The status of this species should be studied further at the Barataria Preserve, especially to establish its population size, dynamics, and impact on the overall ecology of the natural systems.

Family Procyonidae (procyonids)

***Procyon lotor* (raccoon)**

PARK STATUS: Present. Occurs in swamp, bottomland hardwood forest, natural levees / canal spoil banks, and marshes.

ABUNDANCE: Common. Occurs in all habitats.

RESIDENCY: Resident and Breeder. Native.

VOUCHER / OBSERVATIONS: Voucher photographs, numerous additional photographic and personal observations of tracks, scat, and live individuals.

COMMENTS: Raccoons were observed in all major habitats of the Barataria Preserve with motion-activated cameras, observations of sign and live individuals. They are adaptable, wide ranging generalists that can live in many different habitats and settings. Today, they are among the most common medium-large mammals in all habitats of the park. Motion-activated cameras captured many photographs of raccoons, some of which appear to be different individuals. Raccoon sign (scat, tracks,) was commonly observed on park trails, in forests, swamps, and on natural levees and canal spoil banks.

Family Mustelidae (mustelids)

Mustela vison (mink)

PARK STATUS: Present. Occurs in marshes and swamps.

ABUNDANCE: Uncommon. May be locally common, but population size is likely low.

RESIDENCY: Resident and Breeder. Native.

VOUCHER / OBSERVATIONS: Voucher specimen (road-killed).

COMMENTS: Mink are not common at the Barataria Preserve, but observations and records indicate that they inhabit marsh habitats. None were documented by motion-activated cameras, trapping, or observation of sign in the present study. One mink was found dead on LA HWY 45 within the park boundaries. JLNHPP hunting and trapping records dating back to the mid-1980s record mink as being occasionally taken as “by-catch” to nutria-trapping in swamp and marsh habitats. The most recent of these records are from 1992, although trapping focus has been on nutria this past decade. The status of this species should be studied further at the Barataria Preserve, especially to increase knowledge of their residency, population status, and use of the park

Lutra canadensis (river otter)

PARK STATUS: Present. Occurs in marshes, swamps, along waterways, and in bottomland hardwood forests.

ABUNDANCE: Uncommon. May be locally common, but population size is likely low.

RESIDENCY: Resident and Breeder. Native.

VOUCHER / OBSERVATIONS: Voucher specimen (road-killed).

COMMENTS: River otters are not common at the Barataria Preserve, but regular observations and records indicate that they are residents of the park. None were documented by motion-activated cameras, trapping, or observation of sign in the present study. Two river otters were found dead on the Lafitte-LaRose HWY (LA HWY 3134) at the northern boundary park. NPS staff and visitors report visual observations of river otters along park trails (Plantation trail and the Bayou Coquille trail), in waterways (Twin Canals, Kenta Canal, Bayou des Familles), and on natural levees and canal banks within the marsh habitats of the park about 5-6 times per year. JLNHPP hunting and trapping records dating back to the mid-1980s record river otters as being occasionally taken as “by-catch” to nutria-trapping in swamp and marsh habitats. The status of this species should be studied further at the Barataria Preserve, especially to increase knowledge of their residency, population status, and use of the park

Family Felidae (cats)

Felis rufus (bobcat)

PARK STATUS: Present.

ABUNDANCE: Uncommon. May be locally common, but population size is likely low.

RESIDENCY: Unknown, possible Resident or Migrant. Native

VOUCHER / OBSERVATIONS: Voucher photograph of tracks, personal observations of tracks at a scent station.

COMMENTS: The distribution records of bobcats and their natural history suggests that they should be expected to occur at the Barataria Preserve. No documented records existed prior to the present study, although a visitor sighting (on one of the Plantation trails) was reported in 2000. A set of well preserved, fresh tracks were observed at a scent station that was established on the Oak Chenier site locality. The station had been baited with bobcat urine scent. The tracks were photographed (see **FIGURE 14**) and a motion-activated camera placed at the site. Unfortunately, no additional tracks or photographs or live individuals were captured thereafter. The status of this species should be studied further at the Barataria Preserve, especially to establish their residency, population status, and use of the park

ORDER ARTIODACTYLA— Even-toed ungulates
Family Cervidae (cervids)

Odocoileus virginianus (white-tailed deer)

PARK STATUS: Present. Occurs in swamp, bottomland hardwood forest, natural levees / canal spoil banks, and marshes.

ABUNDANCE: Common. Occurs in all habitats.

RESIDENCY: Resident and Breeder. Native

VOUCHER / OBSERVATIONS: Voucher specimen, voucher photographs, numerous additional photographic and personal observations of tracks, scat, and live individuals.

COMMENTS: White-tailed deer were observed in all major habitats of the Barataria Preserve with motion-activated cameras, and observations of sign. They are the most common large mammals in all habitats of the park. Visitors can observe deer or deer sign along park trails and visitors walking on the Plantation trails (in bottomland hardwood forest) in early mornings or evenings are likely to see or hear deer moving through the forest. Motion-activated cameras captured over 150 photographs, many of which appear to be different individuals. Many of these records come from natural levees and canal spoil banks adjacent to marsh habitats. Cameras within the wax myrtle marsh site captured 31 photographs deer in less than one month. During the 2002-2004 hunting seasons, 70-80 deer are taken by hunters annually (pers. comm., Leigh

Zahm, NPS Law Enforcement officer). White-tailed deer populations are clearly quite large for the size and nature of the habitat at the Barataria Preserve. The impacts of deer populations on the park's ecology should be studied, especially as recent housing developments immediately north of the park have converted forested areas into residential subdivisions.

7. SPECIES ACCOUNTS FOR SPECIES REPORTED BUT UNDOCUMENTED OR NO LONGER PRESENT

The following accounts provide comments on the status of species have been reported (in previous NPS inventories, public hunting and trapping records, naturalist reports), or have been observed by NPS staff as occurring within the Barataria Preserve in the past (before 1990). Species with asterisk (*) are introduced or domesticated.

ORDER RODENTIA—Rodents Family Sciuridae (squirrels and allies)

Glaucomys volans (Southern flying squirrel)

PARK STATUS: Unconfirmed. Would occur in swamps and/or bottomland hardwood forests.

ABUNDANCE: Expected to be Common

RESIDENCY: Unknown Resident. Native

VOUCHER / OBSERVATIONS: None verified.

COMMENTS: Southern flying squirrels are common inhabitants of hardwood forests in the Southern United States., especially those dominated by oaks and hickories. Given their distributional records, the large number of large oak and other hardwood tree species in forested areas of the Barataria Preserve, they would be expected to occur in the park. Live traps (10 stations) were positioned on trees (at 2 m, **FIGURE 6**) within the north and south Old Barataria trail trapping sites for 66 trapnights, but failed to capture any individuals. Motion-triggered cameras in this area also did not photograph any southern flying squirrels. The bat field work included over 20 nights of work in these areas and another 20 nights of field observation did not lead to observations of southern flying squirrels. There does not seem to be any special reason why southern flying squirrels would not occur at the Barataria Preserve, aside from their evading observation given their secretive nature. This species should be studied further at the Barataria Preserve, especially to establish their residency, population status, and use of the park.

Family Castoridae (beavers)

Castor canadensis (beaver)

PARK STATUS: Historical. A beaver dam was constructed in the 1980s, and occupied for a short time, no re-occurrence. Would occur in swamps and/or bottomland hardwood forests.

ABUNDANCE: Expected to be Uncommon

RESIDENCY: Unknown Resident. Non-native (Native to Louisiana, not native to the Barataria Preserve).

VOUCHER / OBSERVATIONS: No vouchers. A beaver dam was constructed in the 1980s, and occupied for a short time.

COMMENTS: Beavers are moderately-common species of forested wetlands and waterways in much of eastern United States. They are not common in southeastern Louisiana. Given their distributional records, they could be expected to occur in the park. A beaver dam was observed to be constructed N. of Kenta Canal in the early 1980s (pers. comm., David Muth, Chief of Planning and Resource Stewardship). It was not maintained for more than a couple of years and the beaver was presumed to have left. No beavers were documented by motion-triggered cameras, trapping, or observations of sign in the present study. A special effort was made in the present study to determine if beavers occur at the Barataria Preserve. The lack of observations suggests that they do not presently occur in the park. This species should be studied further at the Barataria Preserve, especially to establish their residency, population status, and use of the park.

Family Cricetidae (native mice and rats)

Neotoma floridana (Eastern woodrat)

PARK STATUS: Unconfirmed. Would occur in swamps and/or bottomland hardwood forests.

ABUNDANCE: Expected to be Uncommon, but may be locally common in suitable habitat.

RESIDENCY: Unknown Resident. Native

VOUCHER / OBSERVATIONS: None verified.

COMMENTS: Eastern woodrats are common inhabitants of hardwood forests in the eastern U.S., especially those dominated by hardwoods. They are known to create stick middens (“woodrat middens”) throughout their range and have been recorded from hardwood forests and marsh habitats in southeast Louisiana. Given their distributional records, the large number of large oak and other hardwood tree species in forested areas of the Barataria Preserve, they would be expected to occur in the park. No evidence of eastern woodrats were documented through the field work of the present study. Care was taken to search for eastern woodrat middens and to trap in areas that included large amounts of woody debris on the forest floor. There does not seem to be any special reason why eastern woodrat would not occur at the Barataria Preserve,

aside from their evading observation through low population numbers. This species should be studied further at the Barataria Preserve, to establish their residency, population status, and use of the park.

ORDER CARNIVORA—Carnivores
Family Canidae (canids)

Vulpes vulpes (red fox)

PARK STATUS: Unconfirmed. Would occur in swamps, marshes, natural levees and canal spoil banks, and/or bottomland hardwood forests.

ABUNDANCE: Expected to be Uncommon, but may be locally common in suitable habitat.

RESIDENCY: Unknown Resident. Native

VOUCHER / OBSERVATIONS: None verified.

COMMENTS: Red foxes are moderately-common inhabitants of forests, agricultural areas in northern and central Louisiana. Historically, they were targeted as furbearers. They are not common in southeast Louisiana, although they have been observed in habitats on higher ground in the region over the past 20-30 years. Given their distributional records, they would not be expected to occur in the park. None were documented by motion-activated cameras, scent stations (baited with red fox urine), trapping, or observations of sign in the present study. JLNHPP hunting and trapping records dating back to the mid-1980s do not record any taken as “by-catch”, although annotations of “fox” occasionally are noted. This species should be studied further at the Barataria Preserve, especially to establish their residency, population status, and use of the park

Urocyon cinereoargenteus (gray fox)

PARK STATUS: Unconfirmed. Would occur in swamps, marshes, natural levees and canal spoil banks, and/or bottomland hardwood forests.

ABUNDANCE: Expected to be Uncommon, but may be locally common in suitable habitat.

RESIDENCY: Unknown Resident. Native

VOUCHER / OBSERVATIONS: None verified.

COMMENTS: Gray foxes are moderately-common inhabitants of forests and agricultural areas in northern and central Louisiana. Historically, they were targeted as furbearers. They are not common in southeast Louisiana, although they have been observed in habitats on higher ground in the region in recent years. Given their distributional records, they would not be expected to occur in the park. None were documented by motion-activated cameras, scent stations (baited with red fox and coyote urine), trapping, or observations of sign in the present study. JLNHPP hunting and trapping records dating back to the mid-1980s do not record any taken as “by-

catch”, although annotations of “fox” occasionally are noted. Several visitor reports have been made of “gray fox” on park trails, however field identification of gray fox and small (young adult) coyotes is difficult. This species should be studied further at the Barataria Preserve, especially to establish their residency, population status, and use of the park

ORDER ARTIODACTYLA— Even-toed ungulates
***Family Suidae (pigs)**

**Sus scrofa* (wild pig)

PARK STATUS: Historical. A small number of wild pigs were hunted and extirpated from the park in the early 1980s. Would occur in swamps and/or bottomland hardwood forests.

ABUNDANCE: Expected to be Common

RESIDENCY: Unknown Resident. Non-native

VOUCHER / OBSERVATIONS: No vouchers. A management hunt in early 1980s removed some individuals.

COMMENTS: Wild pigs (boar) are moderately-common, non-native invasive species of forests and agricultural areas in much of eastern United States. They are common in forested areas of southeast Louisiana. Large populations of wild pigs can be found in bottomland hardwood forests and swamps adjacent to the Mississippi River levee and in forests near Belle Chasse, LA (only 5 miles to the east of the Barataria Preserve). Given their distributional records, they would be expected to occur in the park and be a serious management concern. A small number of wild pigs were hunted and extirpated from the park in the early 1980s (pers. comm., David Muth, Chief of Planning and Resource Stewardship). None were documented by motion-triggered cameras, trapping, or observations of sign in the present study. A special effort was made in the present study to determine if wild pigs occur at the Barataria Preserve. The lack of observations suggests that wild pigs do not presently occur in the park. In February 2006 following fieldwork for this study, several visitor reports were made of wild pigs in the area of south Plantation trail. This species should be studied further at the Barataria Preserve, especially to establish their residency, population status, and use of the park.

RESULTS FOR CHALMETTE BATTLEFIELD

1. SPECIES LISTS

The following are checklists (organized in several ways) of the mammal species documented in this study at the Chalmette Battlefield of JLNHPP.

A. Species List of Documented Recent Mammals – Chalmette Battlefield

A total of 11 mammal species were documented as occurring within the Chalmette Battlefield in the present study. Species with asterisk (*) are introduced or domesticated.

ORDER CHIROPTERA—Bats

Family Vespertilionidae (vespertilionid bats)

Myotis austroriparius (southeastern myotis)

Pipistrellus subflavus (eastern pipistrelle)

Nycticeius humeralis (evening bat)

Family Molossidae (free-tailed bats)

Tadarida brasiliensis (Brazilian free-tailed bat)

ORDER XENARTHRA—Edentates

Family Dasypodidae (armadillos)

Dasypus novemcinctus (nine-banded armadillo)

ORDER LAGOMORPHA—Lagomorphs

Family Leporidae (hares and rabbits)

Sylvilagus aquaticus (swamp rabbit)

ORDER RODENTIA—Rodents

Family Sciuridae (squirrels and allies)

Sciurus carolinensis (eastern gray squirrel)

Family Cricetidae (native mice and rats)

Sigmodon hispidus (hispid cotton rat)

*Family Muridae (Old World rats and mice)

**Mus musculus* (house mouse)

*Family Myocastoridae (myocastorids)

**Myocastor coypus* (nutria)

ORDER CARNIVORA—Carnivores

Family Procyonidae (procyonids)
Procyon lotor (raccoon)

2. RESULTS FOR BATS – ELECTRONIC DETECTION

The following is a summary of the results of electronic detection of bats occurring within the Chalmette Battlefield unit. **FIGURE 14** illustrates a map of electronic detection site localities. The use of electronic bat detectors at 6 site localities for 6 detector nights resulted in the documentation of 136 bat pass sequences and 1,699 bat calls documenting the occurrence of 4 species – evening bat, eastern pipistrelle, southeastern myotis, and Brazilian free-tailed bat. Of the 136 bat pass sequences recorded, 90% were positively identified as one of the 4 species. The remaining 10% were documented as bat calls but were unidentifiable. The most frequent species encountered was the Brazilian free-tailed bat, which comprised nearly 70% of the bat pass sequences. A summary of electronic detecting effort and results follows:

Site 1 (NE. Battlefield Viewing Area)

Nycticeius humeralis 5 pass sequences, 103 calls
Tadarida brasiliensis 3 pass sequences, 15 calls

Site 2 (SE Battlefield Viewing Area)

Myotis austroriparius 3 pass sequences, 7 calls
Pipistrellus subflavus 1 pass sequences, 10 calls
Nycticeius humeralis 2 pass sequences, 33 calls
Tadarida brasiliensis 7 pass sequences, 74 calls

Site 3 (SW. Battlefield Viewing Area)

No calls recorded

Site 4 (Visitor Center)

Myotis austroriparius 1 pass sequences, 10 calls
Pipistrellus subflavus 1 pass sequences, 5 calls
Nycticeius humeralis 14 pass sequences, 140 calls
Tadarida brasiliensis 20 pass sequences, 273 calls

Site 5 (SW Mississippi River levee)

Myotis austroriparius 1 pass sequences, 16 calls
Pipistrellus subflavus 1 pass sequences, 10 calls
Nycticeius humeralis 7 pass sequences, 74 calls
Tadarida brasiliensis 1 pass sequences, 1 call

Site 6 (NW Boundary)

Pipistrellus subflavus 1 pass sequences, 10 calls
Nycticeius humeralis 20 pass sequences, 252 calls
Tadarida brasiliensis 50 pass sequences, 631 calls

Summary of Electronic **Detection** Results – by Species

Species	Number of Sequences	Number of Calls	Frequency Min.
<i>Tadarida brasiliensis</i>	83	1,053	27
<i>Nycticeius humeralis</i>	48	595	35-37
<i>Pipistrellus subflavus</i>	3	25	42-44
<i>Myotis austroriparius</i>	2	26	45-47
Total	136	1,699	--

3. TRAPPING RESULTS FOR SMALL/MEDIUM-SIZED MAMMALS

The following is a summary of the results of trapping for documenting mammals occurring within the Chalmette Battlefield. **FIGURE 15** illustrates a map of trapping site localities. A total of 2 site localities, 5 traplines, and 1,516 trap-nights resulted in capture of 8 mammals (with no recaptures of those individuals) representing 2 species – hispid cotton rat and house mouse. A summary of trapping effort and results follows:

Summary of Site Trapping Results:

Site 1 (Herbaceous Battlefield) – 2 traplines, 920 trap-nights

6 *Mus musculus* (kept as vouchers)

2 *Sigmodon hispidus* (kept as vouchers)

Site 2 (NE. Boundary Woods) – 3 traplines, 596 trap-nights

no captures

4. SPECIES ACCOUNTS

The following accounts provide assignments of a) park status, b) abundance, c) residency, d) voucher/observation status, and e) additional comments of the mammal species documented in this study at the Chalmette Battlefield of JLNHPP.

ORDER CHIROPTERA—Bats
Family Vespertilionidae (vespertilionid bats)

Myotis austroriparius (southeastern myotis)

PARK STATUS: Present.

ABUNDANCE: Uncommon. May be locally or seasonally common, but population size is likely low.

RESIDENCY: Unknown. Native.

VOUCHER / OBSERVATIONS: Voucher recordings of echolocation calls collected.

COMMENTS: Southeastern myotis are uncommonly and rarely encountered throughout their range in the southern United States. In southeast Louisiana and along the Mississippi Gulf Coast, they have been most commonly found in inhabiting bridges and occasionally roosting in hollow trees (oaks, hickories, tupelos). Two recordings (in June and August, 2005) of echolocation calls document the occurrence of the species at Chalmette Battlefield. Given the lack of suitable roosting habitat it is not likely that southeastern myotis are residents. Recordings were made a full hour after sunset, supporting the idea that these bats traveled to the area and are using it as a foraging site. The population status of this species should be studied further at the Chalmette Battlefield, especially to determine residency and use of the park as a foraging resource. The Louisiana Natural Heritage Program does not list southeastern myotis as a species of concern, but does recommend the need for study to understand its status in the state. Other states and some National Wildlife Refuges list it as a species of concern.

Pipistrellus subflavus (eastern pipistrelle)

PARK STATUS: Present.

ABUNDANCE: Uncommon. May be locally common, but population size is likely low.

RESIDENCY: Unknown. Native.

VOUCHER / OBSERVATIONS: Voucher recordings of echolocation calls collected.

COMMENTS: Eastern pipistrelles are commonly encountered throughout their range in the southern United States. In southeast Louisiana and along the Mississippi Gulf Coast, they have been most commonly found in inhabiting man-made structures, buildings, and occasionally roosting in trees (hardwoods and pines). Three recordings of echolocation calls in June and August, 2005 document the occurrence of the species at the Chalmette Battlefield. Given the lack of suitable roosting habitat it is not likely that eastern pipistrelles are residents. Recordings were made one to two hours after sunset, supporting the idea that these bats traveled to the area and are using it as a foraging site. The population status of this species should be studied further at the Chalmette Battlefield, especially to determine residency and use of the park as a foraging resource.

Nycticeius humeralis (evening bat)

PARK STATUS: Present.

ABUNDANCE: Common.

RESIDENCY: Unknown but possible Resident. Native.

VOUCHER / OBSERVATIONS: Voucher recordings of echolocation calls collected.

COMMENTS: Evening bats are commonly encountered throughout their range in the eastern United States. In southeast Louisiana and along the Mississippi Gulf Coast they have been most often found roosting in buildings, other man-made structures, and in hollow trees (hardwoods and pines) in uplands and swamps. Numerous pass sequences were recorded at 5 of 6 electronic detector sites in June and August 2005. Evening bats are known to be found in urban settings and adapt to use of building and man-made structures as roost sites. The number of pass sequences recorded each night suggest that a significant population of evening bats are foraging over the Chalmette Battlefield and may have roost sites nearby. The status of this species should be studied further at the Chalmette Battlefield, especially to determine residency and use of the park as a foraging resource.

Family Molossidae (free-tailed bats)

Tadarida brasiliensis (Brazilian free-tailed bat)

PARK STATUS: Present.

ABUNDANCE: Common.

RESIDENCY: Unknown Resident, but likely Migrant or Vagrant. Native.

VOUCHER / OBSERVATIONS: Voucher recordings of echolocation calls collected.

COMMENTS: Brazilian free-tailed bats are commonly encountered throughout their range in North America. In southeast Louisiana and along the Mississippi Gulf Coast, they have been most often found roosting in buildings and other man-made structures. Free-tailed bats form very large colonies (1,000s of individuals), usually occupying large cave systems or abandoned buildings. Based on their natural history and distributional records in southeast Louisiana, the Brazilian free-tailed bat was expected to be encountered at the Chalmette Battlefield foraging at the park from immediately surrounding urban areas. Numerous recordings (136 pass sequences and 1,700 calls) were made at 5 of 6 detector sites in June and August 2005. The number of pass sequences recorded each night suggests that a significant population of Brazilian free-tail bats are foraging over the Chalmette Battlefield and may have roost sites nearby. The status of this species should be studied further at the park to establish their residency, population status, and use of the park.

ORDER XENARTHRA—Edentates
Family Dasypodidae (armadillos)

Dasypus novemcinctus (nine-banded armadillo)

PARK STATUS: Present.

ABUNDANCE: Common.

RESIDENCY: Resident and likely Breeder. Non-native to southeast Louisiana and the Chalmette Battlefield

VOUCHER / OBSERVATIONS: No voucher specimens, personal observations of live individuals at early mornings and dusk.

COMMENTS: Nine-banded armadillos can be observed foraging in early mornings and dusk within the herbaceous field representing the battlefield site. They are non-native to Louisiana and the Chalmette Battlefield, having extended their range from northern Mexico into western Louisiana in the 1920s. The occurrence of nine-banded armadillos in southeast Louisiana and in the vicinity of Chalmette is as recent as the 1970s.

ORDER LAGOMORPHA—Lagomorphs
Family Leporidae (hares and rabbits)

Sylvilagus aquaticus (swamp rabbit)

PARK STATUS: Present.

ABUNDANCE: Common.

RESIDENCY: Resident and Breeder. Native.

VOUCHER / OBSERVATIONS: Voucher photographs of live animals and personal observations of scat and live individuals.

COMMENTS: Swamp rabbits are the most common mammal observed at the Chalmette Battlefield. In southeast Louisiana and along the Mississippi Gulf Coast, they are the most common medium-sized mammal of wetlands, including both within marsh and swamp habitats. Swamp rabbits are active and sighted in early morning and early evening hours at the edges of the forest areas at the park boundaries, in the mowed road shoulder, and in the herbaceous field representing the battlefield site. During those months when the herbaceous field is allowed to grow (i.e., is not mowed), swamp rabbits probably occupy and are resident in the field. They also probably take shelter in the wooded areas at the park boundaries. NPS staff and visitors report that this is one of the few animals they regularly observe when visiting the park.

ORDER RODENTIA—Rodents
Family Sciuridae (squirrels and allies)

Sciurus carolinensis (eastern gray squirrel)

PARK STATUS: Present.

ABUNDANCE: Common.

RESIDENCY: Resident and likely Breeder. Native.

VOUCHER / OBSERVATIONS: No voucher specimens, personal observations of live individuals

COMMENTS: Eastern gray squirrels are found in forested areas and near cities and towns. Eastern gray squirrels are active and sighted in early morning through the early evening hours at the edges of the wooded areas at the park boundaries and on the large oak trees near the Visitor's Center. They also probably take shelter in the wooded areas at the park boundaries. NPS staff and visitors report that this is one of the few animals they can observe when visiting the park.

Family Cricetidae (native mice and rats)

Sigmodon hispidus (hispid cotton rat)

PARK STATUS: Present. Only recorded from herbaceous field (Battlefield site)

ABUNDANCE: Uncommon. May be locally common, but population size is likely low.

RESIDENCY: Resident and Breeder. Native.

VOUCHER / OBSERVATIONS: Voucher specimens and personal observation of live captured specimens.

COMMENTS: Hispid cotton rats are a common rodent inhabiting many grassland, wetland, forest and riparian habitats, as well as agricultural land in the United States, including Louisiana. Given its distributional records, it was not unexpected to find them at the Chalmette Battlefield. Two individuals were live-trapped in the herbaceous field (battlefield site) and both of these were sacrificed as voucher specimens. Nearly 600 trap-nights within the wooded areas at the park boundaries did not result in any captures. The status of this species should be studied further, especially to establish their residency, population status, and use of the park

****Mus musculus*** (house mouse)

PARK STATUS: Present. Occurs in near NPS buildings, public facilities, and in nearby forested areas.

ABUNDANCE: Uncommon. May be locally common (near NPS buildings, public facilities), but population size is likely low.

RESIDENCY: Resident and Breeder. Non-native.

VOUCHER / OBSERVATIONS: Voucher specimens and personal observations of live individuals.

COMMENTS: The house mouse is an introduced species commonly associated with buildings and urban areas. At the Chalmette Battlefield, they are pests that occasionally occupy NPS buildings and public facilities. Six individuals were trapped in the herbaceous field (battlefield site) and all of these were sacrificed as voucher specimens. Nearly 600 trap-nights within the wooded areas at the park boundaries did not result in any captures. The status of this species should be studied further, especially to establish their residency, population status, and use of the park. Because house mice are a non-native, invasive species, an effort should be made to control their populations at NPS facilities so that their populations do not grow and expand into natural areas.

***Family Myocastoridae (myocastorids)**

****Myocastor coypus*** (nutria)

PARK STATUS: Unconfirmed, but reported

ABUNDANCE: Uncommon.

RESIDENCY: Unknown, possible Vagrant. Non-native.

VOUCHER / OBSERVATIONS: No vouchers. NPS staff report seeing nutria in the mowed shoulders of the park roads and in the herbaceous.

COMMENTS: Nutria are an introduced species that became established in Louisiana in the 1920s and dramatically expanded their distributional range and population numbers. There is no suitable habitat for nutria at the Chalmette Battlefield. However, drainage canals border the park boundaries and nutria are observed to travel and use these areas on occasion. NPS staff have reported seeing nutria in the mowed shoulders of the park roads and in the herbaceous field.

Family Procyonidae (procyonids)***Procyon lotor*** (raccoon)

PARK STATUS: Present.

ABUNDANCE: Uncommon.

RESIDENCY: Possible Resident or Vagrant. Native.

VOUCHER / OBSERVATIONS: No voucher photographs, but personal observations of tracks, and a live individual trapped by the NPS staff.

COMMENTS: Raccoons are adaptable, wide ranging generalists that can live in many different habitats and settings. There is no suitable habitat at the Chalmette Battlefield to sustain raccoons. Animals are likely attracted to the park as it is the only non-developed area in the region. Raccoons and other mammals can travel along the Mississippi River bature (on river side of the Mississippi River levee) and stop as vagrants at the park.

RESEARCH, MANAGEMENT, AND OUTREACH RECOMMENDATIONS

1. BARATARIA PRESERVE

The following are recommendations for future research, natural resource management, and public education outreach concerning mammals for the Barataria Preserve.

Research. This inventory project provides significant new knowledge about the occurrence, distribution, habitat use, and status of mammals at the Barataria Preserve. As required in the Statement of Work, the design of the inventory focused on documenting the species that occur in the park unit (as residents, migrants, or vagrants) with limited data collection on abundance. Thus, the inventory goals of this project did not allow for collection of data on population and community ecology, including population size or dynamics, fine-scale habitat use, movement, and of many other aspects of population biology. Nonetheless, the results provide a baseline of occurrence, associations with major habitats, rough estimates of abundance, and observations on mammal activity and natural history.

The following research opportunities are evident –

- ***Studies focused on population status, size, and dynamics of several groups of mammals should be initiated and carried forward for multiple years.*** The best baseline data and opportunity for generating high quality research results are for a) bats, b) rodents – white-footed mouse in bottomland hardwood forests and marsh rice rat in marshes, and c) coyotes and deer. These have specific scientific questions that can be pursued with each species group and have specific field protocols. An important element in these studies will be to evaluate their results in the context of environmental change that is ongoing in the park. Additionally, each contributes to important natural resource management concerns (see below).

Bats. – The inventory project provided a baseline for pursuing a monitoring program for species of bats. Population ecology questions include descriptions of population size, seasonal dynamics, habitat use, and movement; none of which has been conducted in southeast Louisiana. Recent published studies of bat population ecology in other localities in the southeast United States will allow for powerful comparative studies to be conducted.

Rodents. – The most common rodent species in bottomland hardwood forest habitats (white-footed mouse) and marsh habitats (marsh rice rat) are appropriate targets of research that aims at addressing biotic changes in response to ecosystem change. Both of these species have been used extensively in small mammal monitoring and as response organisms in landscape ecology, therefore comparative studies are possible. There are some logistical and experimental design challenges – a) the challenge of an unsecured study area in the bottomland hardwood forests (visitors frequently travel through the forests on and off-trail), b) the challenge of extended boat travel to marsh habitats, and c) the challenge of

accommodating the public hunting and trapping seasons in marsh and swamp areas in the western and northern portions of the park.

Coyotes and White-tailed Deer. – Both of these large mammals co-occur in all major habitats throughout the Barataria Preserve. Because use of motion-activated cameras is a primary research protocol, there can be an economy of scale in monitoring design and implementation to study both species. The use of marsh habitats and the landscape features of the park (spoil banks traverse a large area of marsh) by coyotes here is unique and allows for a number of research projects in landscape ecology. The logistical and experimental design challenges of traveling to marsh habitats throughout the park and working around the public hunting and trapping seasons are very significant, but the research opportunities are also significant.

- ***Studies on bats focused on their population biology (foraging and reproduction), habitat use, and roost site selection should be initiated and carried forward for multiple years.*** These studies are not specifically focused on monitoring population ecology (as above), but on population biology phenomena. Specific studies include the assessment of habitat use and selection in foraging, day roost use, and maternity roost use. The discovery of the use of bridge supports by evening bats is a special opportunity to conduct a high quality study of reproductive ecology. The logistical and experimental design challenges include – a) the challenge of a highly unsecured study area in the bottomland hardwood forests (visitors frequently travel through the forests on and off-trail), and along the Bayou Coquille Trail, and b) the challenge of working at night when safety can become a concern.
- ***Studies on other mammal species, as described in the Species Accounts in this report.*** Several mammal species occurring in the Barataria Preserve need additional study to contribute to understanding their status in the park. Additionally, several species not documented but expected – southern flying squirrel and eastern woodrat – should be targeted for additional study. Specific projects, designed for these species should be pursued.

Natural Resource Management. Each of the recommendations for new research described above has important natural resource management implications, as well.

The following research opportunities are evident –

- ***Mammal monitoring programs should be linked to ongoing studies of environmental change to assess and conserve the habitats and ecosystem functions at the Barataria Preserve.*** These goals should be accomplished in concert with the research studies described above, however they should be distinctly focused on management issues. Ongoing invasion of all park habitats by Chinese tallow tree and of wetlands by water hyacinth (*Eichhornia crassipes*) and common salvinia (*Salvinia minima*) has been made

much worse by damage done by Hurricanes Katrina and Rita in August and September 2005, respectively. The damage to the natural levees and canal spoil banks, as well as canopy in the bottomland hardwood and swamp forest is very significant and a rapid growth of these invasives is possible. The role of mammals in these systems is not well understood at the Barataria Preserve and monitoring programs should be focused on addressing those roles.

Bats and Rodents. – Bats have been successfully used as target animal species to monitor changes in forest structure. They also provide significant ecosystem functions in controlling insect populations (all species at the Barataria Preserve are insectivorous). Rodents are also significant response species to environmental change in all habitats and marsh rice rat could be a useful to assess the Davis Pond Freshwater Diversion project.

Coyotes and White-tailed Deer. – Coyotes and white-tailed deer at the Barataria Preserve are distributed throughout the park and can provide direct measures of impacts from environmental change. However, both also provide important ecosystem services – the coyote as a top predator and deer as a primary herbivore. The number and density of deer seems high, especially given how little natural (and suitable) habitat exists outside of the park boundaries. The impacts of deer on plant community ecology in all habitats of the park may be (or become) a significant management concern, especially as the last remaining forested areas north of the park are converted to residential development (see below).

Nutria. – Nutria remain an invasive mammal species of management concern at the Barataria Preserve. Their populations fluctuate annually, however their numbers are clearly significant when the limited public trapping season generates several thousand nutria taken each year.

- ***The studies on bat habitat and roost site selection should provide important assessments of the quality of forest ecosystem functions.*** Establishing the use by bats of specific tree species, assemblages of tree species stands, and habitats will provide tools to make informed management decisions about tree stand composition and setting of priorities for conservation of plant communities in the park. Although none of the bat species inhabiting or using the Barataria Preserve are listed as rare or endangered species, at least two, the southeastern myotis and Rafinesque's big-eared bat, are species that could be elevated to species of special concern in this region.
- ***The recent rapid residential development of most forested areas immediately north of the Barataria Preserve will place significant new management pressures on the park.*** In the past three years (2003-2006), most of the undeveloped land north of the Barataria Preserve boundary has been identified for residential development and housing tract development is underway. Housing pressure following Hurricane Katrina will undoubtedly accelerate this development. This could well generate new management pressures as follow:

Translocation of mammals to the park. – It is likely that mammals inhabiting these areas that are capable of dispersal (especially White-tailed deer and coyotes) could take refuge in the park. This could lead to a number of ecological consequences that would transform or re-shape the ecosystem functions of the park. Of special concern would be a significant increase in deer populations leading to over-browsing and various other impacts on plant communities. Non-native mammals including wild pigs, murid rodents, feral dogs and cats may also increase. Most of the species mentioned here are known to have significant impacts on native flora and fauna. Monitoring that targets these and other species will become an important management strategy in the near future.

Increase in human impacts. – It is likely that visitor traffic to the Barataria Preserve will increase significantly as urbanization accelerates immediately adjacent to the park. Park usage is a major factor in NPS appropriations. However, increase visitor traffic on trails (and especially off-trails where people will wander) will likely increase impacts on park ecosystems. Increase in poaching or other prohibited activities is also possible. The expansion of urban areas to the boundaries of the park will also likely place increased pressures on the park to manage mosquitoes with concerns about the nuisance of insect bites and West Nile Virus. Thus, the park will need to integrate its natural resource management and its public information strategies.

Public Education Outreach. The recommendations for research and natural resource management described above have specific implications for public education outreach and yet, improved outreach programs can make these recommendations work more efficiently and to better results.

The following public education outreach opportunities are evident –

- ***The Research and Natural Resource Management projects should be fully integrated with Public Education Outreach Programs.***

Bats. – Bat research and conservation have been very successfully used as public education outreach tools to both educate the public and develop a sense of “stewardship” of nature. Because the selection and use of roosts and foraging for insects are major components of bat ecology, developing a sense of stewardship for bats also generates one for the hardwood forests and even of the insect community. The bat research and management projects should include electronic monitoring stations that continuously monitor bat activity and the public should engaged in the process of the work. Public education programs, including “bat walks”, and interactive web access to summarized data on bat activity has the potential to contribute very significantly to the mission of the park as interpreting the natural, cultural, and historic features and uses of the Barataria Preserve

Monitoring Environmental Change. – Several of the recommended mammal research and management projects concern tracking environmental change including the impacts of mammals on ecosystems. Developing public education

programs that identify work in the park as contributing to and remediating environmental change would be very powerful. Although mammals are not always the best species to use as bioindicators, the general public is often connected to mammals (the charismatic species phenomenon). In addition to bats, large mammals including especially coyotes attract public attention and interest. The integration of all biotic and abiotic components is important and should be a central part of the overall public education program.

2. CHALMETTE BATTLEFIELD

The following are recommendations for future research, natural resource management, and public education outreach concerning mammals for the Chalmette Battlefield. It is important to acknowledge and understand that this park unit is a small historical site that has so little available natural habitat (for both flora and fauna) that ecological research studies are difficult or impossible. There are very few mammals that inhabit or can inhabit the park at this time. There are very limited opportunities for mammals to establish and maintain populations in the park and even their use of the park grounds for foraging is limited. The park is entirely surrounded by residential and industrial development and much of these areas lack landscaping features (trees, shrubs, gardens) that would contribute to a network of “urban ecosystems.” Therefore there are very limited opportunities for mammals to disperse into the park.

A critical factor to developing mammal research and public education projects will be the management strategy concerning the herbaceous field that seasonally develops at the Chalmette Battlefield. If this area (or reasonably significant portions of it) is allowed to progress through secondary succession – rather than being regularly mowed – then there may be adequate habitat to attract and maintain populations of small mammals. Likewise, the wooded park boundaries would need to progress through an ecological succession to a much more diverse system. At present they are not functional forest ecosystems.

Logistical challenges to conducting any projects at the Chalmette Battlefield are very significant. The visibly public nature of the park, the large volume of visitors, and security and safety issues working at night (many people walk, jog, and ride bicycles in the park after hours), make conducting field projects very difficult. Hurricane Katrina (August 2005) not only significantly damaged the park (destroying NPS facilities and damaging visitor areas and the vegetation), but the surrounding area was largely destroyed. As time passes, the park and its surroundings will recover, but for the near future the area is not secure.

Research. At present, there does not appear to be many opportunities to conduct mammal research projects at the Chalmette Battlefield. The most viable research (and public education) project concerns bats.

- **Monitoring bat activity.** – As noted in the sections describing bats encountered at Chalmette Battlefield, it is unlikely that there are bat populations roosting on the park grounds. Bats were not detected for a full hour after sunset and, coupled with the very limited stands of trees on the park boundaries, it is likely that bats are traveling

to Chalmette Battlefield to forage on insects over the herbaceous field and at the edges of the wooded fence lines. Therefore it is likely that the park is providing a foraging resource for them. A passive, long-term electronic detection monitoring project (establishing bat detectors that continuously monitor bat activity) in this highly urbanized setting would address some novel conservation biology questions.

Natural Resource Management. As noted above, without significant, active habitat management (effectively to create functional oldfield ecosystems) there are few management issues concerning mammals.

Public Education Outreach. Because the park does not presently maintain significant mammal populations or habitat, there is little opportunity to conduct outreach programs focusing on interpreting mammals in the park. However, a public education program centered on bat conservation could be effective.

- ***Bat Conservation Biology.*** As described in the section above on the Barataria Preserve, bat research and conservation has been very successfully used as public education outreach tools to both educate the public and develop a sense of “stewardship” of nature. The focus of the project at Chalmette Battlefield would be to interpret bat foraging and migration.

POST-HURRICANE IMPACTS – KATRINA AND RITA

1. BARATARIA PRESERVE

Shortly after completion of field work for this study (June 2005), Hurricane Katrina struck on August 29th, 2005 causing catastrophic damage to the Louisiana and Mississippi Gulf coasts. On September 24th, 2005, Hurricane Rita made landfall on the Texas-Louisiana border; its outer storm bands still possessing tropical storm force winds that inflicted additional damage to the area. Both hurricanes severely damaged the forests, marshes, and natural levees / canal spoil banks at the Barataria Preserve. Tornadoes embedded in the storms apparently touched down in several locations within the park. The bottomland hardwood forests east of Bayou des Familles had many trees uprooted and broken – an estimated 60% of the trees taking severe damage. Storm surge associated with Hurricane Rita overtopped most natural levees and canal spoil banks in the marshes of the park and some marsh areas were disrupted and converted to open ponds.

The ecological consequences of the impacts of the storms will take time to be realized, however several observations can be made at this date (June 2006). First, is that the forest canopy in the hardwood bottomland forests and swamps has been substantially disturbed and predictable ecological consequences of weedy growth of herbaceous plants, saplings, and invasive species is already underway. Shifts (at least temporarily) in the plant and animal community structure and composition will likely occur. Existing invasive plant species (notably Chinese tallow trees, vines, and floating aquatics) may expand their current ranges and impacts within the park. Concerning mammals, it is possible that the increase in herbaceous understory vegetation (including sapling recruitment) could stimulate increases in herbivore populations in response to increase forage. A careful monitoring of the population response by white-tailed deer to these changes would be advisable in the next year. The amount of woody debris within the forests will likely have a number of affects on mammals – mice may be afforded greater protection from some predators (e.g., owls). Tree roosting bats may have lost a significant resource, but they may benefit from increased insect populations associated with the increase in herbaceous understory growth.

Second, is that the marsh habitats have been disturbed in several significant ways. Saltwater from the storm surge inundated the freshwater marshes and remained trapped within them for months. Changes (turnover) in the structure, composition, and productivity of the marsh plant communities due to salt stress is likely to be significant and that could well impact mammal ecology. The damage to natural levees and canal spoil banks on the southwest and west boundaries of the park was severe and this will affect the hydrologic systems in the park and in the larger Barataria Basin region. As documented in the present study, many mammals use the spoil banks as corridors to travel throughout the park. The response by nutria to the re-structured marsh ecology is uncertain. Prior to these hurricanes, nutria herbivory posed a threat to marsh structure and stability, although large-scale “eat-outs” were not common within the park. With a damaged marsh, impacts of nutria may be quite different.

This disturbance event was large in both magnitude and spatial scale and changes in park ecosystems will likely be affected by many factors and manifested over a long timeframe. The research, management, and public education outreach recommendations described in the previous section will need to be integrated with the recovery.

2. CHALMETTE BATTLEFIELD

The storm surge from Hurricane Katrina overtopped hurricane protection levee systems to the northeast of Chalmette battlefield and inundated the park with nearly 10 feet of water. In addition to the destruction of most NPS facilities, the larger trees at the battlefield and cemetery were uprooted or destroyed. In addition, the surrounding residential area was largely destroyed. At this date (June 2006), the park is not open except for limited special events. In time, the park facilities and the surrounding residential areas will be restored. It may be appropriate to reexamine the natural resource management plan for Chalmette Battlefield during the rebuilding of the park facilities. As described in the research, management, and outreach section, there were few opportunities to study, conserve, or interpret mammals inhabiting or using the park, pre-Katrina. The management decisions made concerning the herbaceous field at the battlefield site and other areas of the unit will affect the mammal ecology that will (or will not) be established at Chalmette.

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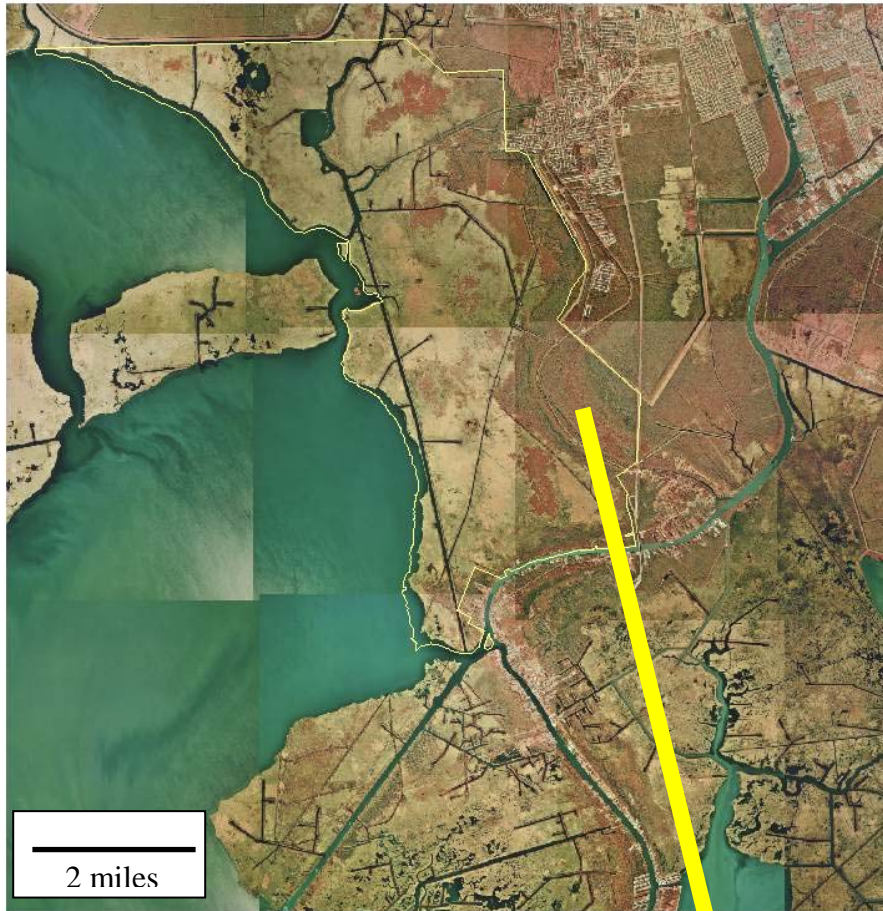
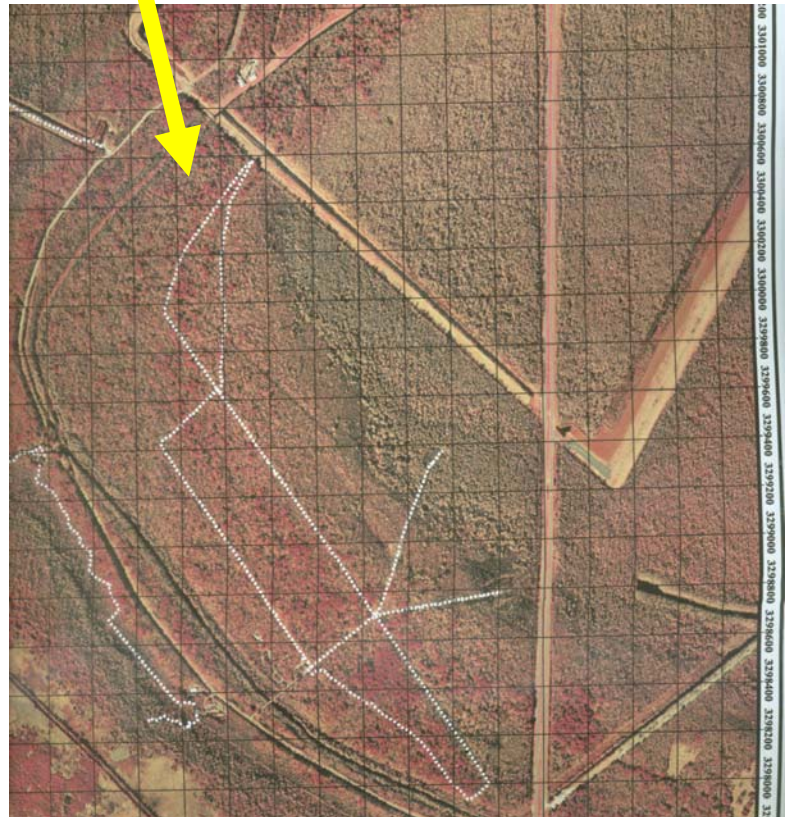


FIGURE 1. Map of Barataria Unit.

A. Upper map depicts the Barataria Preserve with boundaries in yellow. Northern boundary limits are approximate. Base map is DOQQ (2002) with park boundaries produced by JLNHPP staff.

B. Enlargement of hardwood forests and swamps E. of Bayou des Familles. Base map is DOQQ (2002) with 200 m UTM coordinate grid produced by JLNHPP staff.



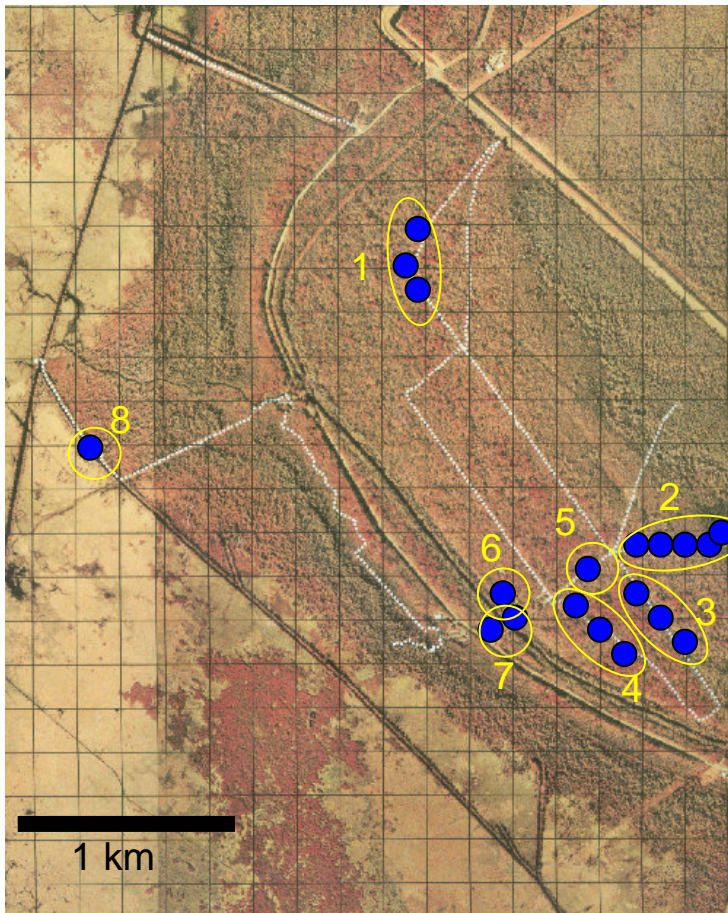


FIG.2. Mist-net Site Localities.

Sites labeled with numbers, blue symbols are locations of **bat nets** within a site.

1. N. Plantation trail site
2. Wood Duck trail site
3. N. Old Barataria trail site
4. S. Old Barataria trail site
5. Main road site
6. Canoe launch site
7. Bayou des Familles Bridge site
8. Kenta Canal Bridge site

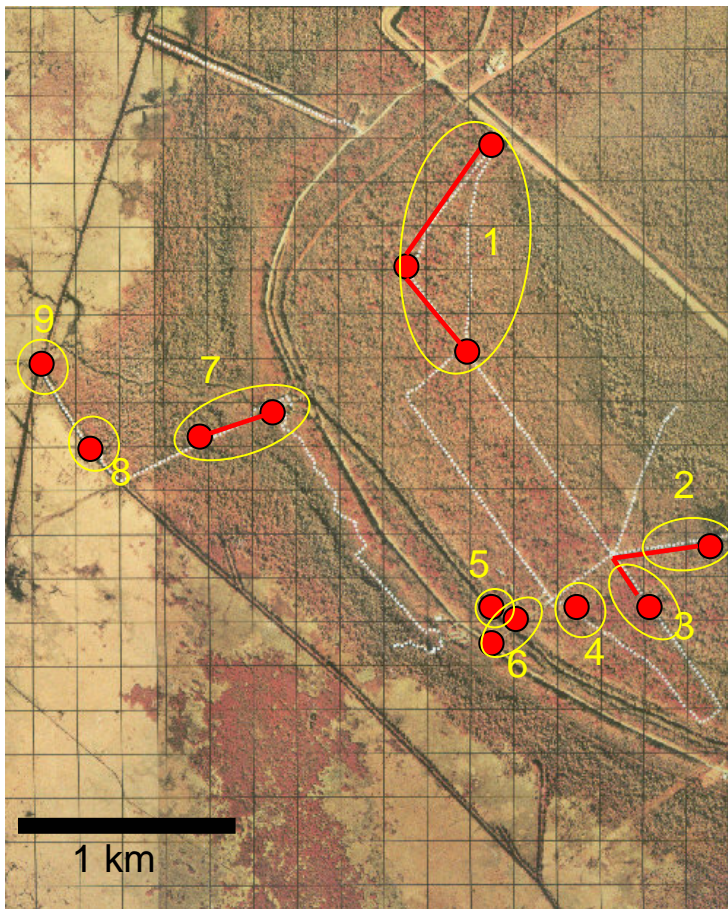


FIG.3. Electronic Detector Site Localities.

Sites labeled with numbers, red symbols are locations of **bat detectors** within a site.

1. N. Plantation trail site
2. Wood Duck trail site
3. N. Old Barataria trail site
4. S. Old Barataria trail site
5. Canoe launch site
6. Bayou des Familles Bridge site
7. Coquille trail site
8. Kenta Canal Bridge site
9. Marsh Overlook site



FIGURE 4. Field methods for Documenting Bats.

Top. Mist nets set on Bayou des Familles bridge.

Middle. Mist nets and Anabat II bat detector in forest location.

Bottom. Bat detector on Marsh Overlook bridge and Laptop-configured bat detector



FIGURE 5. Trapping Site Localities.

1. Bayou Segnette waterway site

2. Oak Chenier site

3. Tarpaper Canal site

4. E. Plantation trail site

5. N. Old Barataria trail site

6. S. Old Barataria trail site

7. NE Twin Canals site

8. Bayou des Familles site

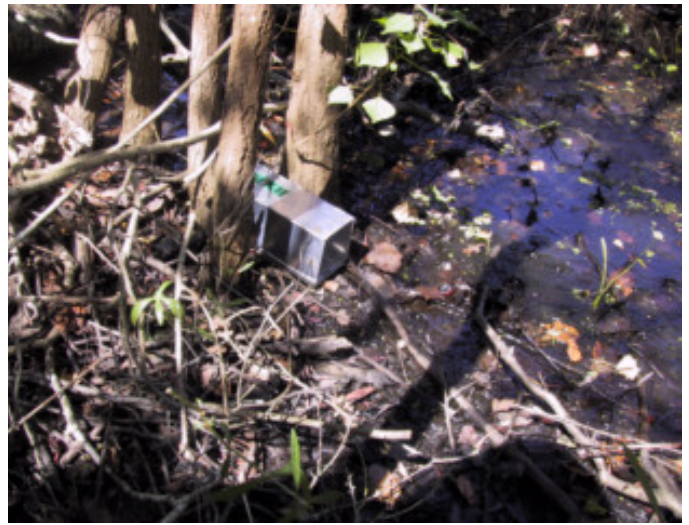


FIGURE 6. Field methods for Live-trapping .

Top. Sherman trap at marsh site; Sherman trap at a swamp site.

Middle. *P. leucopus* at forest site; Flying squirrel trap set at forest site.

Bottom. Handling mice at marsh site; Handling opossum captured in Havahart.

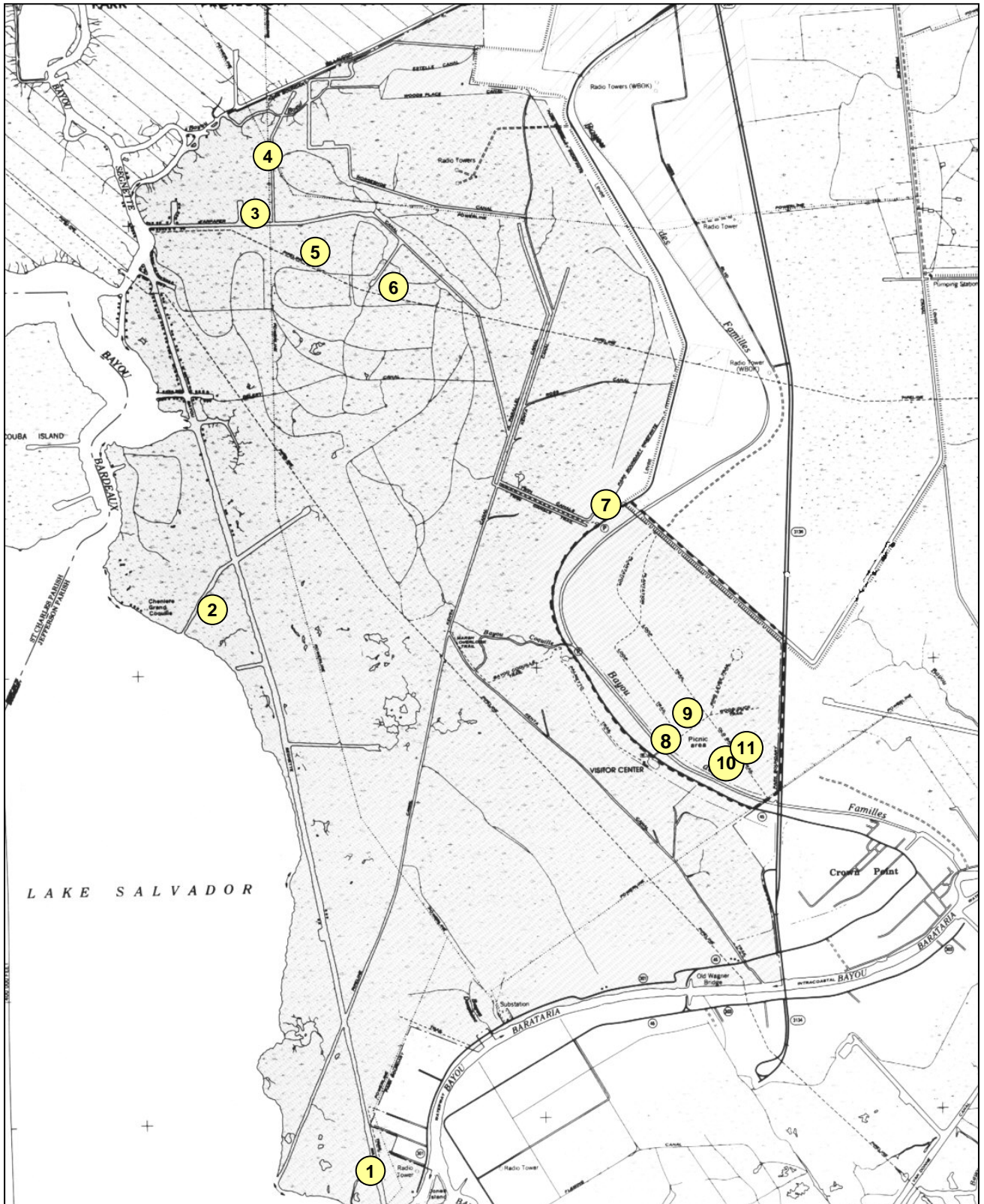


FIGURE 7.. Motion-activated Camera Site Localities.

- | | | |
|------------------------------------|----------------------------|---------------------------------|
| 1. Bayou Segnette waterway site | 5. Wax myrtle site | 9. NE Plantation trail site |
| 2. Oak Chenier site | 6. Tarpaper Canal site | 10. S. Old Barataria trail site |
| 3. E. Spoilbank Wreck Keyhole site | 7. NW Twin Canals site | 11. N. Old Barataria trail site |
| 4. W. Spoilbank Powerline site | 8. Bayou des Familles site | |



FIGURE 8. Field methods for Motion-activated Cameras.

- Top. Camera setup with scent station; Coyote on spoil bank.
Middle. Camera setup coupled with Havahart traps; Camera setup in swamp.
Bottom. Coyote in wax myrtle marsh; Deer in wax myrtle marsh.



FIGURE 9. Mammal sign.

Top. Raccoon tracks

Middle. Coyote tracks; Raccoon tracks.

Bottom. Coyote path; Swamp rabbit scat characteristically placed on log.



FIGURE 10. Maternity roost of *Nycticeius humeralis* inhabiting bridge support at Kenta Canal and Bayou Coquille.

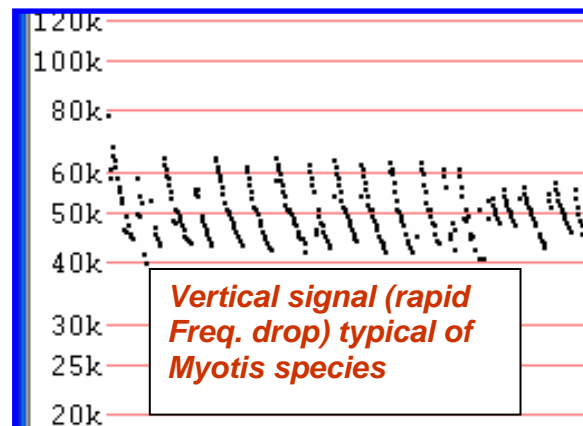
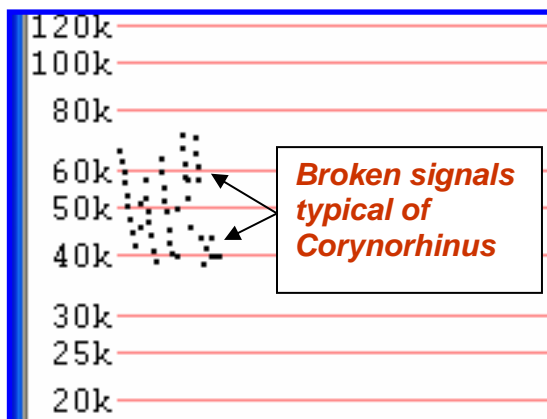
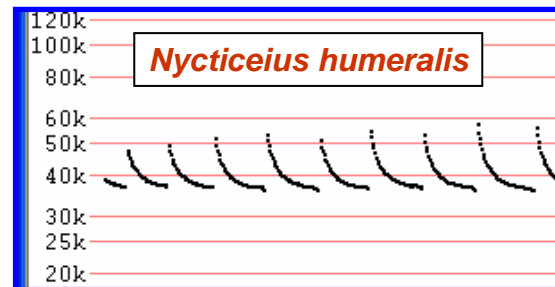
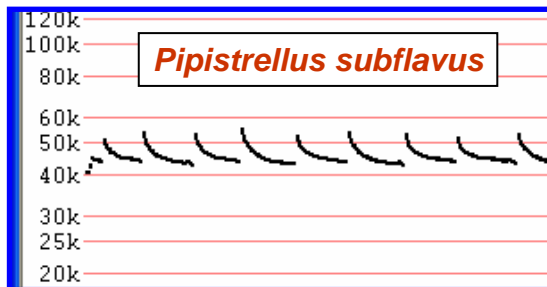
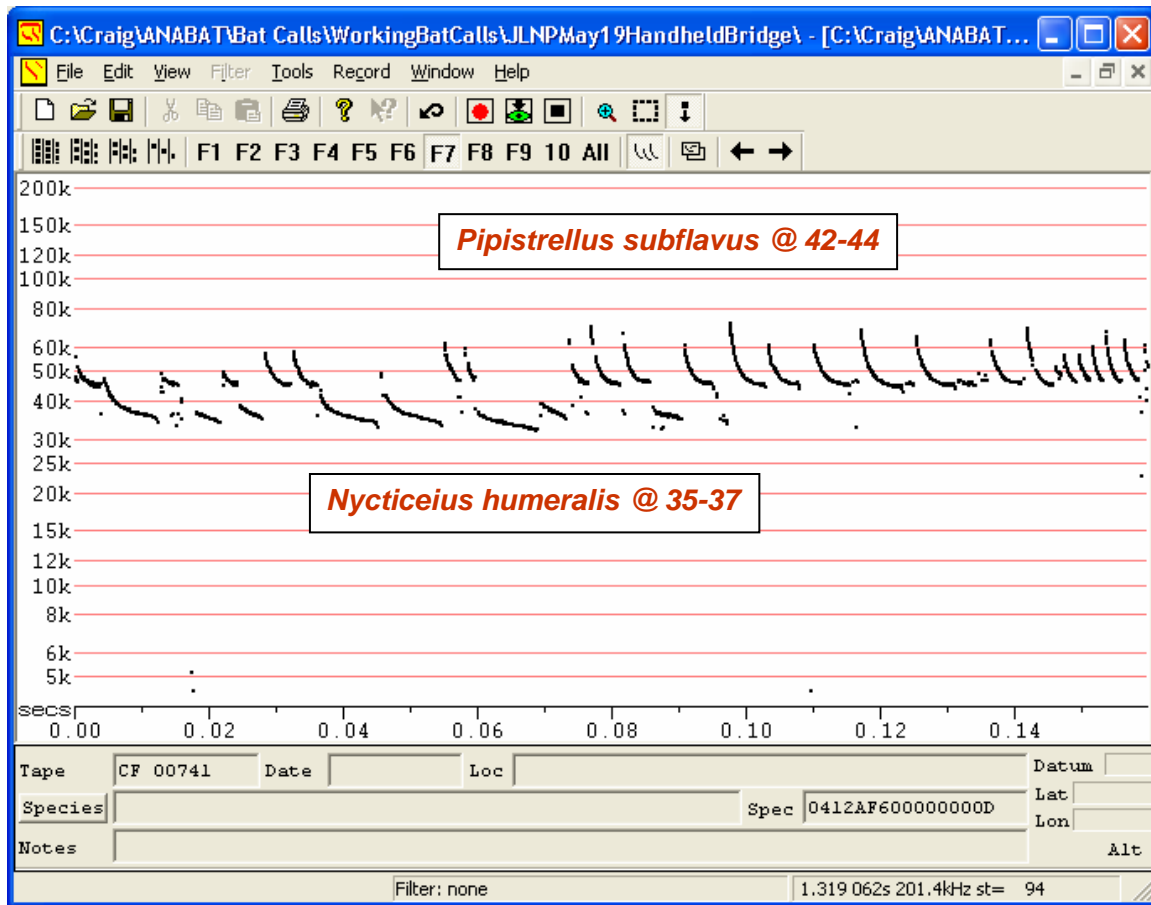


FIGURE 11. Examples of recordings of bat echolocation calls from Barataria.

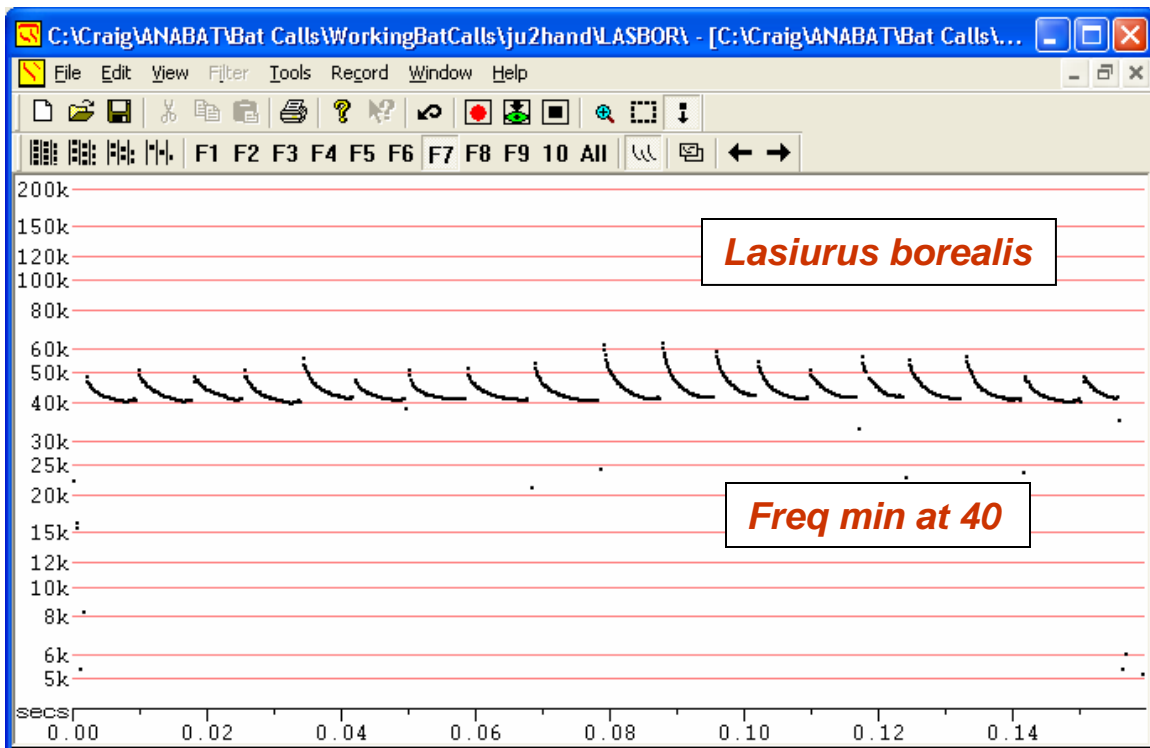


FIGURE 12. Recordings of bat echolocation calls of *Lasiurus borealis* from Barataria.



FIGURE 13. Muskrat mound in *Scirpus*-patch W. of Tarpaper Canal Keyhole.



FIGURE 14. Bobcat tracks at scent station at Oak Chenier camera site locality.



FIGURE 15. Chalmette Battlefield Map. 2000 DOQQ basemap.

Trapping Sites (yellow)

1. Herbaceous Battlefield site
2. Boundary Woods site

Bat Detector Sites (red)

- | | |
|--------------------------------|------------------------|
| 1. NE Battlefield Viewing site | 4. Visitor Center site |
| 2. SE Battlefield Viewing site | 5. MS River Levee site |
| 3. SW Battlefield Viewing site | 6. NW Boundary site |