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Protocol for Monitoring Landbird Communities in Southeast Coast Network Parks

Natural Resource Report NPS/SECN/NRR—2014/853



ON THE COVER
Painted Bunting (*Passerina ciris*)
Photograph by: Darlene Moore

Protocol for Monitoring Landbird Communities in Southeast Coast Network Parks

Natural Resource Report NPS/SECN/NRR—2014/853

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Executive Summary

The National Park Service (NPS) Southeast Coast Inventory and Monitoring Network (SECN) has initiated landbird community monitoring in 17 SECN parks. These include: Canaveral National Seashore (CANA), Cape Hatteras National Seashore (CAHA), Cape Lookout National Seashore (CALO), Chattahoochee River National Recreation Area (CHAT), Congaree National Park (CONG), Cumberland Island National Seashore (CUIS), Horseshoe Bend National Military Park (HOBE), Kennesaw Mountain National Battlefield Park (KEMO), Fort Caroline National Memorial (FOCA), Fort Frederica National Monument (FOFR), Fort Matanzas National Monument (FOMA), Fort Pulaski National Monument (FOPU), Fort Sumter National Monument (FOSU), Moores Creek National Battlefield (MOCR), Ocmulgee National Monument (OCMU), and Timucuan Ecological and Historic Preserve (TIMU). Parks within the SECN occur along the south Atlantic Coast from North Carolina to central Florida and inland to north Georgia, eastern Alabama, and central South Carolina. SECN parks encompass approximately 185,000 acres (75,000 ha) of federally-owned property. The NPS Inventory and Monitoring (I&M) Program originated from the 1999 Natural Resource Challenge, with the goal of understanding, measuring, and improving the health of park ecosystems. To achieve this goal, the SECN pursued an in-depth scoping process to identify the factors influencing park resources and the elements, or Vital Signs, to be measured that would provide park managers with the best understanding of the health of park resources.

Because of their potential to serve as indicators of several natural and anthropogenic stressors and as an indicator of the condition of park resources, landbird communities were selected as a Vital Sign for the SECN. The objectives of this protocol are:

- Determine the status and trends in species richness and diversity of the landbird community at each park.
- Determine the status and trends in occupancy by selected landbird species.
- Determine the status and trends in frequency of detection of selected landbirds.
- Determine trends in the vocalization phenology of select landbirds with high detectability.
- Determine the similarity in the species assemblage of samples collected with the automated recording device and variable radius circular plot point count methodologies.

The landbird community is monitored in the spring with automated recording devices deployed for a 77-day period. The current 2013 park boundaries are used as the sampling frames and a suite of permanent spatially-balanced random sampling locations were drawn from a 0.5-ha grid with a Reversed Randomized Quadrant-Recursive Raster (RRQRR) algorithm (Theobald et al. 2007). This temporal design consists of sampling all parks every three years. Data collected under this protocol are stored in the SECN data management system and are available online in the Integration of Resource Management Applications (IRMA) database maintained by the I&M Division national office located in Ft. Collins, Colorado. Data are summarized and a summary report is published for

each park each year of sampling. Data are summarized to communicate diversity, composition, and distribution. Synthesis reports, which consist of occupancy models or trend analyses, will be produced approximately once every six years for each park.

This document provides a credible and scientifically rigorous strategy for landbird community monitoring with accompanying standard operating procedures (SOPs) that provide systematic instructions on conducting all aspects of the protocol. The SOPs are sufficiently detailed to ensure consistent and comparable data collection across personnel, locations, and over time. This protocol is co-located with the SECN's Vegetation Community, and Amphibian Community Vital Signs Monitoring protocols.

List of Terms

Automated recording device (ARD): ARDs are often used to characterize soundscapes, and to monitor birds (Haselmayer and Quinn 2000, Acevedo and Villanueva-Rivera 2006, Hutto and Stutzman 2009, and Venier et al. 2012). The SECN is applying this technology to monitor birds and vocal anurans. ARD use is more advantageous than any other single method potentially used in SECN parks because of the safety concerns related to working in urban parks in the early morning when the target taxa are most active and have the highest probability of detection. Recordings gathered by the ARDs are evaluated to determine detection/non-detection of target taxa.

Community (landbird): The assemblage of all landbird species' populations that occur together in SECN parks and use park lands for any aspect of their life history during the year. Although landbirds are the focus of this protocol, shorebirds and waterbirds are also detected.

Detection: Observation of a species or species group during one morning of monitoring using automated recording devices at a sampling location.

Diversity: The variety and relative abundance of species in a defined unit of area that is a community property related to trophic structure, productivity, stability, immigration/emigration, and ecological condition. Species diversity consists of two components: the number of species (i.e., species richness) and the relative abundance of those species (i.e., species evenness/dominance), and is often communicated in the form of indices.

Dune communities: In SECN parks, dune communities are found only in the coastal parks. These communities consist of beaches (i.e., the area from the toe of the primary dune to the water's edge), secondary dunes, and occasionally tertiary dunes with vegetation composition similar to the primary and secondary dunes if the area is extremely dynamic and experiences frequent washover and wind-blown sand movement. Plant species in these areas consist primarily of early successional or pioneering species such as sea oats (*Uniola paniculata*), beach morning-glory (*Ipomoea stolonifera*), bitter panicgrass (*Panicum amarum*), and largeleaf pennywort (*Hydrocotyle bonariensis*). Herbaceous flats, or intradunal swales, often delineate primary from secondary dunes, and occasionally serve as ephemeral saline or freshwater wetlands. Plant species composition can vary widely in these areas and is dependent upon washover frequency, dune height, precipitation, and many other variables. Woody species, such as seacoast marshelder (*Iva imbricata*) and wax myrtle (*Morella cerifera*) occasionally occur in the secondary and tertiary dunes.

Frequency of detection: Frequency of detection is the number of mornings or sampling events a species or species group is observed during the sampling event at each sampling location, summed across all sampling locations.

Metadata: A description of a particular data set in a standardized format, which ensures the proper use and utility of that dataset throughout the dataset life cycle.

Naïve occupancy: The number of times a species or species group is detected, by any monitoring technique implemented as part of this protocol, at a specific location during a specified period of

time. Value is communicated as a proportion or percentage. May also be referred to as frequency of occurrence. Provides insight into the likelihood of encountering a specific species, commonness/rarity, diversity, and distribution of a species or group, but does not take into account imperfect detectability and typically underestimates occurrence. Not used for comparative purposes unless detection probabilities are equal.

Proportion of area occupied: A modeled measure of the occupancy of a species or group at a specific location, expressed as the proportion of area the species or group occupies. The estimate is generated from occupancy-modeling procedures detailed in MacKenzie et al. (2006). The modeling procedure requires multiple visits to a sampling location for the creation of a detection history (i.e., a binary response indicating detection or non-detection of a species for each sampling/survey event). In this protocol, the detection histories used for analysis are generated from the 20 sampling events of the ARDs. Detection histories can also be generated, under a removal-monitoring framework (Farnsworth et al. 2002), (a) using a time-of-detection method (Alldredge at al. 2007) from the time four intervals within each one of the 20 ARD sampling events, or (b) from the four time intervals of the two VCP control surveys. The estimate takes into account imperfect detectability (i.e., a species may be present but is not always detected) from the detection history and incorporates several other user-defined variables hypothesized to affect occupancy (i.e., vegetation community type, time of year, weather variables). A very useful estimate to evaluate change over time. Occupancy is generally considered an effective surrogate for species abundance, due to cost-effectiveness, applicability in many scenarios, and a focus on less intensive and complex detection/non-detection monitoring techniques.

Permanent sampling locations: Sampling locations, and all protocol-specific subplots or subsamples within, that are permanently marked for relocation purposes. In the event that plot attrition occurs (i.e., loss of a plot due to natural or anthropogenic causes — common in dynamic systems), new sampling locations will be selected from the pool of previously-sampled locations where baseline data exist. If none exist, locations generated as alternate sampling locations are used.

Phenology: The expression of periodic and recurring biological phenomena and the relationship of those phenomena to climatic conditions such as sunlight, temperature, and precipitation. Examples include the timing of migration, territory establishment, vocalizations, nest initiation, egg hatch, or molt.

Relative detection efficiency: The sum of all detections for each individual species across all sampling locations divided by the total number of possible opportunities for detection of that species (i.e., the number of sampling locations multiplied by the number of sampling events). This estimate has little management utility, but is important to the authors for interpretation of results. Expressed as a proportion, without accounting for known influences on detectability (i.e., similar to naïve occupancy in that sense); can be referred to as naïve detectability.

Relative detection frequency: The percentage of detections by an individual species in the context of (i.e., relative to) all other species' detections. This is calculated as the sum of all detections for each individual species across all sampling locations divided by the total number of detections across

all sampling locations by all other species combined. This yields a proportion that sums to one, which is then converted to a percentage by multiplying by 100.

Response design: The response design is the determination of how the attributes identified in the objectives are accurately and effectively monitored (Stevens and Urquhart 2000). This is also referred to as the methodology or the monitoring techniques. As with the sampling design of any monitoring program or protocol, the efficacy of both the response design and the sampling design should, and can be, evaluated and modified as necessary to ensure the monitoring, sampling, and management objectives are met by the monitoring endeavor.

Reversed Randomized Quadrant-Recursive Raster (RRQRR) algorithm: An algorithm that produces a probability-based survey design in a Geographic Information System in which a pre-determined number of sampling locations are identified. Implementation of this algorithm allows for a spatially-balanced random sample to be drawn across a landscape, or sampling frame. This technique is deemed far superior to a simple-random sample draw procedures for application in SECN parks because simple-random sample draws often produce spatially inefficient clusters of sampling locations or voids despite being a random sample. Sampling locations that are close to one another tend to be more similar in many attributes (Stevens and Olsen 2004) and have a higher likelihood of being autocorrelated. Conversely, widely distributed sampling locations tend to be more independent (Stehman 1999). Further, a spatially-balanced design maximizes the likelihood that sampling locations will occur in attribute types (i.e., vegetation community types) relatively proportional to their occurrence within the sampling frame (Theobald et al. 2007). A spatially-balanced technique also maximizes the likelihood that sampling locations are relatively evenly distributed across the sampling frame. The RRQRR technique is used to generate all sampling locations for the vegetation, landbird, and amphibian communities, and fire fuels Vital Signs, and is the foundation of the spatial component of the SECN sampling design. The process is grid-based, thus the sampling location is the grid-cell selected. The user chooses the size of the grid cells; the SECN uses a grid-cell size of 0.5 ha. The RRQRR procedure can accommodate existing sampling locations and the specification of various inclusion probabilities. The SECN currently uses an inclusion probability of one (i.e., all sampling locations have an equal probability of being selected).

Variable circular point counts (VCP): VCP with distance estimation are a standard method for surveying birds in forested environments (Reynolds et al. 1980, Buckland et al. 1993, Ralph et al. 1995, Nelson and Fancy 1999, Buckland et al. 2001). The SECN VCP method is a compatible adaptation of the USFWS-led interagency bird protocol (Knutson et al. 2008). The observer records all auditory and visual detections over a pre-determined time period, 12 minutes for the SECN monitoring. Monitoring occurs within four hours of sunrise. Distance is estimated into distance groups (i.e., 50–100 m) to reduce error and improve efficiency. An important benefit of using the variable circular plot method is the ability to accommodate a wide range of bird species, each of which possesses a different singing style and each of which may occur in a variety of acoustically-different habitats. VCP counts operate by essentially allowing the vegetation characteristics and structure of the sampling location to determine the size of the area being surveyed. VCP measures include detection/non-detection, relative abundance, and abundance estimates for species where 60–

80 independent observations are made (Buckland et al. 1993) (i.e., valid abundance estimates are typically only available for the most common species).

Introduction

Background

In 1992, the National Academy of Sciences (1992) reviewed the Natural Resource Management Program of the NPS and concluded, “if this agency is to meet the scientific and resource management challenges of the twenty-first century, a fundamental metamorphosis must occur.” Indeed, that metamorphosis materialized when the NPS implemented a strategy to standardize inventories and monitoring of natural resources on a programmatic basis throughout the agency. The effort was undertaken to ensure that the approximately 270 park units with significant natural resources possessed the resource information needed for effective, science-based, managerial decision-making and resource protection. The national strategy consists of a framework having three major components:

1. Completion of basic natural resource inventories in support of future monitoring efforts,

2. Creation of experimental Prototype Monitoring Programs to evaluate alternative monitoring designs and strategies, and

3. Implementation of operational “Vital Signs Monitoring” in all parks with significant natural resources.

Knowing the condition of natural resources in national parks is fundamental to the NPS’s ability to manage park resources “unimpaired for the enjoyment of future generations.” National Park managers across the country are confronted with increasingly complex and challenging issues that require a broad-based understanding of the status and trends of park resources as a basis for making decisions, and for working with other agencies and the public for the benefit of park resources.

In 1999, the NPS initiated a long-term ecological monitoring program, known as “Vital Signs Monitoring,” to provide the minimum infrastructure to allow more than 270 National Park System units to identify and implement long-term monitoring of their highest priority measurements of resource condition (Fancy et al. 2009). The overarching purpose of natural resource monitoring in parks is to develop scientifically sound information on the current status and long-term trends in the composition, structure, and function of park ecosystems, and determine how well current management practices are sustaining those ecosystems.

Vital Signs are a subset of physical, chemical, and biological elements and processes of park ecosystems that are selected to represent the overall health or condition of park resources, known or hypothesized effects of stressors, or elements that have important human values. The elements and processes that are monitored are a subset of the total suite of natural resources that park managers are directed to preserve "unimpaired for future generations," including water, air, geological resources, plants and animals, and the various ecological, biological, and physical processes that act on those resources. Vital Signs may occur at any level of organization including landscape, community, population, or genetic level, and may be compositional (referring to the variety of elements in the system), structural (referring to the organization or pattern of the system), or functional (referring to ecological processes).

The NPS Vital Signs Monitoring Program addresses five goals for all parks with significant natural resources:

- Determine the status and trends in selected indicators of the condition of park ecosystems to allow managers to make better-informed decisions and work more effectively with other agencies and individuals for the benefit of park resources.

- Provide early warning of abnormal conditions of selected resources to help develop effective mitigation measures and reduce costs of management.

- Provide data to better understand the dynamic nature and condition of park ecosystems and provide reference points for comparisons with other, altered environments.

- Provide data to meet certain legal and Congressional mandates related to natural resource protection and visitor enjoyment.

- Provide a means of measuring progress toward performance goals.

These goals are accomplished through park-wide inventories and a long-term monitoring program. In establishing a service-wide natural resources I&M program, the NPS created networks of parks that are linked by geography and shared natural resource characteristics. Working within networks improves the efficiency of I&M because parks are able to share budgets, staffing, and other resources to plan and implement an integrated program.

Beginning in 2009, the federal government engaged in a renewed effort to consider the interwoven effects of energy production and consumption and the effects of global climate change in the stewardship of its resources. As a part of EO 13514 (2009), the President directed all federal agencies to participate in the Climate Change Adaptation Task Force and develop strategies in support of the national adaptation strategy.

The subsequent Secretarial Order 3289 charged the Department of Interior (DOI) Bureaus to take the lead in protecting our country's water, land, fish and wildlife, and cultural heritage resources from the dramatic effects of climate change by establishing a "… Department-wide approach for applying scientific tools to increase understanding of climate change and to coordinate an effective response to its impacts on tribes and on the land, water, ocean, fish and wildlife, and cultural heritage resources that the Department manages."

This included a directive to each bureau to "consider and analyze potential climate change impacts when undertaking long-range planning exercises, setting priorities for scientific research and investigations, developing multi-year management plans, and making major decisions regarding potential use of resources under the Department's purview," with a further expectation that data collected under this directive "will support the integration of our nation's scientific database, improving availability and dissemination of climate change impact and vulnerability information, and access and decision-support to scientists, resource managers, decision makers, and the general public through http://www.data.gov and other appropriate mechanisms."

As a portion of the NPS effort to implement these new programs, the Southeast Coast Network received planning funds in FY2010 to identify ways to augment its existing Vital Signs Monitoring Program to (a) improve parks' ability to incorporate climate science into planning, while (b) collaborating with and contributing to other DOI climate science programs within the South Atlantic LCC (SALCC) and Southeastern Climate Science Center (SECSC) to meet the other Departmental goals.

An additional purpose of this protocol, therefore, is to serve as an operational guide to collect Vital Signs Monitoring data that can be used by NPS and other strategic partners to better plan for, and respond to, impacts caused by global climate change (DeVivo et al. 2011).

This document has two main objectives: (1) to present a credible and scientifically rigorous protocol for monitoring landbird communities, and (2) to provide a specific set of instructions in the form of SOPs that are sufficiently detailed to ensure consistent and comparable data collection in the future. The structure of this monitoring plan generally adheres to the framework and suggestions of Oakley et al. (2003). This document also broadly summarizes the relative importance of, and need for, landbird community monitoring as a proactive tool to understand and abate influences that adversely affect the ecological integrity, or health, of park ecosystems.

Study Area

The SECN is one of 32 Vital Signs Monitoring networks across the NPS. The SECN includes 17 parks, in 15 administrative units, with significant natural resources and extends along the Atlantic Coast from the North Carolina-Virginia border south to Cape Canaveral, Florida and inland to Atlanta, Georgia and the Alabama Coastal Plain (Figure 1). The northern and southern boundaries are significant in that both coincide with generally recognized geographical delimiters for species distributions. The southern end of Chesapeake Bay and the James River represent the northern and southern boundaries for many species, including several associated with bottomland hardwood communities throughout the Southeastern U.S. Further, Canaveral National Seashore generally occurs in the transition zone where coastal vegetation shifts from the saltmarsh cordgrass (*Spartina alterniflora* and *S. patens*) dominated community ubiquitous along the Southeastern coast, to the mangrove community (i.e., red mangrove [*Rhizophora mangle*], black mangrove [*Avicennia germinans*], and white mangrove [*Laguncularia racemosa*]) typical of sub-tropical latitudes.

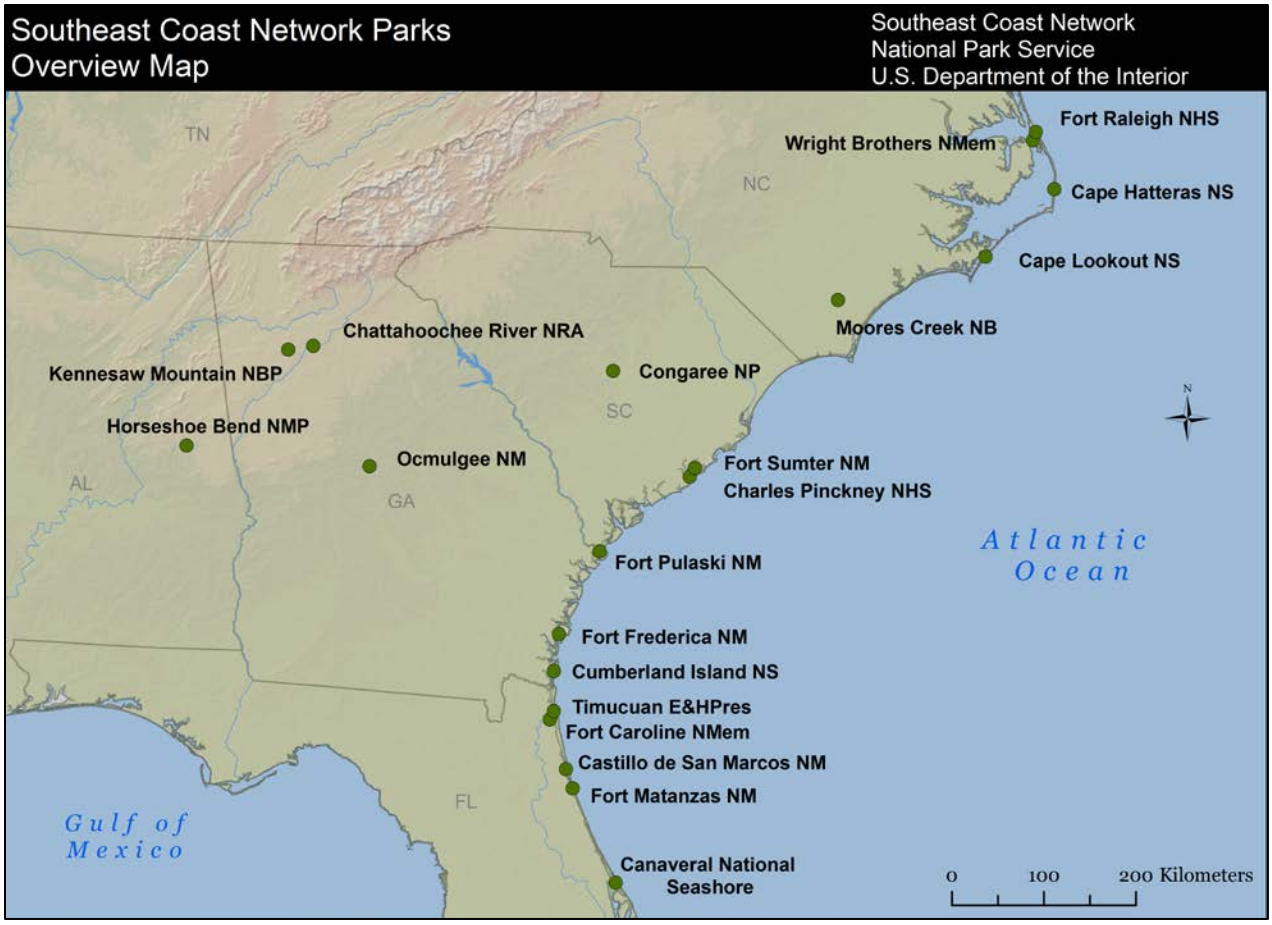


Figure 1. Southeast Coast Network parks.

Twenty parks occur in the administrative units of the SECN: CANA, CAHA, CALO, Wright Brothers National Memorial (WRBR), Fort Raleigh National Historic Site (FORA), CONG, FOPU, FOSU, Charles Pinckney National Historic Site (CHPI), MOCR, CHAT, KEMO, HOBE, OCMU, CUIS, TIMU, FOCA, FOFR, FOMA, and Castillo de San Marcos National Monument (CASA). Three of these parks, however, do not contain significant natural resources (i.e., CHPI, FORA, WRBR), as determined by the authors of the Natural Resource Challenge and the NPS Inventory and Monitoring Program, and are not part of our monitoring activities. This protocol is implemented at all SECN parks with significant natural resources except CASA, because the areas do not exist to safely deploy the equipment and conduct monitoring.

Cape Hatteras National Seashore (CAHA)

CAHA is the northernmost park unit in the SECN (Figure 1). Located along the northern section of the Outer Banks (Figure 2), Cape Hatteras contains 35,400 acres (14,326 ha) of land and 74 miles (119 km) of beaches. The U.S. Fish and Wildlife Service administers Pea Island National Wildlife Refuge within the boundary of the Seashore.

The ecological zonation of CAHA is due in part from artificial alterations dating from the turn of the twentieth century. The most important perturbations were due to early efforts at mosquito control and waterfowl management, which involved excavation of drainage ditches and construction of water control structures, and vegetative stabilization of primary dunes along the length of the Seashore. Later changes were wrought when road construction included excavation of borrow ponds for roadbed material. For the most part, these actions ended by the 1970s, except for localized projects designed to protect specific and discrete portions of infrastructure.

Given the location of the Seashore, it is subject to a high frequency of naturally occurring wind-, tide-, and wave-driven processes of erosion, accretion, and overwash that result in a very dynamic landscape and vegetation response despite stabilization efforts. The unique and varied vegetation communities, such as mature broad-leafed evergreen forest and shrub, freshwater marsh, and primary and secondary dunes support diverse assemblages of aquatic and terrestrial species. The Seashore was designated a Globally Important Bird Area by the American Bird Conservancy because of the importance of the Seashore habitats to avian breeding, migration, and wintering. Seashore marshes contribute heavily to primary estuarine productivity and provide habitat for numerous wildlife and aquatic species.

Vegetation communities at the Seashore include sea oats (*Uniola paniculata*) dominated dune communities, wax myrtle (*Morella cerifera*) shrub communities, and coastal maritime hammock commonly characterized by Virginia live oak (*Quercus virginiana*). Small remnant slash pine (*Pinus elliottii*) plantations also occur in the Seashore. The southern interior of Hatteras Island contains Buxton Woods, a unique and complex freshwater wetland system very uncommon in barrier islands. Approximately one-third of this wetland complex occurs within the Seashore's boundary. Despite its complexity, sweetbay (*Magnolia virginiana*) and loblolly pine (*Pinus taeda*) generally occur throughout this system. The bayside of the Seashore generally consists of salt marsh cordgrass communities.

Nags Head and nine other smaller towns border the Seashore, causing some developmental pressure from outside the park. Visitor and recreational uses represent the major categories of threat to the integrity of natural resources on the CAHA.

CAHA has 362 known bird species (Table C-1).

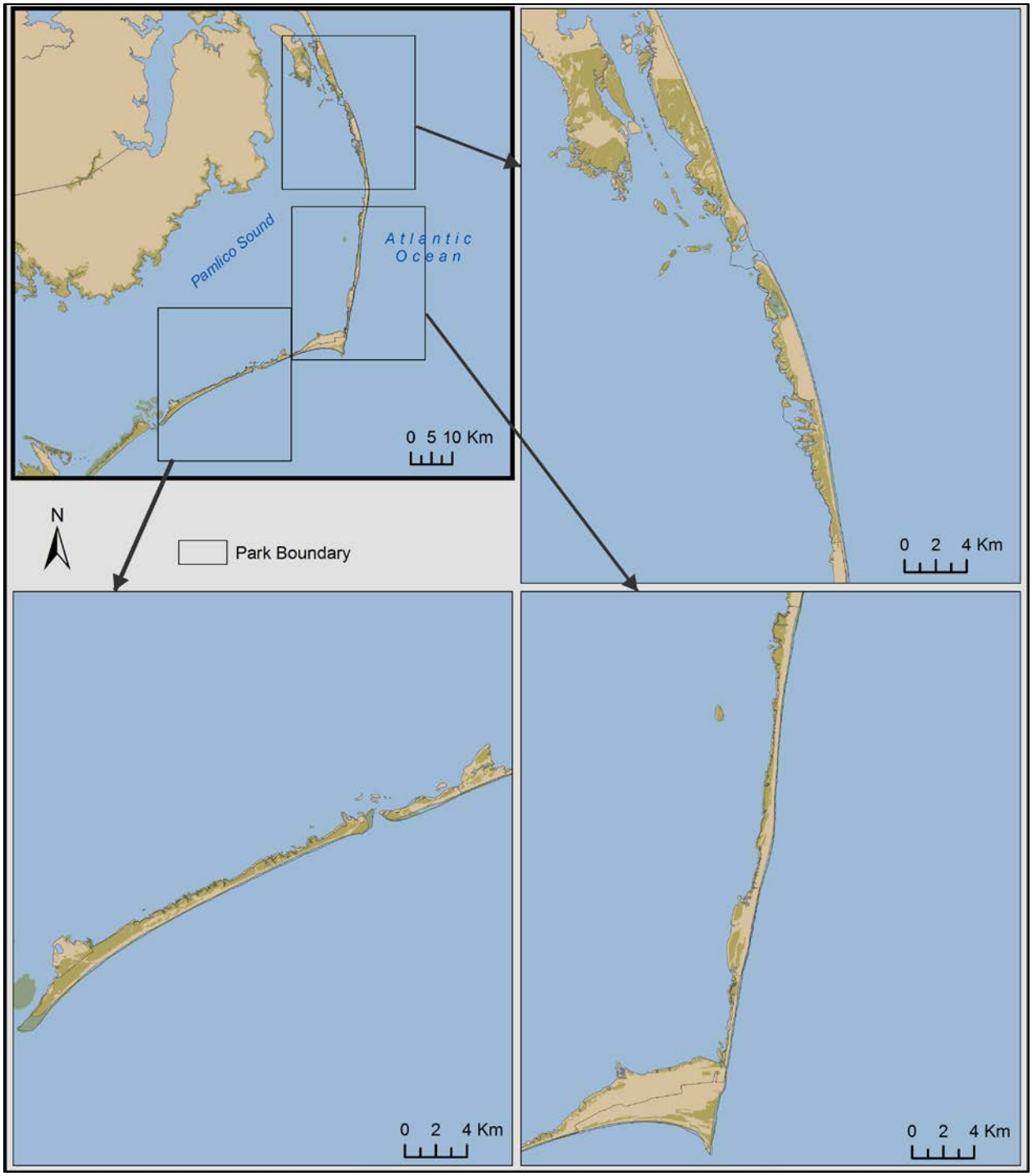


Figure 2. Location of Cape Hatteras National Seashore.

Cape Lookout National Seashore (CALO)

CALO, located along the southern end of the Outer Banks, is largely undeveloped and accessible only by boat. CALO is primarily composed of three barrier islands covering 56 miles (90 km) of the central coast of North Carolina (Figure 3). Most of the Seashore consists of North and South Core Banks, a 44-mile (71 km) long barrier system oriented in a southwest to northeast direction and separated by Ophelia Inlet. CALO extends into the Atlantic Ocean from its southern end. The other barrier system within the Seashore, Shackleford Banks, extends westward from Cape Lookout.

Core Banks is a long, narrow expanse of low dunes and maritime grasslands, dominated by sea oats, and extensive salt marsh cordgrass communities. Wax myrtle dominated shrub communities border the grassland in many places, and a low maritime forest, characterized by Virginia live oak, occupies small areas of higher ground. The islands are generally about 3 to 6 feet (0.9 to 1.8 m) above sea level and 0.6 to 1.2 miles (1 to 2 km) wide. For the most part, these areas are open and treeless. The morphology of the northern end of Portsmouth Island differs from the remainder of the Seashore and is characterized by large sand flats, approximately 0.6 miles (1 km) in width, located between the berm and the dunes of a series of marsh-fringed islands. At Cape Lookout, continuous dunes characterize its southwest side, with several small freshwater marshes present in depressions between the dunes. Some small remnant slash pine plantations from the 1970s occur at the Seashore. A long spit extends from the western tip of Cape Lookout, where a jetty built in the early 1900s has encouraged accretion in this direction.

The Seashore is year-round host to a wide variety of plants and wildlife, including several state- and federally listed species. CALO also plays a crucial role in providing nesting areas for sea turtles, shorebirds, stopover sites for migrating birds, and wintering grounds for birds.

CALO is one of the few barrier islands where natural wind-, tide-, and wave-driven processes of erosion, accretion, and overwash still occur and create a very dynamic environment and vegetation communities. Because the Seashore consists of barrier islands with no road access, the influences of urban development are generally limited. Runoff from mainland sources adds nutrients, fecal coliforms, and contaminants to the waters adjacent to the Seashore. Park managers actively attempt to curb illegal off-trail use by motorized off-road vehicles to prevent the adverse impacts this activity has on barrier-island vegetation, dune formation, natural barrier-island processes, and wildlife. A managed feral horse herd occurs on Shackleford Banks and creates a grazing pressure to which the native plants did not evolve, and alters the plant community structure, composition, and function. The effect of sea level rise on the Seashore's resources remains unknown.

CALO has 266 known bird species (Table C-2).



Figure 3. Location of Cape Lookout National Seashore.

Canaveral National Seashore (CANA)

CANA occurs on the east coast of central Florida (Figure 4). The park is approximately 57,000 acres (23,067 ha), including Mosquito Lagoon, and the southern portion is jointly managed by the NPS and the U.S. Fish and Wildlife Service (USFWS) Merritt Island National Wildlife Refuge. The park's natural resources include a diverse assemblage of wildlife, plant communities, geophysical features, and natural processes reflecting the complexity of the land/lagoon/sea interface of east-central Florida. Mosquito Lagoon, extending along the backside (i.e., west side) of Canaveral's barrier island, is the northernmost part of the Indian River Lagoon and has been designated as an Estuary of National Significance by the Environmental Protection Agency and an Outstanding Florida Water by the State of Florida. The lagoon acts as an important nursery area for a wide variety of game and non-game species.

Unlike many barrier islands, CANA has a less complex dune system separating the lagoon from the ocean and generally consists of a single primary dune, averaging 12 feet (3.7 m) in height. Predominant vegetation communities at CANA include coastal dune/coastal strand, dominated by *Serenoa repens*, *Coccoloba uvifera*, *Myrcianthes fragrans*, and *Morella cerifera*, hardwood hammock, mangroves, salt marsh, oak (*Quercus* spp.) scrub, and pine flatwoods (*Pinus elliottii* and *P. palustris*) interspersed with freshwater wetlands forming a unique and diverse mosaic.

The park hosts many federally listed species, including several species of sea turtles and birds (e.g., wood stork [*Mycteria americana*], piping plover [*Charadrius melodus*], and Florida scrub jay [*Aphelocoma coerulescens*]). Between 3,000 and 4,500 sea-turtle nests are recorded on CANA's 24 miles of beach each year, which is also vital foraging area for piping plovers. The wetlands are important foraging areas for wood storks, and the dry uplands provide year-round habitat for Florida scrub jays. CANA also sustains nationally-renown recreational and commercial fisheries, including finfish, oysters, and clams. The park has a rich Native American occupational history and several shell middens occur at the park.

The park is exposed to natural and anthropogenic stressors that affect the park's resources. Natural disturbances include severe storms, such as hurricanes and tropical storms, which can have a substantial impact on the distribution of vegetation communities. Frequent fires historically occurred in many of the vegetation communities at the park and, consequently, these communities are fire dependent. Over the last century, many of these naturally occurring fires were suppressed. Currently, however, the park, in cooperation with the USFWS, has an active fire management program to reduce fuel loads and restore this vital process to park lands. The park has a prominent wildland-urban interface along the northern and northwestern boundary. Potential anthropogenic stressors from adjacent lands include polluted runoff (i.e., nutrients, sewage), encroachment of non-native plant species, and landscape fragmentation. Historic fire suppression at Kennedy Space Center, which borders the park to the south, has also influenced the park. Canals and mosquito ditches altered natural hydrologic processes in portions of the park, and have likely influenced the distribution of plant and wildlife species. Historic land uses of the park include orange groves, timber harvest, and several home sites.

Rooting by feral hogs (*Sus scrofa*) causes extensive damage at the Seashore, especially in wetland communities. Despite an eradication program by USFWS that removes over 2,000 feral hogs each year, population estimates appear consistent due to high productivity and the immigration of feral hogs from lands adjacent to the Refuge and park.

CANA has 272 known bird species (Table C-3).

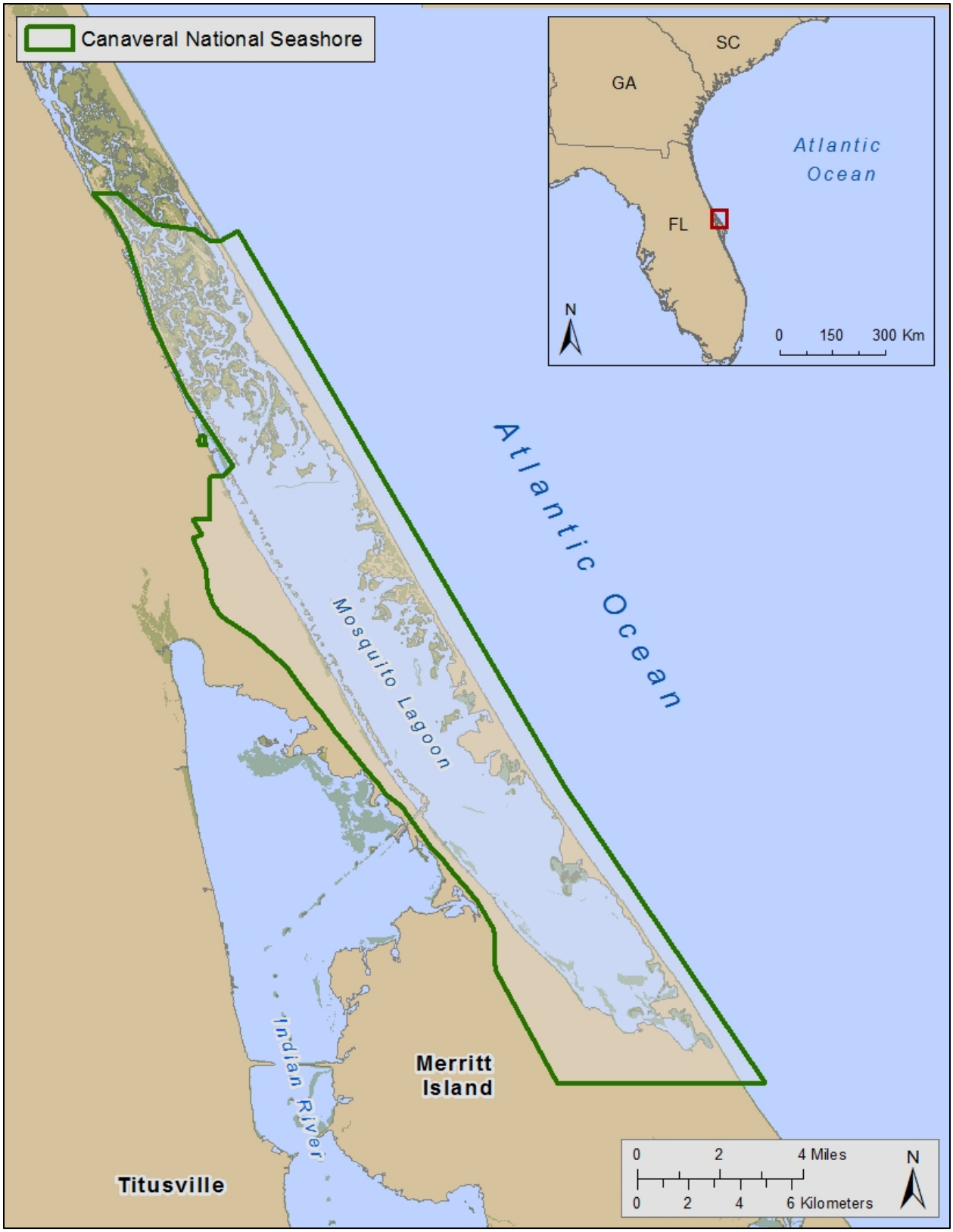


Figure 4. Location of Canaveral National Seashore.

Chattahoochee National Recreation Area (CHAT)

Located in north-central Georgia, CHAT extends for 48 miles (77 km) along the Chattahoochee River corridor between the city of Atlanta and Lake Lanier to the north (Figure 5). The upstream terminus of the park is Buford Dam, which is operated by the Army Corps of Engineers, and generates electricity and provides water to the greater Atlanta metropolitan region. The operation of the dam dramatically alters river flows and water temperatures within the park. The Park's entire length runs along the Brevard Fault Zone, which forms the Chattahoochee River channel, one of the oldest river channels in the United States. The Brevard Fault is a major 320+ mile long geological feature that, in part, delineates the Appalachian Mountains and the Piedmont Plateau physiographic provinces.

NPS owns 9,886 acres (4,000 ha) of land along the river. The park has one of the most prominent wildland-urban interfaces of all SECN parks, resulting in property-encroachment issues, non-native plants and animals, pesticide use, contaminated runoff (i.e., sewage, nutrients), and several other management challenges. According to the 2010 census, the five counties in which the park occurs have been some of the fastest growing and most densely populated in Georgia since 1990.

Despite these challenges, the park hosts a diverse array of flora and fauna, ecological communities, topography, and other attributes that make this park a unique and highly prized resource by its users. The vegetation communities vary with topography and proximity to the river. Uplands include mixed hardwood communities dominated by oaks, tuliptree (*Liriodendron tulipifera*), and American beech (*Fagus grandifolia*), and pine forests containing loblolly pine and shortleaf pine (*Pinus echinata*). Lowlands include floodplains and riparian areas with canopy species such as water birch (*Betula nigra*), mesic oaks (i.e., *Quercus nigra*, *Q. laurifolia*), red maple (*Acer rubrum*), green ash (*Fraxinus pennsylvanica*), and hackberry (*Celtis laevigata*).

CHAT has 192 known bird species (Table C-4).

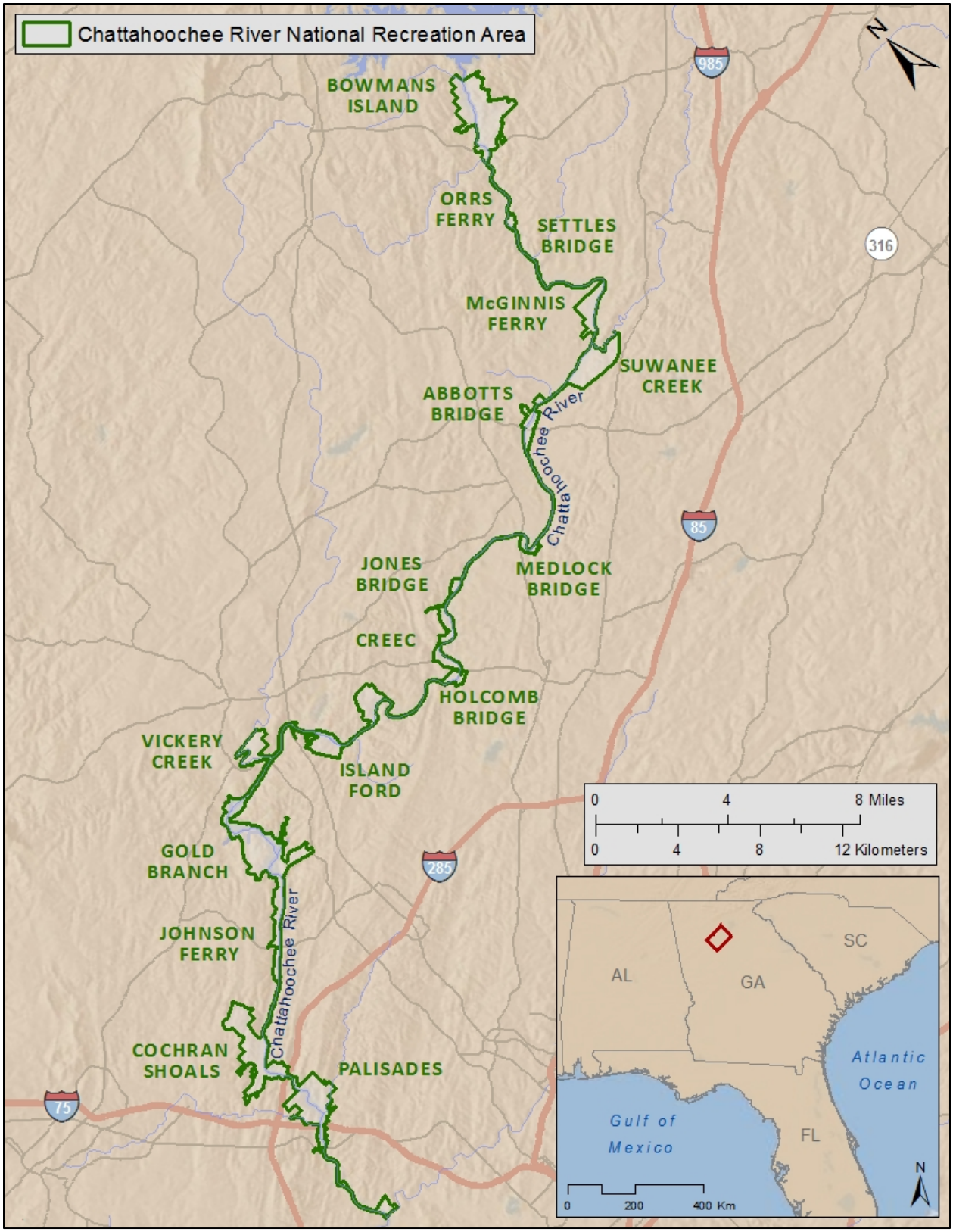


Figure 5. Location of Chattahoochee National Recreation Area.

Congaree National Park (CONG)

CONG is adjacent to the Congaree and Wateree Rivers in southeast Richland County, South Carolina, approximately 20 miles southeast and downstream of the city of Columbia (Figure 6). Encompassing 25,300 acres (10,230 ha), the park protects old-growth trees and diverse plant and animal life within the largest intact expanse of old-growth bottomland hardwood forest remaining in the United States. Periodic flood waters from the adjacent rivers flow through the bottomland forest in winter and spring, carrying nutrients and sediments that nourish and rejuvenate this unique floodplain ecosystem. Water levels in the river are dam-fed, and flow is driven by power need, reservoir management, and precipitation. While the park experiences periodic flooding throughout the year, these floods do not follow the natural hydrologic fluctuations or facilitate a natural hydroperiod; the effects of this alteration on the plant community remain unknown. Nearly 90 species of trees grow within the park, with many that are recognized as national and state champions for their size. Forested wetlands, oxbow lakes, and slow moving creeks and sloughs provide habitat for fish, birds, reptiles, mammals and other aquatic life. The diversity of flora and fauna, tall tree canopy, champion trees, and intact floodplain ecosystem earned the park the designation of an International Biosphere Reserve, National Natural Landmark, Globally Important Bird Area, and Congressionally-designated wilderness area.

A wide variety of forest communities are represented at CONG, with dominant tree species ranging from upland pines (*Pinus* spp.) to wetland cypress (*Taxodium* spp.) and tupelo (*Nyssa* spp.). The Congaree River floodplain is characterized by silty clay soils, oxbow lakes, swales and sloughs, and meandering creeks. The Congaree and Wateree Rivers are the major source of floodwaters, sediment, and nutrients delivered to the Park, although several tributary creeks are also present. The significance of CONG lies in its: (a) unique old-growth bottomland hardwood forest community associated with the swamp-like floodplain, (b) large trees, including loblolly pine, bald cypress (*T. distichum*), tupelo, sweet gum (*Liquidambar styraciflua*), American sycamore (*Platanus occidentalis*), swamp cottonwood (*Populus heterophylla*), oak, and American holly (*Ilex opaca*); (c) the intact floodplain ecosystem, and (d) high biodiversity.

CONG has 191 known bird species (Table C-5).

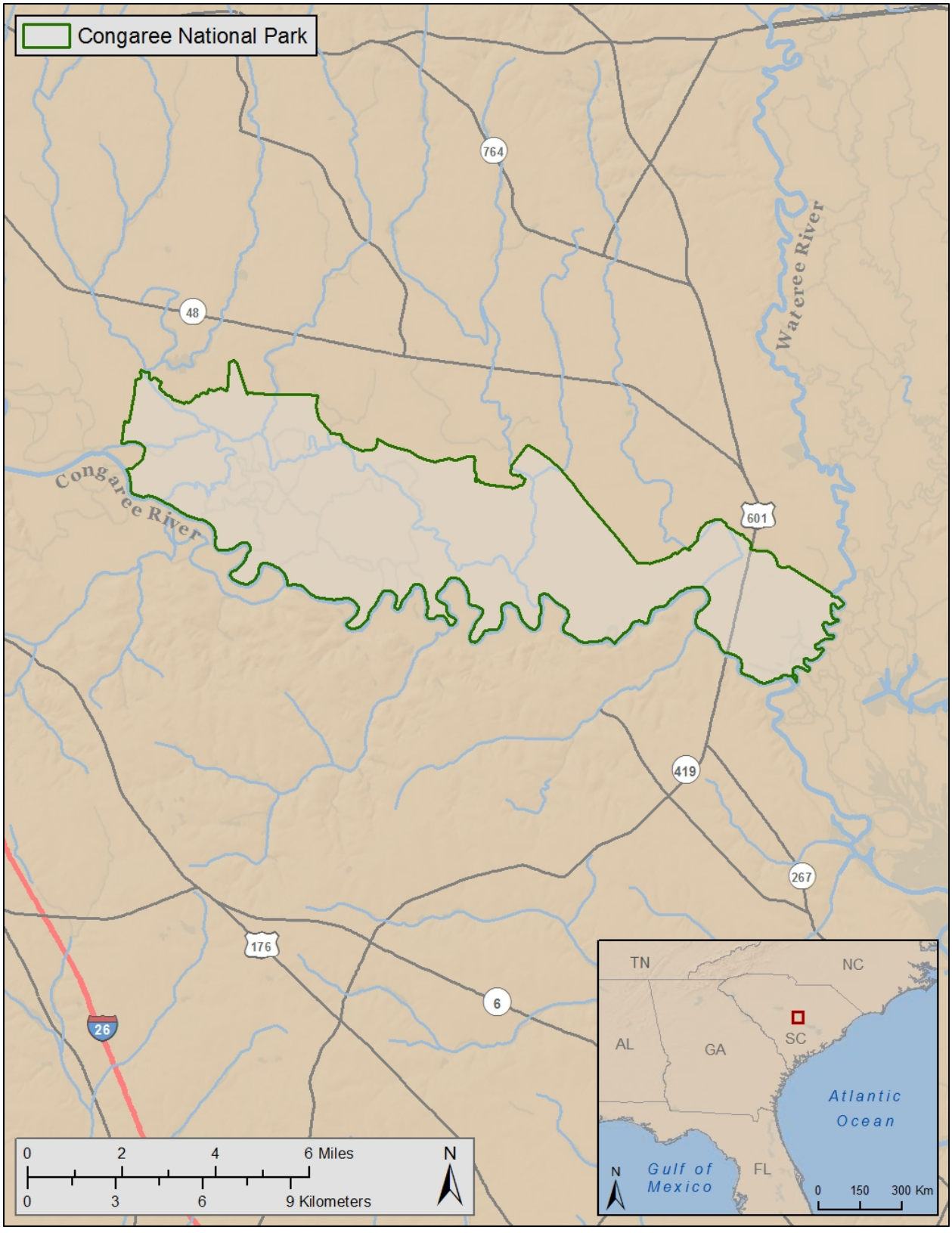


Figure 6. Location of Congaree National Park.

Cumberland Island National Seashore (CUIS)

CUIS is on the Georgia coast between St. Andrews Sound and the mouth of the St. Marys River. At 17.5 miles (28.2 km) long, CUIS is one of the largest and most diverse islands on the Atlantic Coast (Figure 7). Almost half of the Seashore's 36,415 total acres (14,737 ha) are *Spartina* spp.-dominated salt marsh community. These areas also include mud flats and six tidal creeks, which provide the habitat for a diverse assemblage of marine fauna. The terrestrial areas of the park consist of Virginia live oak/cabbage palm (*Sabal palmetto*) maritime forests, extensive dune systems, interdunal wetlands, freshwater ponds and wetlands, and mixed-pine/hardwood forests in the northern part of the park. The island is known for nesting loggerhead sea turtles (*Caretta caretta*), shore birds, undeveloped dune fields, maritime forest ecosystems, and historic structures, and is host to 18 federally listed species.

CUIS was established in 1972 to preserve the scenic, scientific, and historical values of the island as well as provide public outdoor recreational uses to its visitors. Specified areas of Cumberland Island are also part of the South Atlantic-Carolinian Biosphere Reserve and will be permanently protected in a primitive state. Approximately 4,000 ha (9,886 acres) of the northern portion of the island are designated a wilderness area. This unspoiled environment, once prevalent on all the barrier islands, provides a unique opportunity to experience the flora and fauna of a natural coastal ecosystem.

CUIS has 307 known bird species (Table C-6).



Figure 7. Location of Cumberland Island National Seashore.

Fort Frederica National Monument (FOFR)

Established on St. Simons Island in 1736 to protect South Carolina and Georgia from the Spanish, the town of Frederica was the southernmost post of the British colonies in North America. Today, FOFR encompasses three land units totaling 244 acres (99 ha) on St. Simons Island in southeast Georgia (Figure 8). The Monument is divided by the Frederica River, one of the primary salt marsh rivers in the Brunswick area, with 99 acres (40 ha) of marsh lands at the Frederica site on the west side of the river and approximately 137 acres (55 ha) of uplands adjoining the east side of the river. The separate Bloody Marsh site consists of 8 acres (3 ha) of which approximately five acres are tidal marsh. The salt marsh is dominated by cordgrass (*Spartina* spp.), and the uplands are a mix of coastal maritime hammock dominated by Virginia live oak and a small component of slash pine.

FOFR has 82 known bird species (Table C-7).



Figure 8. Location of Fort Frederica National Monument.

Fort Matanzas National Monument (FOMA)/Castillo de San Marcos National Monument (CASA)

FOMA is located 14 miles (23 km) south of St. Augustine on the northeast Atlantic Coast of Florida (Figure 9) and is jointly administered with CASA. The monitoring detailed in this protocol, however, will not be implemented at CASA due to the open character of the park and risk of equipment theft or vandalism. The 298-acre (121-ha) FOMA occurs on two barrier islands, 108 acres (44 ha) on southern Anastasia Island and 190 acres (77 ha) on northern Rattlesnake Island. The Anastasia Island portion of the Monument consists of beaches along the Matanzas River and Atlantic Ocean, stabilized primary dunes up to 23 feet (7 m) in height, a secondary-dune system, and maritime hammock and some salt marsh on the western-most portion. The majority of the Monument on Rattlesnake Island is less than five feet (2 m) above sea level and consists of an 18th-century fortified Spanish outpost, salt marsh, shrubs (i.e., wax myrtle), and maritime hammock that includes red cedar (*Juniperus virginianus*), Virginia live oak, and cabbage palm (*Sabal palmetto*). The northernmost portion of the island formerly served as a depository for dredge spoil from the Intracoastal Waterway.

FOMA has 155 known bird species (Table C-8).



Figure 9. Location of Fort Matanzas National Monument.

Fort Pulaski National Monument (FOPU)

FOPU is located in Chatham County, Georgia along the Savannah River only a few miles from its junction with the Atlantic Ocean (Figure 10). Although the Monument contains significant natural resources, the Monument's primary goal is to interpret technological advances in artillery and brick forts during the Civil War. The 5,623-acre (2,276-ha) Monument consists of two islands, Cockspur Island and McQueens Island. Both islands have been anthropogenically altered since the area was identified as a good defensive position in the 1700s and the Fort's construction began in the late 1820s. Of the two islands, Cockspur Island, however, experienced much more impact by the installation of drainage ditches and the use of the island to deposit dredge spoil. Cockspur Island likely supported some variation of coastal maritime hammock historically, and currently hosts primarily a sabal palm dominated community. The larger of the two islands, McQueens Island at approximately 4,900 acres (1,983 ha), appears less impacted from its history of use and consists of a primarily salt marsh cordgrass community, which is likely similar to its original condition. Both islands provide important habitat for migratory birds and a variety of marine species.

Because the Monument occurs at the mouth of the Savannah River, the direct and indirect effects of contaminants accrued throughout the watershed are known to impact water quality and might also affect the plant and wildlife communities at the Monument, although the extent to which remains unknown. Further, shipping traffic and dredging are contributing to increased shoreline erosion along the north shore of Cockspur Island.

FOPU has 213 known bird species (Table C-9).



Figure 10. Location of Fort Pulaski National Monument.

Fort Sumter National Monument (FOSU)

FOSU is located in Charleston, South Carolina (Figure 11). The Monument occurs at the mouth of Charleston Harbor and on the southern tip of Sullivan's Island. The Monument is co-administered with CHPI, although CHPI was not included as part of this monitoring effort. The Monument is 200 ac (81 ha), of which approximately 122 acres (50 ha) is submerged in the harbor. Although the Monument is primarily managed as an important cultural site (i.e., it was the site of the first engagement of the Civil War), it also contains natural resources that provide important stopover sites for migratory birds. Additionally, an accreted area adjacent to the Fort and the beachfront areas on Sullivan's Island provide foraging habitat for shorebirds year-round.

Vegetation is sparse around the Fort itself, and consists primarily of early successional tidal forbs (i.e., *Batis maritima*). The vegetation communities in the unit on Sullivan's Island are somewhat more complex, although impacted from strong anthropogenic use, and consist of primary dune, beach, and maritime hammock communities, and manicured lawn areas. The primary dune is characterized by sea oats, while the maritime hammock is dominated by Virginia live oak.

FOSU has 178 known bird species (Table C-10).



Figure 11. Location of Fort Sumter National Monument.

Horseshoe Bend National Military Park (HOBE)

HOBE consists of 2,040 acres (826 ha) situated near the southern end of the Piedmont Plateau (Figure 12). It contains low rolling hills, which reach elevations from 600 to 711 feet (183 – 217 m) above sea level. Park lands were extensively cultivated from 1832 until the establishment of the park in 1959, and are in various stages of ecological succession. The land has undergone some minor changes in the intervening 175 years since the battle. In many places, pines have displaced the climax hardwoods that existed in 1814. The vegetation has been altered by human settlement, logging, and by the introduction of non-native species. The timbered lands once used for agriculture have reverted to forests or remained as open fields. The forest type is mesic beech-oak-hickory with some loblolly pine. Drier areas and ridge tops are dominated by loblolly pine, with scattered longleaf pine along the northern third of the park. The understory is relatively open and dominated by sapling American elm (*Ulmus americana*), blueberries (*Vaccinium* spp.), Carolina silverbell (*Halesia carolina*), muscadines (*Vitus* spp.), and ferns. The condition of wildlife species was largely unknown upon acquisition of the Park, and was later realized that feral dogs and cats had extirpated many species. Enforcement of resource laws concerning flora and fauna has allowed a diversity of wildlife species to re-establish throughout the Park. The Park not only contains many species of plants endemic to the Piedmont region, but also species associated with the Southeastern and Southern Coastal Plains.

The hydrologic regime of the Tallapoosa River, 3.5 miles (5.6 km) of which are within the park boundary, is dam-controlled upstream of the Park by Alabama Power Company. The release schedule is determined by hydroelectric needs and bears no relationship to natural flows, more resembling a “trickle or torrent” that affects both natural resources and the cultural landscape. The U.S. Fish and Wildlife Service is currently seeking to accelerate reauthorization of the dam in order to negotiate a flow regime less detrimental to river ecology.

HOBE has 119 known bird species (Table C-11).

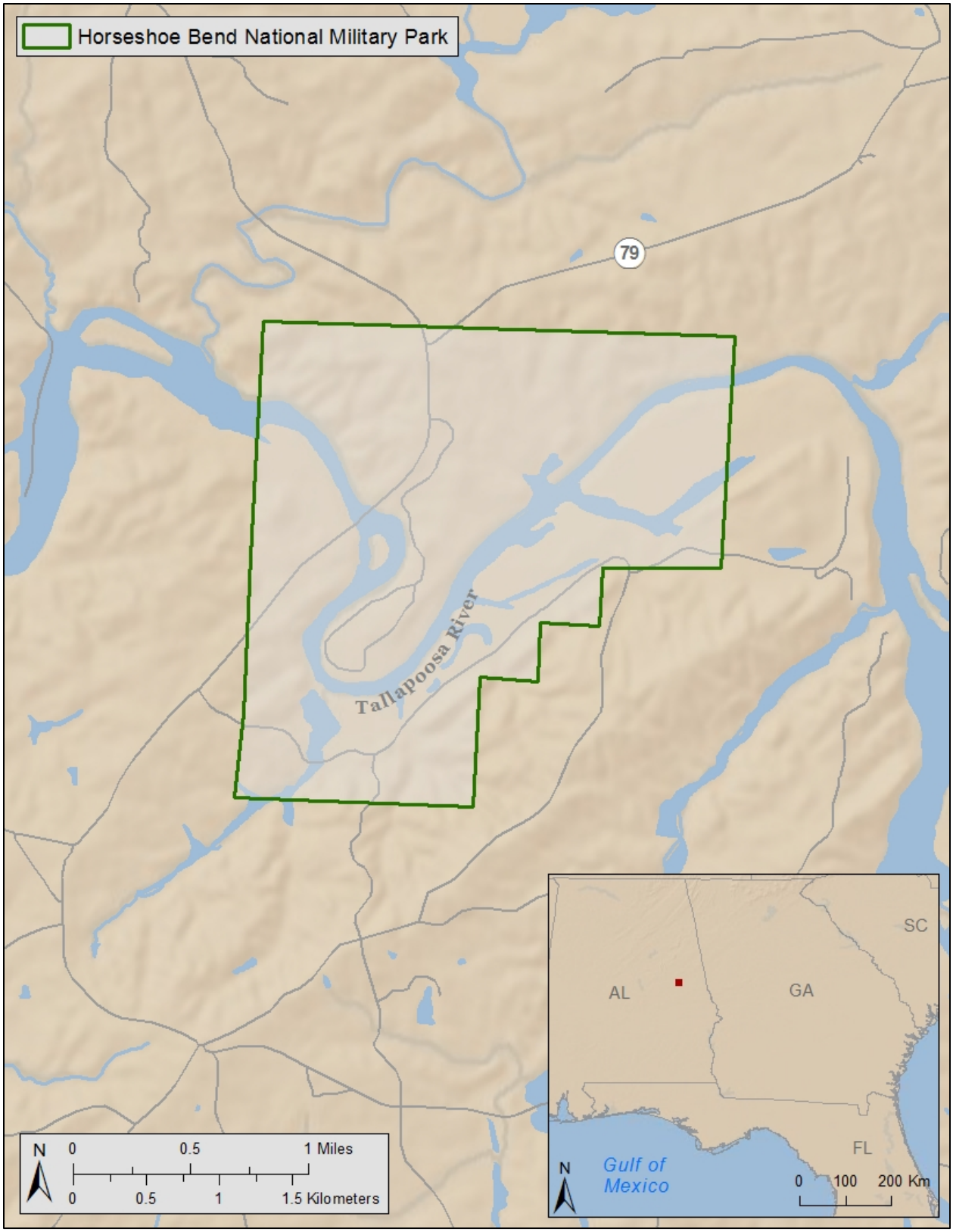


Figure 12. Location of Horseshoe Bend National Military Park.

Kennesaw Mountain National Battlefield Park (KEMO)

KEMO, a 2,923-acre (1,183-ha) park in the metropolitan Atlanta area, includes the 1,808-foot (551-m) peak of Kennesaw Mountain, Little Kennesaw Mountain, and hundreds of acres of mixed hardwood/pine forests intermixed with a number of grassy fields (Figure 13). Forested areas generally consist of oaks, hickories (*Carya* spp.), and loblolly pine. Included are more than 22 miles (35.4 km) of designated hiking trails that attract hundreds of recreational visitors daily. The Park's location in the metropolitan Atlanta area makes it the second-most visited battlefield in the National Park System, and has earned it a position on the Secretary of Interior's list of 25 most threatened parks.

Largely because of its proximity to Atlanta, major threats to natural resources exist at KEMO. The development of Cobb County and greater metro Atlanta makes the lands within Kennesaw Mountain relatively valuable for localized plant and animal communities. Cobb County has plans to expand roads and highways that traverse the park and pose a potential threat to both cultural and natural resources. Air pollution also poses a major threat to the Park, which is located in a designated ozone nonattainment area. Additionally, there are minor threats from encroachment of adjacent landowners, non-native invasive plant species, and industrial air and water pollution. Since 1993, Southern pine beetle (*Dendroctonus frontalis*) infestations have killed several thousand of pine trees throughout the park, thus increasing long-hour fire fuels and the corresponding wildfire risk. The mitigation of encroachments and the removal of non-native plants are ongoing programs.

KEMO has 207 known bird species (Table C-12).

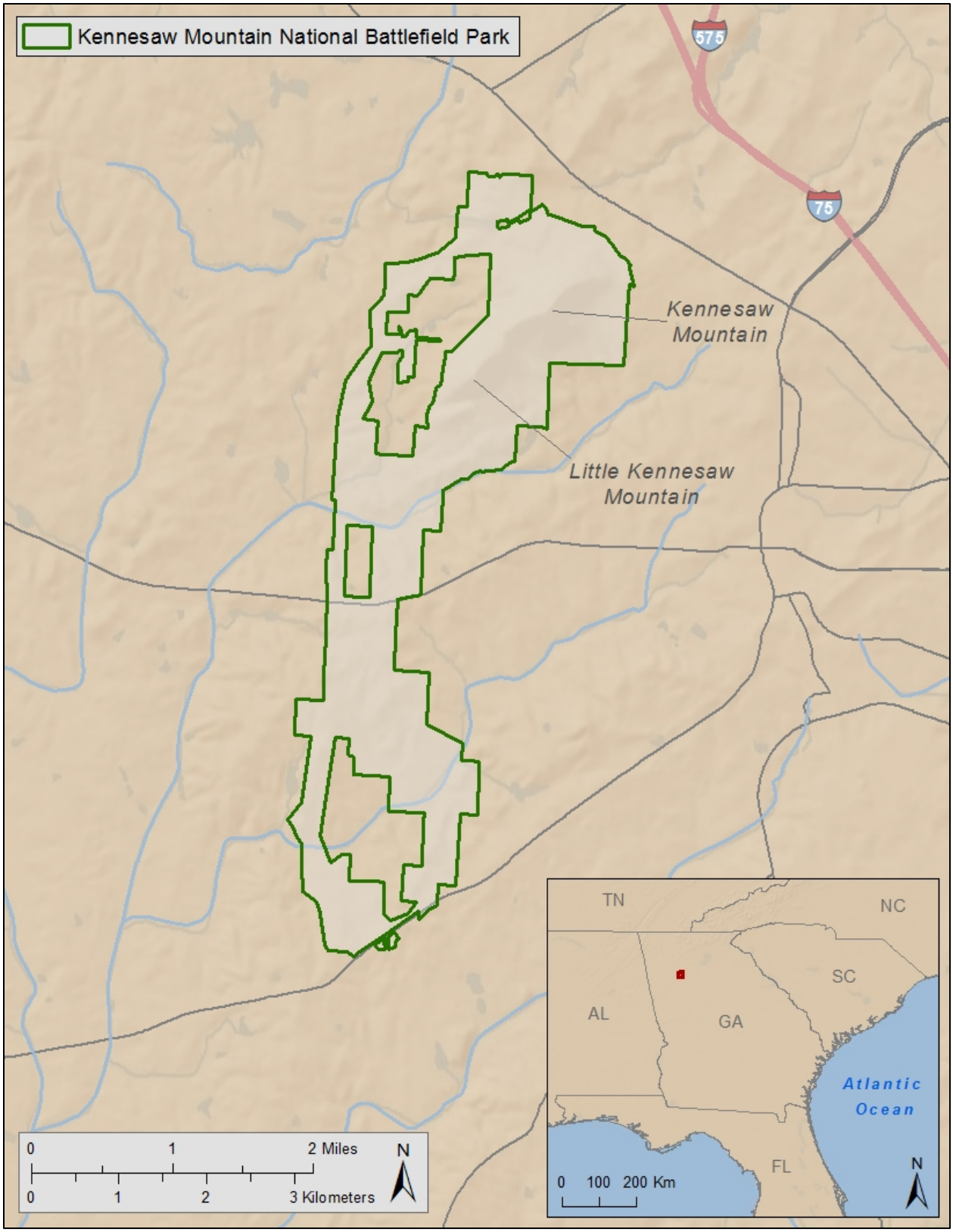


Figure 13. Location of Kennesaw Mountain National Battlefield Park.

Moores Creek National Battlefield (MOCR)

MOCR is in southern coastal North Carolina approximately 20 miles (32 km) northwest of Wilmington, NC (Figure 14). The Battlefield's primary purpose is to interpret the pivotal Revolutionary War battle that occurred on the site; however, the park hosts a variety of natural resources. The 88-acre (36-ha) park contains a small portion of Moores Creek in the western part of the park, north of the confluence of Moores Creek with the Black River. Moores Creek is a tidally-influenced blackwater stream with an approximate width of 26 feet (8 m). Vegetation communities of the park include riparian areas, dry pine forests, and wet pine savannahs. The riparian areas are generally dominated by bald cypress while the uplands are a mix of loblolly pine and sweetgum. A large area in the center of the park is in a restoration process to return it to its historic condition of wet savannah.

MOCR has 98 known bird species (Table C-13).

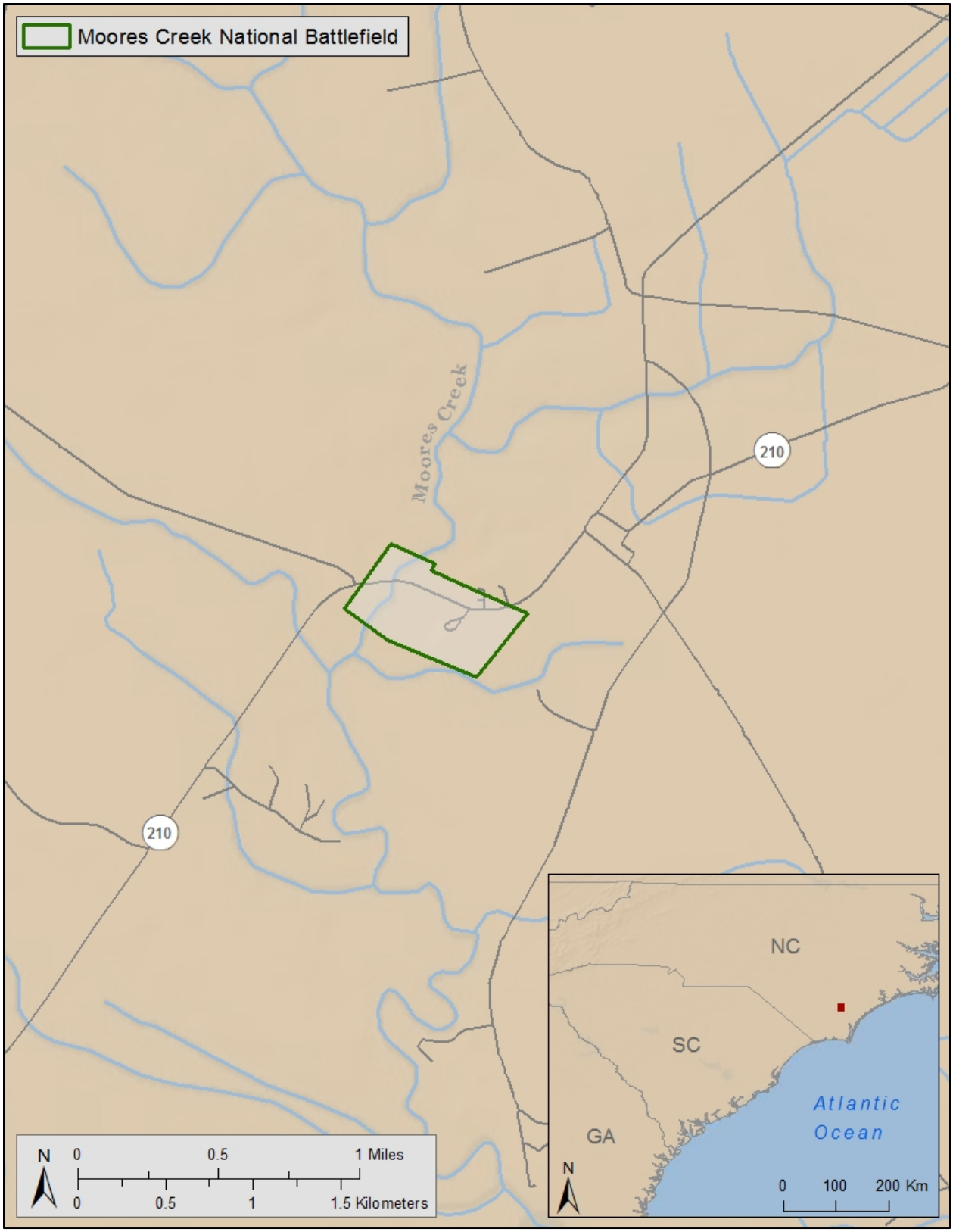


Figure 14. Location of Moores Creek National Battlefield.

Ocmulgee National Monument (OCMU)

OCMU sits on the "Fall Line", the transition between the rolling Piedmont and the flat Atlantic Coastal Plain. A portion of the Monument is within the city limits of Macon, GA, and the Ocmulgee River borders the southwestern side of the Monument (Figure 15). The natural resources of the park have been heavily impacted by human activities, including Interstate Highway 16 and its associated berm, which has essentially cut off the river from its floodplain and altered the natural hydrologic pattern of the area. Despite the anthropogenic influences, OCMU has high biodiversity. This is likely related to a corridor, or what is known locally as the "Greenway," connecting the Monument to other natural areas south of the Monument. The Monument primarily consists of a large floodplain, herbaceous wetlands, and adjacent uplands. The floodplain vegetation community is composed of several canopy species, including green ash (*Fraxinus pennsylvanica*), American elm, hackberry (*Celtis* spp.), and red maple, while the uplands are characterized by canopy species such as loblolly pine, sweetgum, and oaks. Smartweed (*Polygonum* spp.) and maidencane (*Panicum hemitomon*) often occur in the herbaceous wetlands.

Numerous bird species occur in the Monument throughout the year and many migratory birds use the area as a stopover location during spring and fall migrations. The endangered wood stork (*Mycteria americana*) feeds here during summer months. Numerous other wildlife species occur at OCMU, including white-tailed deer (*Odocoileus virginianus*), American beaver (*Castor canadensis*), bobcat (*Lynx rufus*), and several reptiles and amphibians. Recreational fishing is allowed, with largemouth bass (*Micropterus salmoides*) a common catch. Within the last eight years, coyotes (*Canis latrans*) have entered the Monument.

Threats affecting the native plants and animals in the Monument result mainly from human activities, and include non-native species invasion, water quality, air quality, development, and the general proximity to the city of Macon. Non-native species are a disruptive influence in the Monument. Non-native invasive plants at OCMU include Chinese privet (*Ligustrum sinense*), Japanese honeysuckle (*Lonicera japonica*), and kudzu (*Pueraria montana*). Non-native animal species include nutria, fire ants (*Solenopsis invicta*), feral hogs, and domestic/feral dogs and cats. Feral hogs are responsible for a tremendous amount of resource damage in both the main unit and the detached Lamar unit.

OCMU has 168 known bird species (Table C-14).

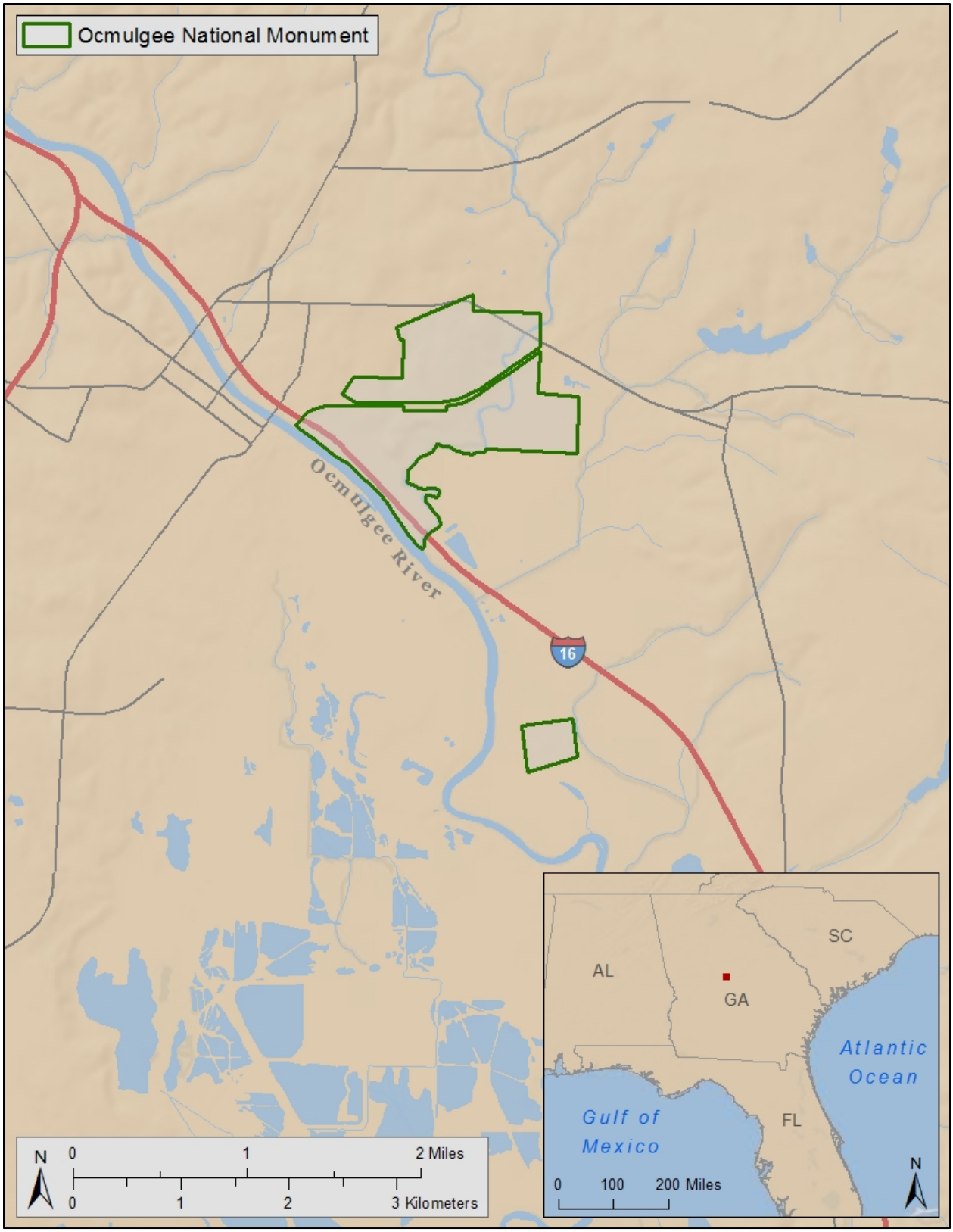


Figure 15. Location of Ocmulgee National Monument.

Timucuan Ecological and Historic Preserve (TIMU)/Fort Caroline National Memorial (FOCA)

The 46,000-acre (18,616-ha) TIMU encompasses the mouth of the St. Johns River and the lower several miles of the Nassau River (Figure 16). The Preserve is a collection of landowners (i.e., private, The Nature Conservancy, City of Jacksonville, Florida State Parks, federal), with approximately 8,500 acre (3,440 ha) of the Preserve under federal ownership. FOCA, also within the TIMU boundary, is 138 acre (56 ha). The Preserve consists of large areas of salt marsh that vary in degrees of salinity, but are generally dominated by saltmarsh cordgrass and needlegrass rush (*Juncus roemerianus*), some freshwater streams, ponds, and wetlands, and adjacent uplands. The uplands are a mosaic of maritime hammock, that contain species such as live oak, cabbage palm, xeric hammock and coastal scrub (i.e., sand live oak [*Quercus geminate*], saw palmetto [*Serenoa repens*], rusty fetterbush [*Lyonia ferruginea*]), slash pine stands, and restored longleaf pine stands.

During the last decade, the lands adjacent to the Preserve and Memorial have exhibited some of the most rapid growth and development in Florida. Consequently, the Preserve has a prominent wildland-urban interface and is host to many external stressors, including altered ecosystem function (i.e., fire suppression, hydrology), invasive species, and the direct and indirect effects of contaminants accrued throughout the watershed of the St. Johns River, Florida's longest river. Despite these threats, the Preserve remains quite diverse and plays a crucial role in providing habitat for many rare species, including West Indian manatee (*Trichechus manatus*), painted bunting (*Passerina ciris*), gopher tortoise (*Gopherus polyphemus*), hooded pitcher plant (*Sarracenia minor*) and is the northernmost extent for some sub-tropical plant species such as wild coffee (*Psychotria nervosa*) and snowberry (*Chiococca alba*).

TIMU/FOCA has 312 known bird species (Table C-15).

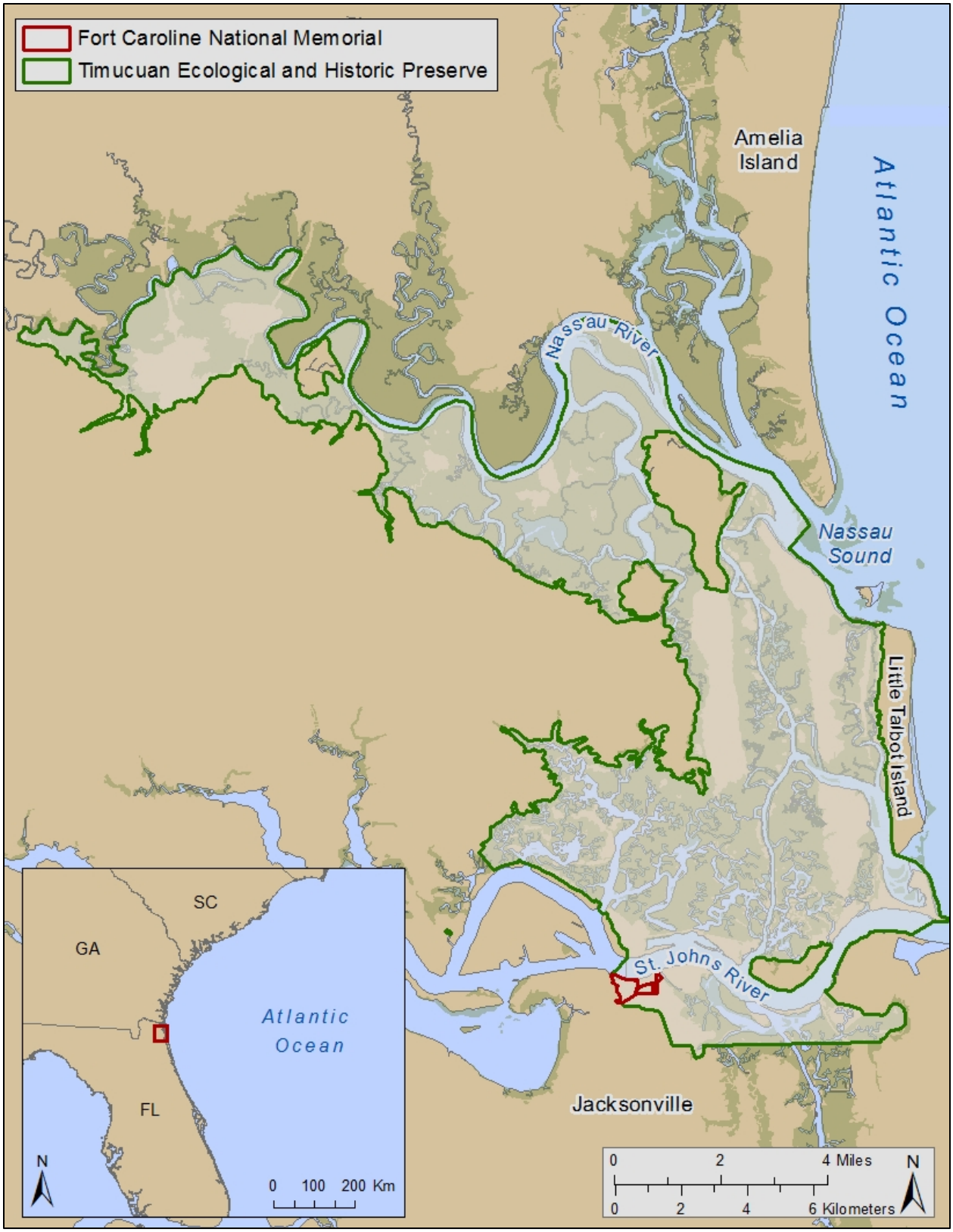


Figure 16. Location of Timucuan Ecological and Historic Preserve and Fort Caroline National Memorial.

Landbird Communities as a Vital Sign

The landbird community is defined as the assemblage of all landbird species' populations that use SECN parks for any aspect of their life history at any time of the year. The landbird community was chosen as a Vital Sign and core natural resource inventory because over 400 species are known to occur, birds play an important ecological role and can be used as indicators of ecological condition, and SECN parks occur in a highly fragmented urban landscape and are critical refugia for birds.

Birds in the SECN

Over 400 bird species in 61 families use SECN parks during any given year for breeding, wintering, or as a migratory stop-over. The high diversity within the SECN exists because the Network is comprised of both inland parks and coastal parks (i.e., four National Seashores) and, consequently, a wide array of bird habitat types. More than 300 species are known to occur in three parks, 200-300 species in four parks, and seven parks have 100-200 known bird species.

Regional Population Status

The Southeastern U.S. has a long history of documented species extinctions associated with habitat loss, degradation, and over-harvest, including the passenger pigeon, Carolina parakeet, ivory-billed woodpecker, passenger pigeon, dusky seaside sparrow, and (very likely) Bachman's warbler. Analysis of both Breeding Bird Survey and Christmas Bird Count (CBC) long-term datasets indicate changes in the counts and ranges of many migratory and non-migratory bird species within the last 40 years (Sauer et al. 1997, Niven et al. 2009).

Because of the observed declines in several species, but most importantly the loss of habitat for many species, the South Atlantic Migratory Bird Initiative compiled a list of priority species (Watson and Malloy 2008); the highest priority species (i.e., those determined to require immediate management attention) consist of 36 species, many of which occur in SECN parks. For the Partners in Flight (PIF) designated Eastern Biome, within which the SECN occurs, PIF has identified nine species warranting "Immediate Action", 19 warranting "Management", and 16 that require "Long-term Planning and Responsibility" (Rich et al. 2004). Within the Southeast Coastal Plain, the USFWS (2008) identifies 53 species of conservation concern, and 18 species of conservation concern in the Piedmont.

Ecological Role and Utility as Indicators

Birds play several critical roles in ecosystem processes. They occupy and interact with several trophic levels of the food web, which include their role as both predator and prey. Birds regulate rodent populations (Ims and Andreassen 2000), insect populations (Mols and Visser 2002), and scavenge dead animals (Pain et al. 2003). Other species aid in plant pollination (Stiles 1978) of wild and cultivated crop plants, and provide mechanisms for seed dispersal (Howe and Smallwood 1982). Bird guano contains nutrients necessary to many vegetation communities (Wootton 1991). Management activities aimed at preserving habitat for bird populations, such as for neotropical migrants, can have the added benefit of preserving entire ecosystems and their attendant ecosystem services (Karr 1991, Maurer and Heywood 1993).

The landbird community is influenced by, and serves as an indicator for, a wide range of natural and anthropogenic stressors. The bird community often responds quickly to environmental stressors,

perturbations, or changes. Because many species of birds have been extensively studied, their biology and life histories well defined, and information is available regarding their habitat use, bird communities can be good indicators of the ecological conditions of an area. Consequently, information about landbird communities in an area provides derivative information about many characteristics of the area (e.g., vegetation community types, extent of fragmentation). Several bioassessment approaches have been developed using birds to determine the ecological condition of an area (Croonquist and Brooks 1991, Bradford et al. 1998, Brooks et al. 1998, O'Connell et al. 1998, Canterbury et al. 2000, Grant et al. 2000, O'Connor et al. 2000, O'Connell et al. 2000, Bryce et al. 2002, Coppedge et al. 2006). Further, birds can be used as part of multi-species approaches used to inform land-management decisions (e.g., Block et al. 1995, Zipkin et al. 2010, Zipkin et al. 2012). Methods and measures for determining the condition, or integrity, of an area, such as bioassessment approaches, are of particular interest because it allows for targeted management thus increasing efficiency. In some instances, measures of birds can be used as a surrogate for an element, attribute, or process for which direct measurements cannot be made.

Because of their utility as indicators, birds can be used as an early-warning mechanism for managers, identify the condition or characteristics of the resource, illuminate our understanding of or the interactions among various stressors, identify the need for specific management actions, and evaluate the efficacy of management actions.

Role of SECN Parks

The southeastern U.S. has experienced comparatively higher levels of fragmentation that other parts of the U.S. (Ritters et al. 2002, Smith et al. 2009), and a higher likelihood of a further increase in fragmentation (Radeloff et al. 2005) compared to other regions. The remaining protected areas, such as SECN parks, are well recognized to be crucial in maintaining stable bird populations. Because most SECN parks are isolated lands in a highly fragmented wildland-urban landscape, SECN parks serve as refugia for many species of birds and provide habitat components not generally available in similar sites across the Southeast. Protected areas, specifically forested areas within a substantially fragmented landscape, are important stopover sites for migratory birds (Bonter et al. 2009). Further, forest cover, arthropod abundance, and the availability of plant fruits are strongly associated with high bird densities (Buler et al. 2007), and these attributes are common in protected park lands.

SECN parks provide resources for resident birds (i.e., wintering/breeding) and neotropical, nearctic, and temperate migrants. SECN parks also occur within a large and important migratory corridor, the Atlantic Flyway. The quality of bird habitat types is critical to neotropical migrants, as these areas serve as stopover sites where the birds forage, rest, and prepare for the over-water portion of their migration in the fall or to continue to fuel their spring migration and move towards acquiring the nutritional and energetic requirements for reproductive readiness. Further, many neotropical migrants use major river corridors during their migration, such as CONG and CHAT. The National Seashores in the SECN are considered integral migratory, wintering, and nesting areas for many species of shorebirds and landbirds, and some of the largest remaining areas available to some of these species. The diversity of vegetation communities, and bird habitat types, also facilitates the use of SECN parks by many bird species.

Recreation and Visitation

Birding is one of the most popular recreational activities pursued by Americans (Cordell and Hebert 2002, Cordell et al. 2007). Because many birds are primarily diurnal, visible and vocal, and attractive, they are a major point of interest for many park visitors and the general public. Birds have a strong public appeal and are the recreational focus for many park visitors. Inquiries regarding birds are one of the most commonly asked question posed to interpretive staff. All SECN parks are well known birding destinations, with CANA, CHAT, CONG, CUIS, KEMO, CAHA, and CALO considered Globally Important Bird Areas by the American Bird Conservancy. Birds can also be the foundation for local, regional, of international partnerships where conservation efforts of federal, state, and non-governmental agencies are leveraged to benefit birds.

Factors Affecting Landbird Communities

Bird populations are affected by a variety of stressors; however, the primary agents that affect birds are habitat loss and degradation. Bird habitats in SECN parks are protected, although park ecosystems are influenced by a variety of factors at local and landscape scales. These stressors include climate change, changes in surrounding land use, human-population growth, water quality and quantity, contaminants from surrounding airsheds and watersheds, and a host of localized influences on habitat quality and availability (e.g., land development or conversion, recreational impacts, fire management, non-native plant management, riparian area erosion in regulated river systems) (Table 1, Figure 17). These stressors have the potential to alter the structure, function, and composition of landbird communities, and are likely to persist indefinitely into the future. Understanding the effects of multiple concurrent stressors affecting parks, and mitigating the impacts of those stressors at multiple spatial and temporal scales on landbird and other biotic communities, is an ongoing challenge for SECN park managers.

Factors that affect (i.e., decrease) resource quality and availability generally result in clustered and aggregated populations which is detrimental to persistence as this increases competition, predation, and disease transmission, and can reduce genetic diversity. Increasing environmental stress on birds could potentially increase a bird's susceptibility to pathogens or the virulence or persistence of pathogens. SECN parks serve as one of the few remaining areas with protected bird habitat. Improving or maintaining a diverse array of high quality resources is paramount to maintaining viable bird populations.

Table 1. Factors affecting landbirds within Southeast Coast Network Parks and potential measures for Vital Signs Monitoring. Measures in **bold** are collected under this protocol, measures in ***bold italics*** are collected under another monitoring protocol, and those in regular text are not collected.

Category	Issue	Potential Measures	Applicable Parks
Landscape Change	Changes in the distribution and types of land uses relative to parks influence the quality and quantity of vegetation, water, and air resources.	**Species richness; Species composition; Species distribution; *Landscape patterns/fragmentation***; Abundance estimation; Age structure; Survivorship; Disease presence/prevalence; Nesting/Brooding success	All SECN parks
Climate Change	Evolving weather patterns affect distribution of vegetation communities, freshwater resources, the associated species assemblages, the timing of various life history traits, and food web dynamics.	**Dates of first and last vocalization**; ***Temperature; Precipitation; Drought severity and duration;*** **Species distribution; Species richness; Species composition;** Ground surface temperature; Abundance estimation; Age structure; Survivorship; Disease presence/prevalence; Nesting/Brooding success	All SECN parks
Altered Hydrology	Availability of freshwater resources.	**Species richness; Species composition; *Drought severity and duration, Precipitation,* Distance to water resources; *Groundwater quantity; Surface water quantity; Landscape patterns/fragmentation***; Abundance estimation; Age structure; Survivorship; Nesting/Brooding success	All SECN parks
Altered Vegetation Patterns	Availability, connectivity, diversity, and suitability of resources related to natural and anthropogenic causes such as fire, non-native plant invasion and management, insect pest outbreaks, storm damage, and succession.	**Species distribution, Species occupancy; Species richness; Species composition*; Litter/duff depth; Downed-woody debris; Vegetation-cover;* Soil moisture;** Abundance estimation; Age structure; Survivorship; Nesting/Brooding success	All SECN parks

[1] Variable Circular Plot methods to be used as a part of this protocol can be used to generate a density estimate, but these methods will only be used at a subset of sampling locations which is insufficient to provide park-wide abundance estimates for all species observed.

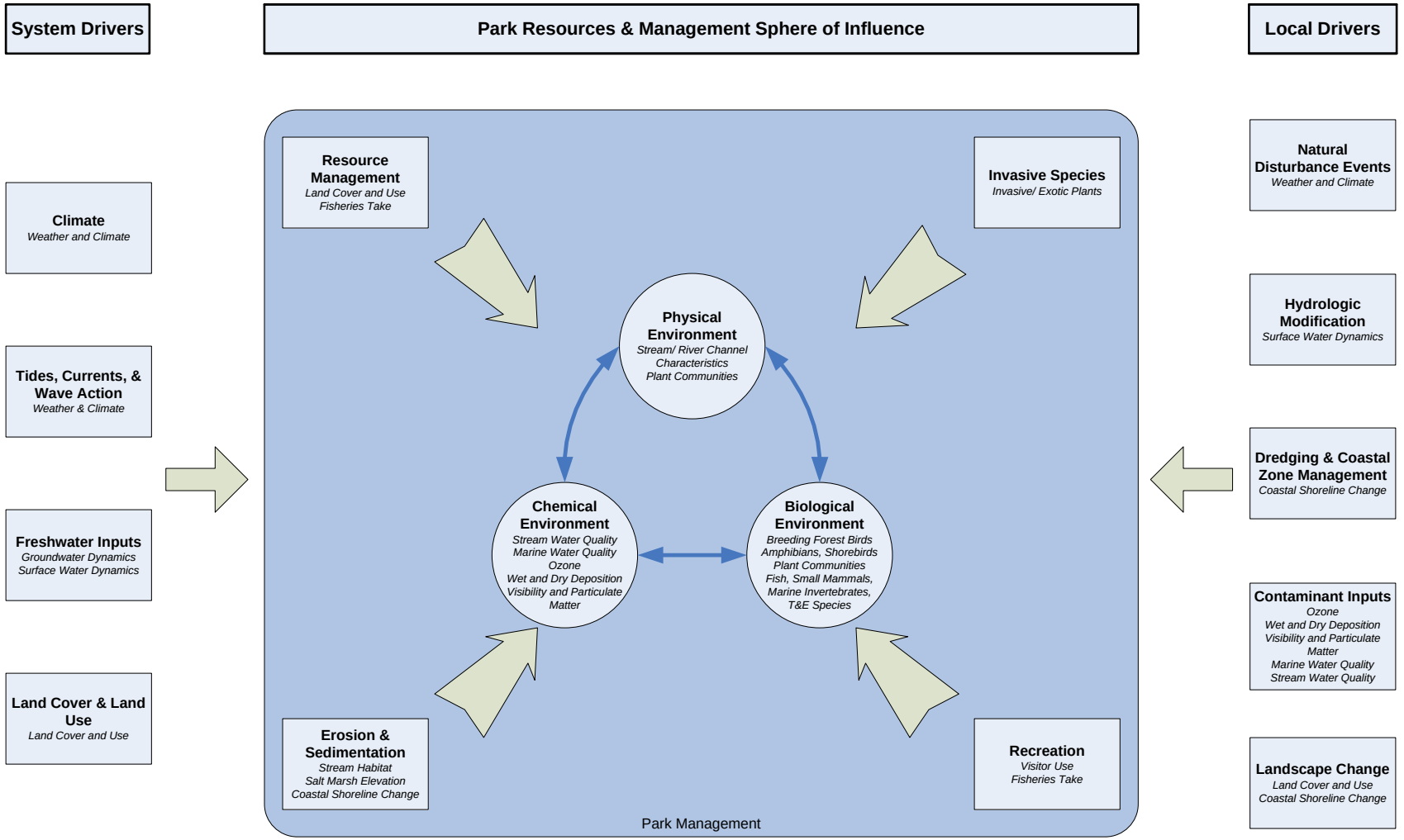


Figure 17. General conceptual model of major ecosystem components (circles), agents of change (rectangles), and associated Vital Signs (italics) for measuring the status and trends of the condition of resources in Southeast Coast Network parks. Large green arrows link agents of change to the biotic, chemical, and physical components of park ecosystems. The dark blue area includes those agents of change or resources that are currently/actively managed by the National Park Service (DeVivo et al. 2008).

Rationale for Selecting Landbirds

In summary, the landbird community is important to monitor for several reasons. Birds are one part of a multi-species approach that informs land-management decisions (Zipkin et al. 2012). Monitoring, and subsequent management, facilitates the maintenance of biodiversity. High diversity is strongly correlated with the resistance and resilience of a system under stress, and its continued integrity. Further, maintenance of overall system integrity provides ecosystem services (i.e., nutrient cycling, soil formation, pollutant/contaminant removal and sequestration), biological services (i.e., food, medicines, construction materials, fibers, genetic resources), and social resources (i.e., tourism, recreation). A diverse gene pool facilitates the adaptive ability of a population and decreases the likelihood of extinction.

Management Applicability and Utility

Applying information collected under this protocol to management decisions is integral to the success of this program. No SECN park specifically manages park lands for landbirds, but as previously mentioned, landbirds are indicators of a variety of influences, some very subtle, and can be used to inform management on emerging, acute, or chronic conditions.

One objective of this protocol is to determine trends in species richness. An increase in species richness can indicate the effectiveness of some management activity, whereas a decrease could indicate the need for one. Decreases in richness can indicate changes in vegetation structure or composition, the effects of fire suppression, or additive and selective predation pressure. Changes in species composition (i.e., what species are detected) also provide a wealth of information. For example, shifts from species considered specialists to those that are generalists can indicate potential issues in specific vegetation community types. Another example might be a decrease in ground-nesting birds could be suggestive of fire suppression or an atypical predatory influence (i.e., feral cats). Changes in the ratio of edge to interior species may indicate changes in adjacent lands. Monitoring will also indicate the arrival of non-native species to provide an opportunity to address this challenge early. The presence or expansion of non-native species may also indicate changes in vegetation composition or structure (i.e., changes on a trajectory away from those expected in a healthy system), therefore warranting management action. Changes in species distribution can be indicative of changing vegetation patterns. Species distribution information can also inform trail management (i.e., creating new, closing old).

Based on our conceptual ecological models (DeVivo et al. 2008), we anticipate that the data we collect will be useful for evaluating ecological condition, and informing land-management activities such as fire management, invasive species control, and wetland restoration. It is important to note that the fullest utility of these data exists when these data are evaluated in context with data collected under other Vital Signs Monitoring protocols. The results of landbird monitoring, however, can frame management objectives by maximizing the efficiency and focus of efforts. Monitoring data will reveal patterns in habitat use by components of the landbird community, which can provide further targeted efforts. For many landbird species, the habitat requirements are known and the decline or loss of those species can assist in setting habitat-based management objectives. Management objectives can evolve into very specific targets that directly relate to habitat

components such as shrub height, herbaceous cover, or tree diameter, of a species or group of management interest.

A litany of other potential uses exist, however these data are much more valuable in context with data collected by other Vital Signs Monitoring protocols, and will be used in that manner to advise management.

Protocol Refinement Process

In 2008, moving forward with the landbird community monitoring questions and objectives identified by SECN staff and park managers in the SECN Vital Signs Monitoring Plan (DeVivo et al. 2008) we began the protocol-development and refinement process. This process was later adapted to address the objectives set forth in the SECN Climate Science Strategy (DeVivo et al. 2011). Initially, a thorough literature review was conducted to determine the status of knowledge regarding the landbird community and landbird habitat types in SECN parks. This was followed by repeat trips to parks to continually improve our understanding of SECN park lands, investigate the logistical constraints of conducting landbird community monitoring, and explore sampling- and response-design considerations. Because all parks could not be sampled each year and the logistical challenges varied across parks (i.e., access difficulty), various sampling-return interval scenarios (i.e., 3-year, 5-year) and annual-sampling suites (i.e., what parks would be sampled during any given year) were evaluated. Preliminary data collection, knowledge of the fauna, and existing literature, when available, was used to determine sample sizes at each park. Several sampling methodologies were evaluated relative to their applicability to the types of landbirds present and landbird habitat types available at each park, safety issues, the monitoring objectives, and logistical constraints. Personnel availability, the rate of data collection, and travel ceilings were taken into consideration as part of the sampling and response designs.

The methodologies implemented in this protocol are ARD, as the primary monitoring technique implemented during each sampling event, and VCP as the secondary technique implemented at a subset of sampling locations and intended as a quality control mechanism for the ARDs and to develop the ability to crosswalk the two datasets. The choice of ARD monitoring, with a subset of VCPs, is not only the safest approach and most compatible with the logistical challenges of working in SECN parks, but also provides a superior characterization of the landbird community at a reasonable cost, labor, and time expenditure. Further, the chosen methods are effective techniques for monitoring landbirds across all landbird habitat types in SECN parks. Consequently, the procedures detailed in this document represent the final determination of the most effective and efficient means to address the monitoring objectives, and provide useful information with management applicability to park managers.

Vital Signs Monitoring Objectives

To characterize the effects of landscape and local ecosystem drivers on landbird communities, the SECN will be monitoring several measures of community structure, function, and composition. Each component provides a picture of community change dynamics, and the following four monitoring objectives will be evaluated in all SECN parks based on detections of landbirds observed from March to June in non-saline wetland and upland vegetation communities in all SECN parks. Detections are considered observations of a species or species group during one morning (i.e., sampling event) of monitoring using automated recording devices at a sampling location.

1. *Determine the status and trends in species richness and diversity of the landbird community at each park.* Species richness and diversity estimates are based on the total number of species detected (i.e., native and non-native). Species richness and diversity are indicators of resource characteristics and condition.

2. *Determine the status and trends in occupancy by selected landbird species.* Occupancy, or frequency of occurrence, is the number of locations at which a species or species group is detected during the sampling event. Occupancy estimates provide insight into the likelihood of encountering a specific species, rarity, diversity, and distribution of a species or group, and relative comparisons provide insight into the composition of the sample. Naïve estimates do not take into account variables that affect imperfect detection and typically underestimate the number of locations occupied; therefore, this estimate is referred to as naïve occupancy. Occupancy-modeling techniques allow the incorporation of additional data, such as environmental variables, to test specific hypotheses about factors influencing the distribution and detection of landbirds, and generate an unbiased occupancy estimate. Occupancy-modeling will focus on breeding birds. Depending on how data are summarized, occupancy information can also serve as a surrogate of species abundance estimation.

3. *Determine the status and trends in frequency of detection of selected landbirds.* Frequency of detection is the number of mornings a species or species group is observed during the sampling event at each sampling location, summed across all sampling locations. Similarly to naïve occupancy, this estimate summarized relative to the other species detected provides insight in the composition of the sample. This estimate does not take into account variables that affect imperfect detection; therefore, this estimate also provides a naïve estimate of detection. Occupancy-modeling techniques allow the incorporation of additional data, such as environmental variables, to test specific hypotheses about factors influencing the distribution and detection of landbirds, and generate an unbiased detectability estimate. Depending on how data are summarized, frequency of detection information can also serve as a surrogate of species abundance estimation.

4. *Determine trends in the vocalization phenology of select species of landbirds with high detectability*. The vocalization patterns of landbird species with high detectability will be analyzed to determine the status and trends in the first and last dates on which species are detected.

5. *Determine the similarity in the species assemblage of samples collected with the automated recording device and variable radius circular plot point count methodologies.* A similarity index

is calculated to evaluate the extent to which the datasets collected by each methodology compare with one another in terms of the species assemblage/composition and the number of species detected.

Enhanced Climate Change Monitoring Objective

Phenology is defined as the relationship between climate and periodic biological phenomena including the timing of animal movements and life cycles. Phenology has a long history (Leopold and Jones 1947, Puppi 2007) as primitive farmers were likely the first phenologists, carefully tracking the response of plants and animals to the seasonal cycles in order to better understand when to plant crops (Puppi 2007). Because phenology is dependent on climate, long-term patterns of climate change can be tracked by monitoring phenological occurrences (Schwartz 1994, Cotton 2003, Bradley and Mustard 2008, Haggerty and Mazer 2008, Badeck et al. 2009).

Objectives Addressed in Other Monitoring Protocols

Changes in landscape dynamics, vegetation patterns, overall sampling location condition, and weather and climate are also of importance to SECN park managers, all of which potentially affect landbird communities (Table 1). The composition, structure, and cover of the vegetation community in the groundcover, shrub, and canopy strata are integral components of landbird habitat. Status and trends of these data will be addressed through other monitoring efforts at the Network, regional, or national scale.

Sampling Design

Design Strategy

As recommended by NPS I&M Program (Fancy et al. 2009), the SECN has initially chosen a design-based approach of permanent sampling locations to address the objectives the Landbird Community Monitoring Protocol (Appendix B). Definitions of design-based and model-based approaches follow those set forth by Olson et al. (1997). The design-based approach is based upon substantially fewer assumptions and results in more reliable estimates for inference to the target population(s) than a model-based approach or non-randomly selected sampling locations (i.e., judgment sampling) (Neusser et al. 1998, Olsen et al. 1999, Schreuder et al. 2004). Further, data upon which to base or derive assumptions for a model-based design do not currently exist for the terrestrial Vital Signs in any SECN park. A model-based approach with sentinel locations may be explored in the future.

Minimizing Variability

To maximize the likelihood of detecting a trend, the design balances available resources with the allocation of sampling effort and allows differentiation among several sources of variability. Further, the sample size chosen for each SECN park is estimated to account for the known variability of some measures, and the estimated variability of others.

Sources of variability include those occurring within and across years. Expected within-year variability, or residual variability (Larsen et al. 2001), is the variation observed during the sampling period across all sampling locations. This component of variance is minimized in the design of the protocol because the monitoring equipment (i.e., ARDs) collects 38 sampling events during a 77-day deployment period (i.e., every-other day).

Expected across-year variability includes coherent variation, or when a measure is affected consistently across sampling locations (Larsen et al. 2001) (e.g., precipitation), and interaction variation, or when a measure is affected by location-specific factors (Larsen et al. 2001) (e.g., fire, tornado). This component of variance is minimized with permanent sampling locations. Another source of variability, non-sampling error, is often found in observer error or observer bias. Although this is generally difficult to measure, several steps are undertaken to minimize this source of variability. Efforts include extensive pre-data collection training and training evaluation, double-blind observer procedures, data collection methods that minimize the potential incorrect and unintentional influence of the observer (i.e., automated vocalization identification with analysis software; vegetation-cover coverage class ranges proven to maximize precision and reduce error), use of detection/non-detection measures, and quality assurance/quality control procedures as part of the data entry and management process. Although retention of field personnel can minimize non-sampling error, it can also become a source of variability as their experience, efficiency, and expertise improves over time; thus introducing this form of variability even in within-observer comparisons across years. Despite our best efforts to prevent and control for non-sampling error, we acknowledge it exists and, given our adherence to the aforementioned efforts to control non-sampling error mentioned above, make the assumption it will remain consistent across years in a long-term monitoring program.

Co-location with Other SECN Vital Signs Monitoring Efforts

In an effort to maximize the utility of the data and minimize sampling costs, data collection efforts of this protocol are co-located with the SECN's *Vegetation Community* and *Vocal Anuran* Vital Signs Monitoring protocols.

Strata

Given the overall goal of the I&M Program to determine the health of park lands (Fancy et al. 2009), it is not prudent to base the spatial-sampling design of a long-term monitoring program on potentially dynamic strata (i.e., vegetation, soils). Because the boundaries of potentially dynamic strata are unlikely to remain constant over time, this can invalidate or complicate the design (Fancy et al. 2009). Although Fancy et al. (2009) suggests that in certain geographic locations it is legitimate to stratify by physical characteristics, such as terrain, that correspond to an area of interest (i.e., riparian areas), geospatial data with an acceptable level of resolution, however, are generally not available for precise delineation of strata in SECN parks. McDonald and Geissler (2004) suggest that areas deemed dangerous, inaccessible, or remote with high travel costs are defined and sampling locations that occur within these areas are excluded.

Because management interest exists for all vegetation communities and wildlife habitats in SECN parks, the sampling design utilizes stratification only to eliminate areas from consideration that are non-natural, open water, or where researcher presence and traffic would cause irreparable harm to the area, henceforth referred to as unsampled areas. Natural areas not used by amphibians are also eliminated from consideration because sampling locations are co-located with sites collected under the SECN vocal anuran monitoring protocol (Byrne et al. 2013a). Specifically, non-natural areas include building footprints, parking areas, roads, and borrow pits. Open water areas include the interior of non-wadeable rivers, lakes, and ponds. Salt marshes are the only naturally vegetated area where researcher presence and foot traffic would cause extensive damage, consequently this Vital Sign is not implemented in salt marshes. Salt marshes are defined as low salt marshes that are periodically (i.e., tidally) or permanently inundated with salt water. Beaches from the surf zone up the beach to the top of the primary dune do not provide a location where the automated recording device can be safely deployed, and are therefore excluded. As previously mentioned, GIS data are generally unavailable for the unsampled areas, therefore these areas are eliminated through the application of selection criteria elaborated in the following section (Theobald et al. 2007). Inference does not apply to the unsampled areas.

Design Limitations

The SECN design strategy consists of monitoring a suite of permanent sampling locations (Appendix B). Although permanent sampling locations are a well-accepted means to reduce variability between sampling events, limitations exist in the long-term integrity of permanent locations. Further, concern exists regarding the appropriateness of using data from non-independent locations when comparing data among sampling periods (Williams et al. 2002). We acknowledge additional challenges specific to SECN park units that a design approach consisting of permanent sampling locations entails, and these include:

- Coastal SECN parks are very dynamic and large portions of them are in a constant state of change (i.e., dune communities). Due to storm events and other known influences on the local landscapes, sampling location attrition (i.e., the complete loss of permanently marked sampling locations) is expected, thus reducing the sample size of a static suite of permanent sampling locations.

- The number of sampling locations sampled at each park across time may fluctuate based on budgetary influences, staff attrition, or national policies that limit travel to sampling locations.

- Several SECN parks are actively acquiring new lands. Because the park boundary is used as the sampling frame, a changing sampling frame would alter the level of inference and complicate data analysis procedures. Professional statisticians will be consulted to assist in addressing the issues this situation presents.

- Despite a concerted effort on the part of a field crew, repeated return visits to a specific location might have inadvertent detrimental effects on sampling locations. Observer bias of permanent sampling locations occurs in several forms, including trail formation, soil disturbance, surface hydrology alterations, transmission vector for non-native and native species, and influencing animal behavior of the area. While some of these effects may be subtle, their cumulative effects can potentially change the trajectory of a location and consequently bias the data.

Each park's initial suite of permanent sampling locations will be used until such a time as conditions necessitate a location's "retirement." Sampling locations will be replaced after a determination that locations have been altered to the point of no longer meeting selection criteria, such as conversion of terrestrial habitat to open water following a hurricane, if persistent observer influences are observed at a location, or if further monitoring cannot be conducted at a location without causing damage.

In the case of sampling location attrition or retirement, sampling locations will be replaced with pre-existing sampling locations where baseline data exist (i.e., those sampling locations monitored during the protocol-development process), alternate sampling locations generated as part of the initial design, or new locations generated that account for and build upon the existing suite of sampling locations. Despite the use of permanent sampling locations, however, within-location variability is expected to be high in sampling locations in dynamic areas.

Sampling Location Draw

Each park's administrative boundary was used as the sampling frame. SECN parks do not have large areas that are inaccessible, defined by unrealistic access time or hazardous terrain (i.e., slopes > 35%). The sampling frame for each park was divided into a systematic 0.5-ha grid; the area of the grid-cell served as the potential sampling location (SOP 1.1.7; Byrne and Blankley 2012). The 0.5-ha grid-cell size was chosen to provide an adequate number of sampling locations given the size and shape of SECN parks, to avoid the bias inherent in a design using larger grid cells that increases the likelihood of missing small patches of vegetation types, and because 0.5-ha is the minimum mapping unit of the SECN vegetation mapping inventory. A spatially-balanced sample was drawn from this grid using the RRQRR algorithm (Theobald et al. 2006, SOP 1.1.1, Byrne 2013a). The RRQRR

algorithm provides a discrete sample (Theobald et al. 2007), thus inferences will be expressed relative to the number of grid-cell center points within the sampling frame. The sample draw included primary sampling locations and an "over-sample" to provide alternate sampling locations.

Sampling locations that fall within unsampled areas are excluded. For example, if locations fall within the salt marsh, those locations are excluded because implementation of the Landbird Monitoring Protocol in salt marsh areas would have an irreversible negative impact (i.e., trail formation from soft sediment). Further, key characteristics of salt marshes, as determined by park managers and SECN staff during the scoping process, are monitored under other SECN Vital Sign monitoring protocols. Other pre-determined and excluded unsampled areas include non-natural areas, such as parking lots and building footprints, and the interior of large bodies of water, devoid of emergent vegetation, that encompass the 0.5-ha grid-cell in its entirety and do not allow for foot travel. As expected, inference does not apply to these areas. Potential sampling locations from the initial sample draw that occur in these unsampled areas were excluded during the preliminary sampling location selection criteria application process.

Occasionally, sampling locations may occur in areas that have the potential to interfere with other management activities or priorities. For example, some of the permanent sampling at CALO occur in areas that are frequently used by nesting shorebirds, specifically piping plover (*Charadrius melodus*). While piping plover management zones or target areas would not be a reason to exclude a sampling location, unless specifically requested by park management, monitoring activities conducted under this protocol will be conducted in a manner that has no impact on the species or management priority. Work at these locations would occur before or after periods of highest use and not cause any disturbance to the target species or management priority (Jon Altman, pers. comm.). All monitoring activities implemented as part of this protocol, however, would be discussed with managers prior to conducting fieldwork in order to accommodate all management concerns and precautions in these situations.

The number of sampling locations for each park was determined after consideration of park size, hypothesized variability in the Vital Sign measures, safety concerns, and the logistical issues regarding travel time and conducting monitoring activities in five to six park units per year. To maintain the integrity of the spatially-balanced properties of the RRQRR draw, the initial draw consisted of approximately 1.5n, where n is the desired number of sampling locations (i.e., less than the 2n used by Steven and Olsen [2004]). Alternate sampling locations were used when selection criteria (see next section) were not met; approximately eight to ten alternate sampling locations are provided for each park-specific sampling design.

The SECN uses an equal inclusion probability design for all sampling locations within the sampling frame. Unequal probability sampling, however, will be explored in the future if managers or ecologists identify domains or strata of interest that are unique or of management importance and should be sampled disproportionately to their availability. As previously mentioned, currently no areas in SECN parks are considered high-priority or of specific management interest.

Selection Criteria

Selection criteria are applied to all sampling locations in lieu of *a priori* categorization of some grid cells as "exclusion zones" (Theobald et al. 2007), or unsampled areas as previously referred. Creating GIS-based exclusion zones can bias the design because of imprecision, spatially or temporally, in the geospatial data used as the foundation of the sample draw process or our lack of location-specific knowledge that could influence sampling location inclusion (Theobald et al. 2007). Therefore, two levels of selection criteria are applied to all sampling locations: (1) those applied in a GIS where relevant data layers were available, accurate, and reliable, and (2) those applied in the field. As previously mentioned, field evaluation is necessary because the resolution in available GIS data is too imprecise for a determination of the sample-ability or applicability of any given sampling location.

Characteristics Evaluated in a GIS

Sampling locations are excluded from the sampling draw if:

- The sampling location is potentially unsafe (i.e., in the middle of a roadway).
- The sampling location occurs in open water.
- The location occurs in marsh or other areas that cannot be sampled without significant impact to the area.
- The entire 0.5-ha plot falls completely within a non-natural area such as a parking lot, building, etc. However, sampling locations that include portions of a park's cultural landscape are retained in the sample draw to adequately characterize the entire spectrum of this Vital Sign on park lands.
- The sampling location occurs on private in-holdings where access is not permitted.
- The sampling location is <200 m from another sampling location in large parks (i.e., CAHA, CALO, CANA, CHAT, CONG, CUIS, HOBE, KEMO, TIMU/FOCA), or <150 m in small parks (i.e., FOFR, FOMA, FOPU, FOSU, MOCR, OCMU). This distance was determined based upon the response design of the landbird and amphibian Vital Signs (i.e., observer detection of vocalizations during pilot visual-encounter surveys and avian point counts and automated detection of vocalizations by the automated recording devices) to avoid double-counting of landbirds and vocal anurans during data collection. Further, this was evaluated through field testing of various vocalizations, observed attenuation of the vocalizations due to the structural effects of vegetation, and the detectable range of the automated recording devices.

Characteristics Evaluated in the Field

Sampling locations are also excluded in the field if upon inspection:

- The sampling location is potentially unsafe (i.e., high risk of equipment vandalism, crew harassment, unsafe terrain, high number of snags present).
- 100% of the plot cannot be sampled due to impenetrable vegetation, manmade obstructions, or open water or non-natural habitats.
- The GIS used as part of the initial evaluation were of inappropriate resolution or incorrect.

In the event a sampling location is omitted, the first alternate sampling location is selected, the aforementioned criteria are applied, the sampling location is accepted or rejected, and if rejected the next consecutive alternate sampling location is evaluated with the same process.

Sampling Schedule and Frequency

This protocol has two temporal design components: within and across years. Within years, audio surveys of landbirds are surveyed 38 times at each sampling location over a 77-day period that includes the breeding season, where recordings are collected every-other day for 12-minutes beginning at 0800. Each species that vocalizes during that period is identified to species. The deployment duration coincides with that used for vocal anurans (i.e., a co-located protocol). Variable-radius circular plot point counts (VCP) are conducted at a subset of sampling locations to serve as a quality-control measure for the ARDs; the minimum number of VCP locations is presented in Table 2.

Across years, all parks are on a three-year sampling-return interval. Parks are aggregated into annual suites that maintain consistency in travel costs, the number of sampling locations sampled annually, and the relative difficulty of working at particular parks. Table 2 outlines the number of permanent sampling locations at each park, the monitoring period, estimated amount of time recorded by the ARDs, and the next three planned monitoring events.

Table 2. Number of sampling locations with automated recording devices (ARDs), the minimum number of variable circular point counts (VCPs), approximate deployment period for ARDs, monitoring period for VCPs, total amount of time recorded by the ARDs, and planned monitoring events for each Southeast Coast Network (SECN) park.

Park	Number of Locations with ARDs	Minimum Number of Locations with VCP[a]	Monitoring Window for ARD Deployment and VCP Surveys	ARD Time Recorded (hrs)	Planned Monitoring Events
CAHA	30	6	March - June	120	2015, 2018, 2021
CALO	30	6	March - June	120	2016, 2019, 2022
CANA	30	6	March - June	120	2014, 2017, 2020
CHAT	30	6	March - June	120	2015, 2018, 2021
CONG	30	6	March - June	120	2014, 2017, 2020
CUIS	30	6	March - June	120	2016, 2019, 2022
FOFR	10	3	March - June	40	2014, 2017, 2020
FOMA	14	3	March - June	56	2015, 2018, 2021
FOPU	6	3	March - June	24	2015, 2018, 2021
FOSU	4	3	March - June	16	2016, 2019, 2022
HOBE	30	6	March - June	120	2016, 2019, 2022
KEMO	30	6	March - June	120	2016, 2019, 2022
MOCR	11	3	March - June	44	2014, 2017, 2020
OCMU	22	5	March - June	88	2014, 2017, 2020
TIMU	30	6	March - June	120	2015, 2018, 2021

Measures Used for Analyses

Species detection data are evaluated using a series of analytical measures selected to assess the status and trends of each of the four monitoring objectives above (Table 3).

Table 3. Relationship between monitoring objectives, sampling methods, measures, and scales of analysis for landbird monitoring in Southeast Coast Network parks.

Objective			Data Collection Method	Measures	Scale of Analysis			Parks
					Location	Unit	Network	
Vital Signs Monitoring	1	Richness & Diversity	ARD	Number of species(native, non-native, total) Diversity indices	x	x		All
	2	Occupancy	ARD	Naïve occupancy Proportion area occupied	x	x	x	All
	3	Frequency of Detection	ARD	Number of detections Relative detection frequency Relative detection efficiency	x	x		All
	4	Similarity	VCP and ARD	Number of species Similarity indices	x	x	x	All
Enhanced Climate Monitoring	5	Phenology	ARD	First detection date Last-detection date		x	x	All

Statistical Power Analyses

The ability to detect change is a cornerstone of a long-term monitoring program, and is related to the temporal-sampling design (i.e., sampling-return interval), spatial-sampling design, sample size, response design (i.e., how well the measurement technique characterizes the attribute of interest identified in the monitoring objective), and properties of the monitoring target (i.e., variability over time or space).

Statistical power is generally defined as the probability of rejecting the null hypothesis when it is false (i.e., the likelihood of not committing a Type II error), therefore accepting the alternative hypothesis when it is true. As power increases, the likelihood of committing a Type II error decreases.

The probability of committing a Type II error is referred to a β, where β symbolizes the false-negative rate. A false-negative error occurs when the statistical test indicates that no difference exists when a difference indeed exists. Therefore, the statistical power of a test is the likelihood of not committing a false-negative error (i.e., β), and is determined by subtracting the false-negative error rate from one (i.e., 1-β).

The ramifications of committing Type I or Type II errors are very different, and dependent upon the monitoring objective. Both errors have ramifications in natural resource management context, and it is incumbent upon managers to determine which error is least detrimental. For example, missing a change (i.e., Type II error) can have large ramifications because management actions generally take time to schedule and implement, and additional time for those actions to influence the target. In contrast, monitoring that falsely detects a change (i.e., Type I error) can result in the expenditure of funds and time planning and implementing actions that were not necessary and could have been exerted more effectively towards other ends.

The effect size is generally the most challenging component of a power analysis. Because the response variable (i.e., target attribute) is often influenced by a variety of variables, many of which are stochastic, effect size is difficult to identify and design around, and reliably predict the influences of various effect sizes beyond generalizations. For example, a 20% change in a measure may seem like a substantial change upon initial review; however, knowledge of the attribute (i.e., pre-existing or acquired through the monitoring activities) provides a realization that this effect could be masked by influences and compounded by the attribute's inherent variability across time and space. It is important to note that effect size must be meaningful and realistic, and determined based upon knowledge of not only the biological and ecological relevance of a given effect size, but also in the context of budgetary and logistical limitations. The initial inclination of most scientists is the desire to determine very small changes (i.e., <5%). Although this definitely has a place in certain types of research, detecting small changes is generally not necessary in a natural resource monitoring context. Further, the relevance of various effect sizes must also be defined, specifically positing the outcomes under varying values or levels of change in the effect size.

A coarse approach to effect size (i.e., effect size groups) is generally appropriate for most natural resource monitoring activities, and is more easily interpretable by those using the monitoring results to affect decisions. It is unlikely that most natural resource experts can differentiate between a 30 and 40% difference in effect size, nor is this relevant or necessary in most cases. Cohen (1988) standardized a scale-free and continuous effect size index, where index values are specific to the statistical test used. For example, in a t-test of the difference between two independent means, the small, medium, and large effect sizes are defined as 0.20, 0.50, and 0.80, respectively, and small, medium, and large effect sizes are 0.10, 0.30, and 0.50, respectively, for Chi-square goodness of fit tests. Effect size indices representing small, medium, and large effect sizes are used for this protocol.

An additional advantage to this approach is that clear expectations can be associated with each index and corresponding magnitude of change. For example, a small change could be defined in large part as the natural variability, influence of stochastic processes, or random error in a population and not necessarily of management concern unless it is preceded by a comparable change on the same trajectory, therefore contributory to a cumulative effect of greater magnitude. A medium change could be of management concern if no significant events (such as hurricanes or high-temperature/low-humidity wildfires) have occurred. Cohen (1988) identifies medium changes as those likely to be detectable by a careful observer. A large change is likely associated with a

substantial event or chronic process with effects that would likely be plainly noticeable without a dataset, except for cryptic or elusive monitoring targets.

Although a monitoring objective identifies the attribute of interest, a measureable property (i.e., status, threshold, change), and the spatial and temporal range of monitoring—the sampling objective is used to communicate information regarding power, specifically the acceptable error rates (i.e., false-change, missed change), confidence level/precision, and detectable effect size. Sampling objectives are presented below for each monitoring objective; however, a common theme throughout the sampling objectives is less emphasis on avoiding a Type I error in an effort to increase power and, subsequently, decrease the likelihood of committing a Type II error. In the land-management scenario that this protocol is designed to advise and support, the ramifications of a Type II error (i.e., issue continues unidentified, target population can cross critical threshold, costs can be much higher than if change were detected earlier) are considered more severe than a Type I error (i.e., expending time, resources, funds when unnecessary). Therefore, false-change error rate is set to 15% for all sampling objectives.

The types of power analyses necessary to address the sampling objectives obviously differ across the measures collected for each monitoring objective. The discussion that follows identifies the power analysis and the magnitude of change (i.e., effect size) detectable by the sampling and response designs presented in this protocol. PASS software (NCSS, Inc.) and the R statistical package (R Core Development Team 2008) were used to conduct power analysis, or they were calculated by hand.

Species Richness/Diversity

Power analysis for species richness was treated as a Poisson distributed count variable for power analysis. Mean and variance estimates of landbird richness were derived from 2011 and 2012 monitoring activities. Effect size groups of small = 0.20, medium = 0.50, and large = 0.80 were used (Cohen 1988). The sampling objective for species richness is to obtain an 80% certainty that, given the response and sampling designs, a 50% change in species richness can be detected with a 15% chance of obtaining a false-change error. Given our proposed sampling effort and estimated sample variance, we have power of 0.97 to detect a 50% change in landbird species richness, and power of 0.81 to detect a 30% change in richness.

Occupancy and Detection Probability

Frequency of occurrence and frequency of detection are, in essence, naïve estimates of occupancy and detection probabilities, respectively, for which factors affecting imperfect detection are unaccounted. Derivation of trend from naïve estimates would produce incorrect results. Because species occupancy and detection probability are integrally linked and are jointly modeled (MacKenzie et al. 2003), species occupancy models will be used for trend analysis. In this protocol, the detection histories used for analysis are generated from the 20 sampling events of the ARDs. Detection histories can also be generated, under a removal-monitoring framework (Farnsworth et al. 2002), (a) using a time-of-detection method (Alldredge at al. 2007) from the time four intervals within each one of the 20 ARD sampling events, or (b) from the four time intervals of the two VCP control surveys. The latter approaches will only be pursued as necessary for methods compatibility, evaluation, or other purposes. Until climate change funds are available or recognizers are developed,

the last five manually-evaluated recording events in the 77-day monitoring window will be used for occupancy estimation (i.e., a detection history of five); which will allow for the best estimation of breeding bird occupancy. Methods for trend assessment in species occupancy are a developing area, and in contrast with many other statistical procedures, no standard or widely applied approach currently exists. The multi-season occupancy model approach presented by MacKenzie et al. (2003) can be used to estimate the initial occupancy probability and project estimated extinction and colonization rates; however, this approach requires many explanatory variables and can result in an over-parameterized model for species with few detections. Weir et al. (2009) presents a technique where hidden Markov models are used to generate less parameterized models and smoothed trajectories from which trend is determined. Because we have not yet created occupancy models from our preliminary dataset, and accounted for imperfect detection, we are unable to estimate variance of occupancy estimates to explore our ability to detect trend given our design with these approaches.

Guillera-Arroita and Lahoz-Monfort (2012) present an extensive treatment of power with imperfect species detection and demonstrate how power varies based upon different occupancy probability and detection probability. As expected, as the number of sampling locations and replicates increases, the power to detect trend increases as does the ability to detect smaller trends. They demonstrate that power increases as detectability increases, and that larger initial occupancy probabilities provide an improved ability to detect small differences in occupancy. Power also increases as the likelihood of committing a Type I error increases.

Equations and curves from Guillera-Arroita and Lahoz-Monfort (2012) were used to estimate power for occupancy and detectability. Given the sampling objective to ensure an 80% certainty that, given the response and sampling designs, a 50% change in occupancy estimates can be detected with a 15% chance of obtaining a false-change error (Table 4), the design presented in this protocol for parks with 30 sampling locations is likely to detect a difference of 50% or greater for occupancy probabilities greater than 0.5. As expected, species with lower detectability will generally require a longer period of time, or larger sample size, to detect fine-scale differences in the target measure (i.e., count) (Steidl et al. 2013). For parks with fewer than 30 sampling locations, it may be much more difficult to detect significant trends in changes in occupancy even for species where occupancy and detectability are high. Because trends in occupancy assume detection probabilities are constant, the sampling objective assumes only a small difference in detectability over time.

Table 4. Power to detect a 50% difference in occupancy estimates, given the response and sampling designs presented in this protocol, with a 15% chance of obtaining a false-change error, using the procedure set forth in Guillera-Arroita and Lahoz-Monfort (2012) for parks with 30 sampling locations.

		Detection Probability		
		0.8	**0.5**	**0.2**
Occupancy Probability	**0.8**	Yes	Yes	No
	0.5	No	No	No
	0.2	No	No	No

Phenology

Because vocalization phenology varies geographically, this trend analysis will be conducted by pooling proximate parks (i.e., CHAT and KEMO, TIMU/FOCA and FOMA, CUIS and FOFR) when climate change funding is available. Vocalization timing will be obtained from Breeding Bird Survey data, the U.S. Phenology Network, expert opinion, or other sources as available, and submitted for peer review and expert consensus. Candidate species will be selected and further evaluated as data are collected and park-specific patterns are identified. Deviation from a long-term average vocalization (i.e., initialization and termination) date (Julian date) is the target measure. The average vocalization date is not available for any SECN park, therefore the average of the vocalization dates of the first three monitoring events (i.e., once every three years covering nine years) will be used as the preliminary phenology baseline for comparison. Because the initiation of vocalization behavior is not governed solely by date, generalized linear models will be used to explore the relationships of climatic variable (i.e., temperature, relative humidity, precipitation) on first- and last-detection dates. A generalized linear model approach with an ordered response, such as Gullet et al. 2013 or Knudsen et al. 2007, will be used to evaluate changes in phenology and associated variables.

The sampling objective for this monitoring objective is to obtain an 80% certainty that, given the response and sampling designs, a shift of two date intervals (i.e., 10% of the within-year monitoring duration) can be detected with a 15% chance of obtaining a false-change error.

The ARD methodology presented in this protocol collects a data point every other morning, therefore the minimum difference to be detected would be one of these four-day intervals. Power analysis of two combined parks indicates power = 0.68 to detect a shift in one interval, and 0.91 to detect a shift of two intervals. Our current design meets the sampling objective.

Methods for Data Collection

Landbirds are monitored with two methods: ARD (Veneir et al. 2012) and VCP with distance estimation (Reynolds et al. 1980, Buckland et al. 1993, Ralph et al. 1995, Nelson and Fancy 1999, Buckland et al. 2001) at a subset (i.e., 20%, or no fewer than three) of sampling locations. Automated recording devices are often used to characterize soundscapes and recently this technology has been applied to monitoring wildlife species. The application of the methods for landbird data collection fall into four process categories: (a) location and establishment of permanent sampling locations, (b) application of the ARDs (i.e., programming, deployment, and retrieval), (c) implementation of VCPs at a subset (i.e., 20%) of the permanent sampling locations, and (d) evaluation of audio recordings to determine species occurrence during sampling events.

Location and Establishment of Permanent Sampling Locations

Waypoints are programmed into handheld GPS units for navigation to sampling locations following the methods outlined in SOP 1.1.2 (Byrne and Smrekar 2013). Navigation instructions to established sampling locations are presented in SOP 1.4.31 (Smrekar and Byrne 2013). If not already established, sampling locations are permanently marked with seven 0.5 × 12 in. rebar as a part of a co-located sampling array for vocal anuran, landbird, and vegetation community monitoring (SOP 1.4.19; Byrne et al. 2013b). Each piece of rebar serves as a permanent tie-in for a specific transect and the plots and subplots associated with that transect. The rebar are installed in a radial array on azimuths of 0°/360°, 60°, 120°, 180°, 240° and 300° (Figure B-2). Each piece of rebar is capped with a unique identifier indicating the position of the rebar within the macroplot. Specifically, the markers identify the transect bearing, the distance from the center of the circular plot, or the center of the plot itself.

Automated Recording Devices (ARD)

Like VCP monitoring, ARDs provide a means by which point count monitoring may be conducted. Unlike VCPs, however, ARD-based monitoring does not allow for the differentiation of individuals and it excludes visual detections. However, pilot monitoring efforts within the SECN using both techniques indicated that approximately 80% of 10,000 bird detections from the VCP method from pilot data were auditory, and the majority of visual detections were birds other than “landbirds” (i.e., shorebirds, wading birds, sea ducks) and were therefore not the focus of this monitoring protocol nor species for which the VCP method is the most effective monitoring technique. This pattern is also observed in other studies and indicates comparability in species detectability between ARD and VCP methods (Haselmayer and Quinn [2000], Acevedo and Villanueva-Rivera [2006], Celis-Murillo et al. [2009], and Venier et al. [2012]). The use of ARDs was selected as the primary technique for monitoring landbirds for a combination of reasons including: characteristics of the target community being sampled, data quality, logistics, costs, and safety (Table 5).

Table 5. Reasons for selection of automated recording devices to achieve landbird monitoring objectives in Southeast Coast Network parks.

Category	Justification
Characteristics of Target Population	Large number (n=404) of landbird species are present in SECN parks.
	Approximately 80% of 10,000 bird detections from the VCP method from pilot data were auditory, with the majority of the visual detections were birds other than "landbirds" (i.e., shorebirds, wading birds, sea ducks) and not the focus of this monitoring protocol nor species for which the VCP method is the most effective monitoring technique. This pattern is also observed in other studies (i.e., Haselmayer and Quinn 2000, Acevedo and Villanueva-Rivera 2006, Hutto and Stutzman 2009, and Venier et al. 2012).
	Research indicates comparability in species detectability between ARD and VCP methods (Haselmayer and Quinn 2000, Acevedo and Villanueva-Rivera 2006, Celis-Murillo et al. 2009, and Venier et al. 2012).
	Improved detection of species that vocalize infrequently or are intolerant to observer presence.
	More adequate characterization of the landbird community due to an increased number of possible sampling events (i.e., a control on vocalization behavior).
	More comprehensive temporal survey of a location increases likelihood of detecting asynchronously arriving migrants.
	Ability to sample over a wide range of weather regimes.
Data Quality	Elimination of observer influence on the target taxa.
	Reduced potential for species misidentification.
	Improved detectability and inter-observer reliability.
	Ability to evaluate recordings using manual or automated techniques.
	Permanent data product (i.e., recordings) that can be further analyzed as technology improves, analyzed by other researchers, analyzed for other taxa, or to quantify the soundscape.
Logistics	Increased flexibility of observer options (i.e., experts / cooperators have time available for analysis but not fieldwork, expert birders that are disabled).
	Increased flexibility in planning concurrent fieldwork activities.
	Ability to survey multiple locations simultaneously.
Cost	Large costs and time savings, despite initial investment; Costs are less than two people conducting manual calling surveys for two or more mornings.
	Cost-effective technique for evaluating phenology.
	Repeat surveys in difficult to access areas do not add costs to monitoring.
Safety	Improved safety when conducting pre-dawn and morning surveys.

To address some of the known environmental influences related to imperfect detection (MacKenzie et al. 2003, MacKenzie et al. 2006), the timing of ARD deployment is integral to maximize detections because vocalizations are, in many species, strongly associated with seasonal timing, and to a lesser extent environmental conditions. To control for variability in the acoustical properties of landbirds, the detection ability of the ARD for landbirds in SECN parks was evaluated prior to deployment and found to be effective when the vocalization originates within the 0.5-ha grid-cell (i.e., the sampling location). ARD data provide an estimate of occupancy, distribution, and habitat associations (NVCS mapping is not yet completed for SECN parks); however detectability plays a strong role in all of these estimates.

The ARD currently used by the SECN is a Song Meter™, manufactured by Wildlife Acoustics®, Concord, MA, USA. The device consists of a digital timer and recording device, four rechargeable D-cell batteries, and a flash memory card housed in a waterproof case with two microphones mounted on the top of the device. A parachute-cord harness is used to secure the device to a tree or other natural objects in the center of the plot. Two deployment regimes were explored during the development of this protocol: a 14-day deployment and a 77-day deployment implemented in 2011 and 2012. Currently, the SECN implements the 77-day deployment duration. A 77-day deployment period (i.e., 38 sampling events) was chosen for several biological reasons: (1) the sampling window captures the end, beginning, or core of the peak vocalization season for many SECN migrants and resident breeders, (2) this produces an extensive detection history and allows for the generation of robust occupancy models; specifically, provides for more degrees of freedom to incorporate variables that influence detectability, and (3) variable weather patterns can influence the initiation of vocalization behavior, which varies by species, therefore a longer deployment duration increases the likelihood of detecting all species that use an sampling location.

ARDs are programmed to record every-other day over the course of 77-days, for 12-minutes, beginning at 0800 (SOP 1.4.1; Byrne and Smrekar 2013a). This schedule collects 38 discrete sampling events for each sampling location. The deployment date is consistent (i.e., +/- 5 days) across years but varies across parks to most adequately reflect the vocalization phenology of the target taxa (i.e., deployment at CANA begins in early March, whereas deployment at KEMO begins in mid- to late-March). The recordings capture both spring migrants and breeding birds.

In most cases, all devices at a park are not deployed the same day due to the available number of field personnel, but rather over the course of several days. Devices are retrieved after the 77-day recording event (SOP 1.4.22; Byrne and Smrekar 2013b) and data are downloaded. Recording are currently manually evaluated. Although we use automated and semi-automated recording analysis for vocal anurans, a manual-evaluation approach is currently the most efficient (i.e., species-specific recognizer algorithms do not exist for all species). We have successfully developed recognizers for 35 vocal anurans known to occur in SECN parks, as proof of concept, however recognizer development for birds in ongoing and not expected to be completed for several years, as is software evaluation. At this time, automated evaluation of audio recordings in not possible and all recordings are manually-evaluated (SOP 1.4.20; Byrne and Jones 2014).

Variable Radius Circular Plot Point Count (VCP)

VCP with distance estimation is a standard method for surveying birds in forested environments (Reynolds et al. 1980, Buckland et al. 1993, Ralph et al. 1995, Nelson and Fancy 1999, Buckland et al. 2001). Although ARDs are widely used and a rapidly developing technique, VCPs are implemented at a subset of the permanent sampling locations to serve as a quality control procedure on the ARDs and as a tool to develop a crosswalk between the ARD and VCP datasets. VCPs are conducted at a minimum of 20% of the permanent sampling locations at a park, or no fewer than three locations, where ARDs are deployed and data are collected at these locations each year the park is sampled (Table 3). An important benefit of using the VCP method is the ability to include visual detections and distance estimates for each detection.

The data collection process for the VCP methodology is detailed in SOP 1.4.6 (Byrne 2012). VCP surveys are conducted during the spring migratory and breeding season (i.e., April-May) in an attempt to detect species that use SECN parks for breeding or migration. Surveys occur from 0530 – 1100 from the center point of the 0.5-ha macroplot used as part of SECN sampling design. At each sampling location (i.e., center point), each 12-minute count is separated into four time segments of equal duration, 0-3 minutes, 3-6 minutes, 5-9 minutes, and 9-12 minutes. Each time interval, however, is treated as a separate and independent, although not in a statistical context, sampling event. Specifically, all birds detected during each specific time interval are recorded, regardless of whether that species or individual was detected in a previous interval. Therefore, upon completion of the point count, the list for each of the time intervals consists of all species detected during each time interval.

To reduce error (i.e., species detection and identification, distance estimation) and data-recording time during the point count, the distance to each bird detected is estimated into one of four distance classes (0-25m, 25-50, 50-100, >100). All detections, regardless of distance detected from the observer, are counted and recorded. Each station is sampled once during the breeding season. VCP measures include detection/non-detection, relative abundance, and abundance estimates for species where 60–80 independent observations are made (Buckland et al. 1993) (i.e., valid abundance estimates are typically only available for the most common species).

The SECN VCP method is a compatible adaptation of the USFWS-led interagency bird protocol (Knutson et al. 2008). Specific differences between the two methods are that (1) Knutson et al. (2008) collects data for nine minutes, whereas the SECN VCP collects data for 12 minutes to increase the likelihood of detecting shy species or those that vocalize infrequently, and (2) the SECN method treats each time interval as a unique event and all bird detections are recorded (i.e., to allow for the possibility of computing detection histories from the time intervals; refer to the Data Analysis section) whereas Knutson et al. (2008) records the first detection during the nine-minute period . Datasets derived from both methods are fully compatible.

Evaluation of Audio Recordings

The ARDs are retrieved after the recording event (SOP 1.4.22; Byrne and Smrekar 2013b) and the audio files are downloaded. Because the algorithms necessary for the automated-analysis are currently in development, we evaluate all audio files manually.

Manual Process

Because recognizers for landbirds are currently in development, audio files are evaluated manually until recognizers are completed (i.e., approximately 3-5 years). A subset of five of the 38 recordings (i.e., 25%) are evaluated manually, which is detailed in SOP 1.4.20 (Byrne and Jones 2014). In order to focus on breeding birds, the last five recordings collected during the 77-day deployment period will be evaluated. Each audio file is named with the park code, the sampling location, the ARD number (for reference purposes only and irrelevant to this procedure), the date (formatted year, month, day = yyyymmdd), and the time the recording started (formatted hhmmss). For example, KEMO-010-133_20120321_080000 is the filename for KEMO, at sampling location 10, monitored with ARD unit number 133, the file was created on 21 March 2012 at 0800.

Performing the manual evaluation of the audio recording is similar to conducting a VCP, except individuals are not counted, and distance estimates are not recorded. At each sampling location (i.e., center point), each 12-minute count is separated into four time segments of equal duration, 0-3 minutes, 3-6 minutes, 5-9 minutes, and 9-12 minutes. Each time interval, however, is treated as a separate and independent, although not in a statistical context, sampling event. Specifically, all birds detected during each specific time interval are recorded, regardless of whether that species or individual was detected in a previous interval. Therefore, upon completion of the manual evaluation, the list for each of the time intervals consists of all species detected during each time interval. It is important to note, however, that unlike a VCP that occurs in the field, the recording can be evaluated repeatedly, rewound, and paused to access identification resources that can be used to confirm any vocalizations or species identifications in which the observer does not have the utmost confidence.

Data are recorded on the same predesigned spreadsheet used to convert the field VCP datasheets to digital format for import into the SECN data management system. Some columns in the spreadsheet, however, are not necessary or applicable to manual evaluation efforts. Table 6 identifies the columns that must be populated and those that are unnecessary.

Table 6. Column-specific instructions for data entry as part of the manual evaluation process for landbirds.

Spreadsheet Column	Instructions
A: Name	Last name of the person evaluating the recordings
B: Site ID	The sampling location / point / site number; in filename
C: Park	Four digit park code
D: Date	Recording date; in filename
E: Time	0800 plus the time into the recording; if we were to subtract 0800 from this entry it would be the time into the recording in which the song/call occurs
L: Notes	Anything possibly considered relevant (i.e., lots of background noise), human voices)
M: Time interval	Each interval is treated as a unique sampling event
N: Species	Select from the dropdown list
O: Count	All counts will be 1; the ARDs provide detection/non-detection data and do not allow for count information
R: Detection	All will be A (i.e., auditory)
S: Comments	As necessary
T: Entered by	NA
U: Entered Date	NA

Detection and Identification Control

To ensure accurate and comprehensive identification of all species that vocalized on the manually-evaluated audio recordings, and because species identification abilities vary across observers, a

subset of one sampling event per sampling location (i.e., 20%) is checked for consistency. This quality assurance/quality control check is necessary to ensure the integrity of the dataset. The same process used here is also used to determine false-negative rates, and is detailed in SOP 1.4.21 (Byrne and Smrekar 2012b).

This secondary evaluation is conducted after all of the manual evaluation has been completed. Because the identification and detection abilities of all observers are vetted prior to the evaluation of any audio files, it is not necessary that the observer conducting this secondary evaluation is different than the original observer. It is imperative, however, that the dataset derived from the original evaluation is not reviewed, otherwise this will bias the secondary evaluation. Data are recorded using the same process as the initial evaluation (i.e., on the predesigned spreadsheet). Upon completion, the observer compares the results, specifically reviewing (a) the species identification of all species in each time interval, and (b) the number of species detected during each time interval. If either (a) the number of species detected, or (b) the number of species detected, differ among the two evaluations by +/-10%, then the files are reviewed by the Protocol Lead. The Protocol Lead will assess the audio files for atypical issues that may have influenced detectability, the abilities of the observers, device issues, sampling location characteristics, park characteristics, background noise influences, the audio-playback equipment, and any other potential causes for the differences, and then make a determination if the extent to which the audio files and dataset must be re-evaluated.

Automated Process

As previously mentioned, we are not currently conducting an automated-analysis of our audio files; however the algorithms necessary are currently under development. We have successfully established the effectiveness and utility of the automated-analysis approach with amphibians, and is detailed in our Vocal Anuran Community Monitoring Protocol (Byrne et al. 2013). Further, an increasingly large user community exists that are currently developing algorithms and conducting automated-analysis, therefore many opportunities exist for collaboration and the exploration of other software options. Because our intention is to move towards an automated-analysis as we have successfully attained with vocal anurans, an automated process is mentioned here, however the manual evaluation process is our current dataset derivation technique.

Taxonomic Standards

Nomenclature accepted by the American Ornithological Union is used for all bird species. Because vocalizations are unique to species, a full identification is possible for all vocalizations on ARD recordings. Similarly, auditory detections during the VCPs can be identified to the species level; however, visual observations may not afford a full identification. In these instances, each individual is identified to the finest taxonomic resolution possible. For example, the movements, body shape, bill shape, and orientation of the tail lead an observer to conclude that a wren is visually observed in a patch of shrubs in a sampling location, however a large shadow precludes identification further than a wren and it flies away before a full identification can occur. Because several particular wrens are possible in this sampling location, and those species cover two genera, the observer can only identify the individual to the family level, and would therefore be recorded as *Troglodytidae* spp. Species that are not fully identified, however, are seldom, if ever, used for analysis.

Data Analysis and Reporting

Annual Data Reports

Data reports will be published as short, concise reports that highlight the most recent data collection efforts as well as any issues or areas of potential concern. Reports will summarize known conditions and/or major issues present in or near the park that may have influenced results, and will provide a brief outline of methods used to collect samples and process data. Citations for detailed methods documents will be provided and updated links to sources of digital data. All data reports will contain a bulleted list of significant findings as part of the executive summary section and will be published in conjunction with a two-page resource brief containing an abbreviated subset of significant findings along with some limited project information including broader programmatic overview of the sampling effort.

At a minimum, annual data reports will:

- Provide a summary history of the samples taken during each year of the study, tabulating numbers of samples for each sampling frame and displaying these locations on maps of the parks.
- Provide summary status statistics of the results relative to monitoring objectives and management goals.
- Provide a summary table for use in park reporting and resource stewardship strategies.
- Evaluate data quality and identify any data quality concerns or deviations from the protocol that affect data quality and interpretation.

Data Analysis

This protocol collects detection/non-detection data, which, although somewhat inaccurately, is also often referred to as presence/absence data. In contrast to detections made from visual survey methods where individuals can be seen, differentiated, and counted, detections from the method used in this protocol (i.e., ARDs) cannot be reliably associated with more than one individual. In general, one individual will vocalize multiple times during the survey period, and is likely to be detected multiple times. Consequently, data summary techniques do not equate one vocalization detection with one individual, and are conducted accordingly. Data are summarized with several different approaches that provide insight into various aspects and properties of the status of the landbird community. The approaches include naïve occupancy, diversity, distribution, relative detection frequency, and phenology.

The exception to the aforementioned is the subset of sampling locations where VCPs are conducted. As previously mentioned, the intent of monitoring a subset of locations with both methods is to serve as a quality control procedure for the ARD methodology, and as a tool to crosswalk the ARD and VCP datasets for use in other monitoring.

Changes in Richness

Species richness and diversity are terms often treated synonymously, however species richness is actually a component of diversity. Diversity is "the variety and abundance of species in a defined unit of study" (Magurran 2004, p. 8). Diversity is a community property that is related to trophic structure, productivity, stability, (McIntosh 1967, McNaughton 1977), immigration/emigration (Colwell and Lees 2000), and ecological condition (i.e., ecological integrity as defined by Karr and Chu 1995). Species diversity consists of two components, the number of species (i.e., species richness) and the relative abundance of those species (i.e., species evenness/dominance) within a defined community (Margalef 1958, Lloyd and Ghelardi 1964, Pielou 1966). Relative abundance data are not collected as part of this protocol, although the summaries derived from detection/non-detection data are generally treated as indices of abundance; specifically, that patterns in detection/non-detection data are reflected in the true abundance of the community measured (i.e., landbirds). Therefore, the "diversity" in the amphibian community in SECN parks is communicated in the form of species richness indices. The term "community" refers to the assemblage of species populations that occur together in space and time (Begon et al. 1986), and we consider each park as a whole community as per the conceptual ecological models presented in our monitoring plan (DeVivo et al. 2008, Chapter 2).

Species richness indices provide information on the number of species that occur at a sampling location. Within species richness estimates, many indices exist, each with their advantages and disadvantages particularly regarding their discriminant ability and sensitivity to sample size. No richness index outperforms the others in all instances and no one best richness index exists, as all are somewhat conditionally dependent. Therefore, the use of several richness indices is desirable. As with all monitoring programs, sample size plays a critical role in the validity of any data summary or analytical procedure, including richness indices. Species detectability also plays a strong role in the validity of any richness index particularly if detectability is highly variable. Consequently, richness indices are just one tool in a suite of indices, metrics, and variables used by the SECN to evaluate community composition and structure and provide insight to ecological patterns, processes and stressor responses.

Because richness indices respond differently to various mechanisms that influence community change, several indices are used to adequately characterize richness in SECN parks (Haedrick 1975, Boyle et al. 1984, Magurran 2004). After careful appraisal of advantages and disadvantages of the many indices, a suite of richness indices was selected to summarize these data (Table 7). Indices were selected based upon their utility or performance relative to several criteria, including (a) the ability to discriminate well across locations and years, (b) they are relatively insensitive to small samples, (c) they are relatively insensitive to sampling-unit size (i.e., grain size), (d) they perform consistently across a variety of sample sizes, richness, and abundance scenarios (i.e., from the literature), (e) both parametric and nonparametric estimators, (f) incidence-based (i.e., use detection/non-detection data) estimators, (g) they serve as a means to evaluate the adequacy of sampling effort, (h) a measure of variability could be associated with the estimate, (i) the estimate is unbiased, (j) can be compared across years, (k) the final suite of indices describe the community in a

slightly different way (i.e., computationally), and (l) the index values are meaningful and easily interpreted by SECN park managers.

Two software packages are used to calculate richness indices, EstimateS (Colwell 2013) and Species Diversity and Richness IV (Seaby and Henderson 2006). All estimates are presented as depicted in Table 8.

Table 7. Species richness indices used, corresponding symbol, community attribute the index reflects, the range of index values, and notes on each index.

Index	Symbol	Community Attribute	Index Citation	Notes
Native Species Richness	$\mathbf{S_{obs}}$	Richness	n/a	Value is a positive integer that indicates the number of native species in the sample. Intuitive. Good discriminant ability if sampling effort is comparable; sensitive to sample size, the occurrence of rare species, or those with low detectability; does not account for relative abundances.
Chao 2	**Chao2**	Richness	Chao (1984) Chao (1987)	Values indicate an estimate of total species richness (including species not present in the sample); incidence-based estimate; works well with dataset containing several infrequent observations[a].
Incidence-based Coverage	**ICE**	Richness	Lee and Chao (1994) Chazdon et al. (1998)	Values indicate an estimate of total species richness (including species not present in the sample); incidence-based estimate.
Jackknife 1	**Jack1**	Richness	Burnham and Overton (1978) Burnham and Overton (1979) Heltshe and Forrester (1983)	Values indicate an estimate of total species richness (including species not present in the sample); incidence-based estimate; the higher the value the higher the species richness. This procedure requires no assumptions regarding the data distribution.
Jackknife 2	**Jack2**	Richness	Smith and van Bell (1984)	Values indicate an estimate of species richness; incidence-based estimate.
Bootstrap	**Boot**	Richness	Smith and van Bell (1984)	Values indicate an estimate of species richness; incidence-based estimate.

[a](Chao 1984)

Table 8. Example table depicting landbird alpha-diversity estimates at Chattahoochee National Recreation Area, 2009. *Data are for illustrative purposes only.*

Index	Symbol	Value	Lower 95% CI	Upper 95% CI	Value Interpretation
Native Spp. Richness	$\mathbf{S_{obs}}$	71.00	65.13	76.86	Number of native species detected.
Chao 2	**Chao2**	80.18	74.00	99.06	Estimated true species richness.
Incidence-based Coverage	**ICE**	92.12	86.59	97.65	Estimated true species richness.
Jackknife 1	**Jack1**	89.36	81.44	97.28	Estimated true species richness.
Jackknife 2	**Jack2**	91.78	85.17	98.39	Estimated true species richness.
Bootstrap	**Boot**	80.27	77.92	82.62	Estimated true species richness.

Changes in Occupancy

Naïve occupancy is the number of sampling locations where a species was detected out of all of the locations surveyed, communicated as a percentage (Table 9). A naïve occupancy estimate does not account for imperfect detection, but provides a conservative estimate (i.e., biased low) of the status of a species' frequency of occurrence (i.e., likelihood of encounter), distribution, and describes the species assemblage and composition. Statistical comparisons of greater than one naïve-occupancy estimate (i.e., from > 1 time periods) are not recommended because detection probabilities are not explicitly taken into account, and can deviate substantially from one time period. Because the naïve occupancy estimate relies on only one detection in the 38 sampling events at any given sampling location, it is relatively robust to the influences of variables that affect detectability. But because naïve occupancy does not account for imperfect detection, these estimates are biased underestimates and therefore a conservative representation of actual population status and trends.

The response design also facilitates the ability to determine trends in the percent-area occupied (PAO) for landbirds in SECN parks (MacKenzie et al. 2002, MacKenzie et al. 2003). This technique allows for imperfect detection of species that are cryptic or difficult to detect despite their presence (MacKenzie et al. 2003). This approach is robust to variation in detectability due to species, habitats, and other biotic and abiotic variables (MacKenzie and Nichols 2004, MacKenzie and Royle 2005, MacKenzie et al. 2006). In addition, the model allows the incorporation of covariates/explanatory variables (i.e., relative humidity, temperature, landscape characteristics) to test specific hypotheses about factors influencing the distribution and detection of landbirds while providing methods to estimate occupancy and detectability despite missed observations at a sampling location (MacKenzie et al. 2003). Species' detection histories will be used to develop multiple candidate models with Program PRESENCE (MacKenzie and Kendall 2002, MacKenzie et al. 2002, MacKenzie et al. 2003, MacKenzie and Royle 2005) that will be compared using information-theoretic criteria (Burnham and Anderson 2002). One of the primary advantages of the PAO metric is its widespread use and subsequent comparability of data collected under this protocol with regional and national occupancy estimates.

Occupancy analyses that account for probability of detection will be conducted by generating detection histories from the 38 sampling events of the ARDs. Additionally, detection histories can be generated under a removal-monitoring framework (Farnsworth et al. 2002), (a) using a time-of-detection method (Alldredge at al 2007) from the time four intervals within each one of the 38 ARD sampling events, or (b) from the four time intervals of the two VCP control surveys. The latter approaches will only be pursued as necessary for methods compatibility, evaluation, or other purposes; therefore no analysis techniques are presented for these approaches. Detection probabilities, however, are estimated as part of the modeled proportion area occupied approach described in the following section and part of the synthesis reports.

Table 9. Example table depicting percentage of sampling locations where each landbird species was detected (i.e., naïve occupancy) at Chattahoochee National Recreation Area, 2009. *Data are for illustrative purposes only.*

Common Name	Scientific Name	Proportion of Sites Where Observed
Carolina Wren	*Thryothorus ludovicianus*	97.0
Northern Cardinal	*Cardinalis cardinalis*	97.0
Northern Parula	*Parula americana*	94.0
Tufted Titmouse	*Baeolophus bicolor*	94.0
Blue-gray Gnatcatcher	*Polioptila caerulea*	81.0
Acadian Flycatcher	*Empidonax virescens*	78.0
Red-bellied Woodpecker	*Melanerpes carolinus*	78.0
Red-eyed Vireo	*Vireo olivaceus*	78.0
Yellow-billed Cuckoo	*Coccyzus americanus*	78.0
Pileated Woodpecker	*Dryocopus pileatus*	72.0
White-eyed Vireo	*Vireo griseus*	0.66
Carolina Chickadee	*Poecile carolinensis*	0.63
Yellow-throated Vireo	*Vireo flavifrons*	0.56
American Crow	*Corvus brachyrhynchos*	0.53
Red-shouldered Hawk	*Buteo lineatus*	0.50
Prothonotary Warbler	*Protonotaria citrea*	0.44
Great Crested Flycatcher	*Myiarchus crinitus*	0.38
Summer Tanager	*Piranga rubra*	0.34

Changes in Distribution

Understanding changes in the distribution of landbird species is integral to informed management of species and their requisite habitats. Changes in species distributions over time provide useful information at both the local and landscape-scale relating to how species respond to large-scale influences such as changing land use, climate, vegetation structure and composition, or habitat availability and condition. Shifting species distributions can produce cascading effects through altered species interactions and alterations within the food web structure, thereby affecting ecosystem processes (Montoya and Raffaelli 2010). Distribution maps for all landbird species encountered will be presented as in Figure 18. In the event that a new species is observed in a park, the official park species list is updated and re-certified following the guidelines in SOP 2.4.12 (Wright et al. 2012).

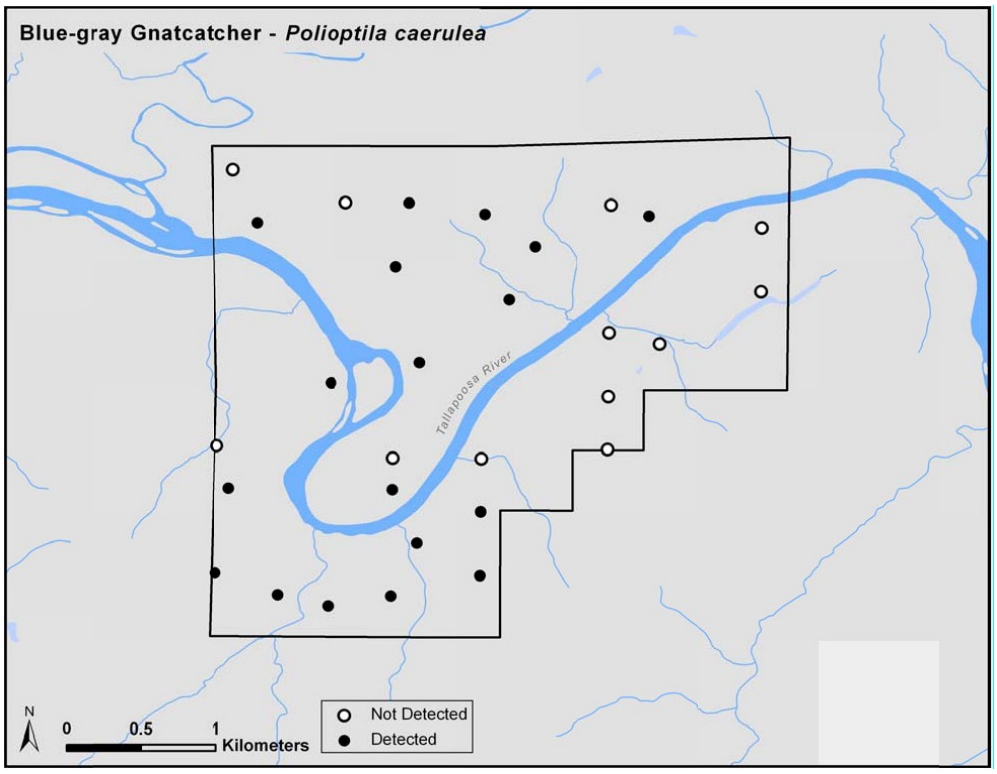


Figure 18. Example figure showing sampling locations where blue-gray gnatcatcher (*Polioptila caerulea*) was detected at Horseshoe Bend National Military Park, 2009. ● = detected, ○ = not detected. *Data are for illustrative purposes only.*

Changes in Frequency of Detection

Frequency of detection is the number of detections at a given location, within or across sampling locations. Frequency of detection provides information on species composition and allows for calculating occupancy probability. These estimates, however, are strongly influenced by the vocalization behavior of a species or individual, the structure of the vocalization, and the automated detection process. These factors influence all data summary perspectives presented here, but have the strongest influence on frequency of detection. Although the response design of the protocol accounts for some aspects of these factors, the analysis process is also structured to ameliorate the influence of these factors on frequency. Frequency of detection can also be summarized relative to all other species or species groups at a sampling location or park.

The detection of an individual is dependent upon it vocalizing. Landbird vocalizations are generally unique to the species, and can be reliably and consistently differentiated. Vocalization behavior in animals is a stimulus-response mechanism intended as a defensive strategy (i.e., predator avoidance or intimidation), to signify a threat to conspecifics (i.e., alarm/alert call), to communicate with conspecifics (i.e., brood/litter assembly), for territory establishment or maintenance (i.e., competitive interactions), as a mating advertisement or part of a breeding ritual. Several factors influence aspects of vocalization behavior, particularly vocalization rate (e.g., inter- and intra-specific competition, background noise, physiological condition).

In addition to the vocalization behavior of a species, knowledge of the major properties of sound is critical to understanding the automated-analysis process and derivation of an accurate and representative dataset from the output. Of the major properties of sounds (i.e., timbre, amplitude, duration, and pitch), duration and pitch are the most important in recognizer development. While amplitude is directly related to detectability and the relative amplitude of SECN landbird vocalizations varies across species, the detection ability of the ARD for SECN landbirds was evaluated prior to deployment and found to be effective when the vocalization originates within the 0.5-ha grid-cell (i.e., the sampling location).

Recognizers for landbirds will not be completed for approximately five years, and until completion we will depend upon a manual evaluation technique of the audio recordings. However, once recognizers are completed, the automated detection process is detailed in SOP 1.4.2 (Byrne and Smrekar 2012a), but generally consists of developing and applying recognizers to audio files in a software environment. Recognizers are species-specific generalized computer algorithms derived from the visual representation (i.e., spectral characteristics or spectrogram) of a vocalization that, in a simplified description, facilitate pattern recognition.

The structure of the vocalization (i.e., the frequency range, number of phrases, the complexity of the vocalization, and the duration of each phrase and the entre vocalization) and the process by which a recognizer is constructed for that vocalization play a critical role in how the automated results can be interpreted. An optimal recognizer results from a balance between the use of enough of the vocalization to allow the recognizer to identify the target species (i.e., avoid false negatives), while limiting the amount of the vocalization which can result in the recognizer identifying non-target species or sounds therefore resulting in a high false positive rate. Recognizers are generated from multiple individual vocalizations, and typically focus on portions of a vocalization that are unique and complex.

As expected, the structure of vocalizations across species is quite variable. For purposes of this topic, landbird vocalizations can be thought of in two broad senses, those that are long-duration of relatively homogenous pitch, and those that consist of multiple short phrases with variable pitch. Figures 19a and 19b depict a scenario in which one individual vocalizes, but the characteristics of the vocalization and recognizer create multiple hits on the same individual. Two spectrograms are presented, one illustrating a species with one long-duration phrase (i.e., hypothetical Bird A and another that illustrates several short-duration phrases (i.e., Hypothetical Bird B). The portions of the vocalization used to develop, or train, the recognizer, are identified by a yellow rectangle. Recognizers developed from annotations identified with a dashed black rectangle will have very high false positive and false-negative rates, would not be considered useful, and be rejected. The red brackets identify “hits”, or potential detections of the target species as indicated by the audio-file processing software. Both figures depict the same time span and the vocalizations of one species, however six detections were obtained for Bird B individual (i.e., an incorrect overestimate), with one detection for the Bird A (i.e., correct estimate). Initially, it seems logical to use the entire vocalization to develop recognizer to train the software, however we found that this approach creates poor performing recognizers because of the high false positive and false-negative rates. This was primarily

due to imperfect vocalization patterns in real-world recordings, or ambient-noise overlap on the frequency range. In both scenarios, the vocalization is clearly identifiable, but the software did not recognize the small permutation in the pattern of the vocalization.

Because each hit does not equate to one individual vocalization, the results are summarized accordingly to avoid the aforementioned potential biases in calculating the total number of detections and the relative number of detections. Each sampling event (i.e., one evening) is treated separately, and detection histories for each species and each sampling location are generated. A detection history is a binary response, with potential responses of "detected" (i.e., 1) or "not detected" (i.e., 0). A hypothetical detection history for one sampling location is presented in Table 10. The first detection for each sampling event satisfies this data need.

Table 10. Hypothetical detection history for three species in one sampling location in a Southeast Coast Network park.

	Sampling Event																			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**6**	**17**	**18**	**19…**	**38**
Species A	1	0	0	1	1	1	1	0	0	0	1	0	1	1	0	0	1	1	0	0
Species B	0	0	1	0	0	1	1	1	1	0	0	0	1	0	1	1	0	0	1	1
Species C	1	1	1	1	1	1	0	1	1	0	0	0	0	0	0	1	0	0	0	0

Detection histories are then used to calculate the total number of detections, the relative detection frequency, and the relative detection efficiency.

- **Total Number of Detections:** The number of sampling events (i.e., mornings) in which a species was detected. This is calculated as the sum of all detections (i.e., detection histories) across all sampling locations for each individual species. The maximum value possible is the number of sampling locations multiplied by the number of sampling events (i.e., maximum number of sampling events is 38). This value has limited standalone utility out of context, but is necessary for the following two calculations.

- **Relative Detection Frequency:** The percentage of detections by an individual species in the context of (i.e., relative to) all other species' detections. This is calculated as the sum of all detections for each individual species across all sampling locations (i.e., the *total number of detections* above) divided by the total number of detections across all sampling locations by all other species combined. This yields a proportion that sums to 1, which is then converted to a percentage by multiplying by 100. An example of this is presented in Figure 20.

- **Relative Detection Efficiency:** The detectability (i.e., likelihood of detection) of a species, expressed as a proportion, without accounting for known influences on detectability (i.e., similar to naïve occupancy in that sense); can be referred to as naïve detectability. This is calculated as the sum of all detections for each individual species across all sampling locations (i.e., the *total number of detections* above) divided by the total number of possible opportunities for detection of that species (i.e., the number of sampling locations multiplied by the number of sampling events). This estimate has little management utility, but is important to the authors for interpretation of results.

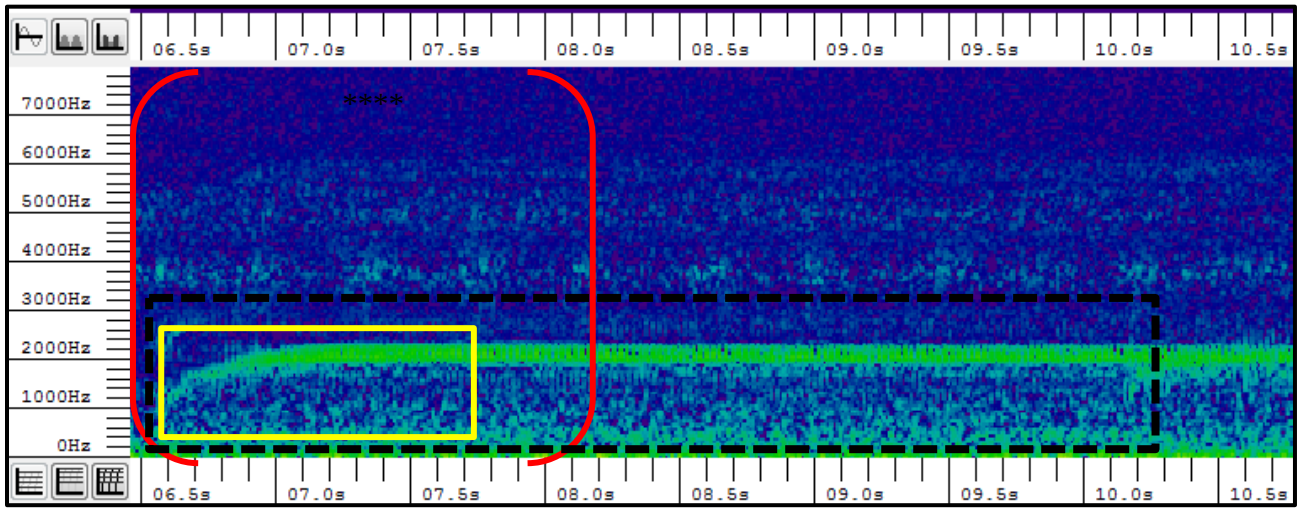


Figure 19a. Hypothetical bird A vocalization spectrogram, with an annotation (yellow rectangle) used to train the recognizer, an annotation from a previously considered recognizer that performed poorly (dashed black rectangle), and a potential vocalization detected by the automated process (red brackets)

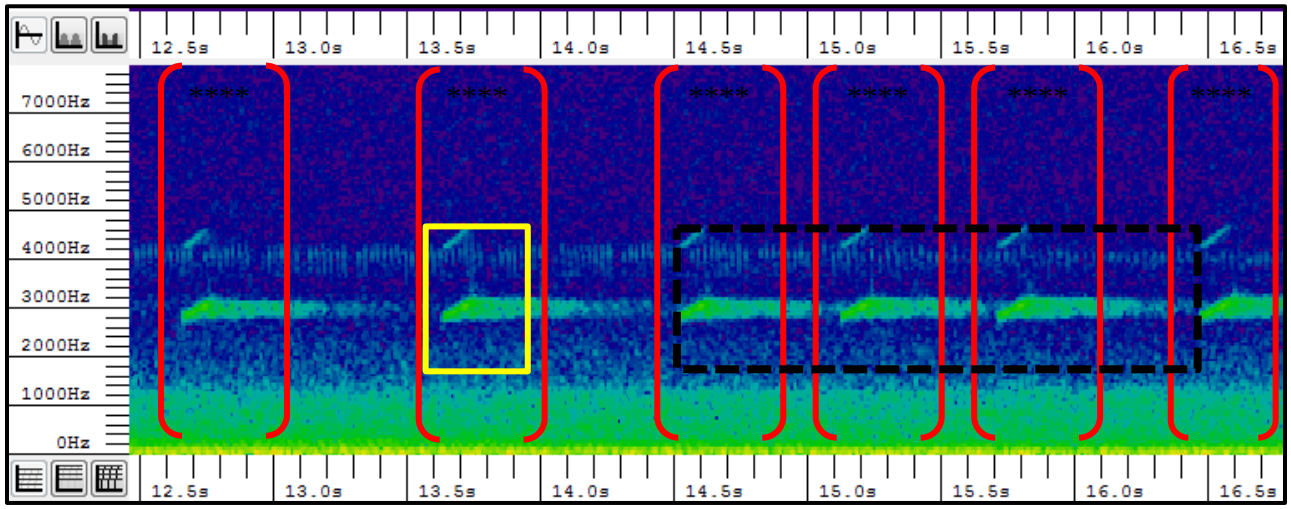


Figure 19b. Hypothetical bird B vocalization spectrogram with an annotation (yellow rectangle) used to train the recognizer, an annotation from a previously considered recognizer that performed poorly (dashed black rectangle), and a potential vocalization detected by the automated process (red brackets).

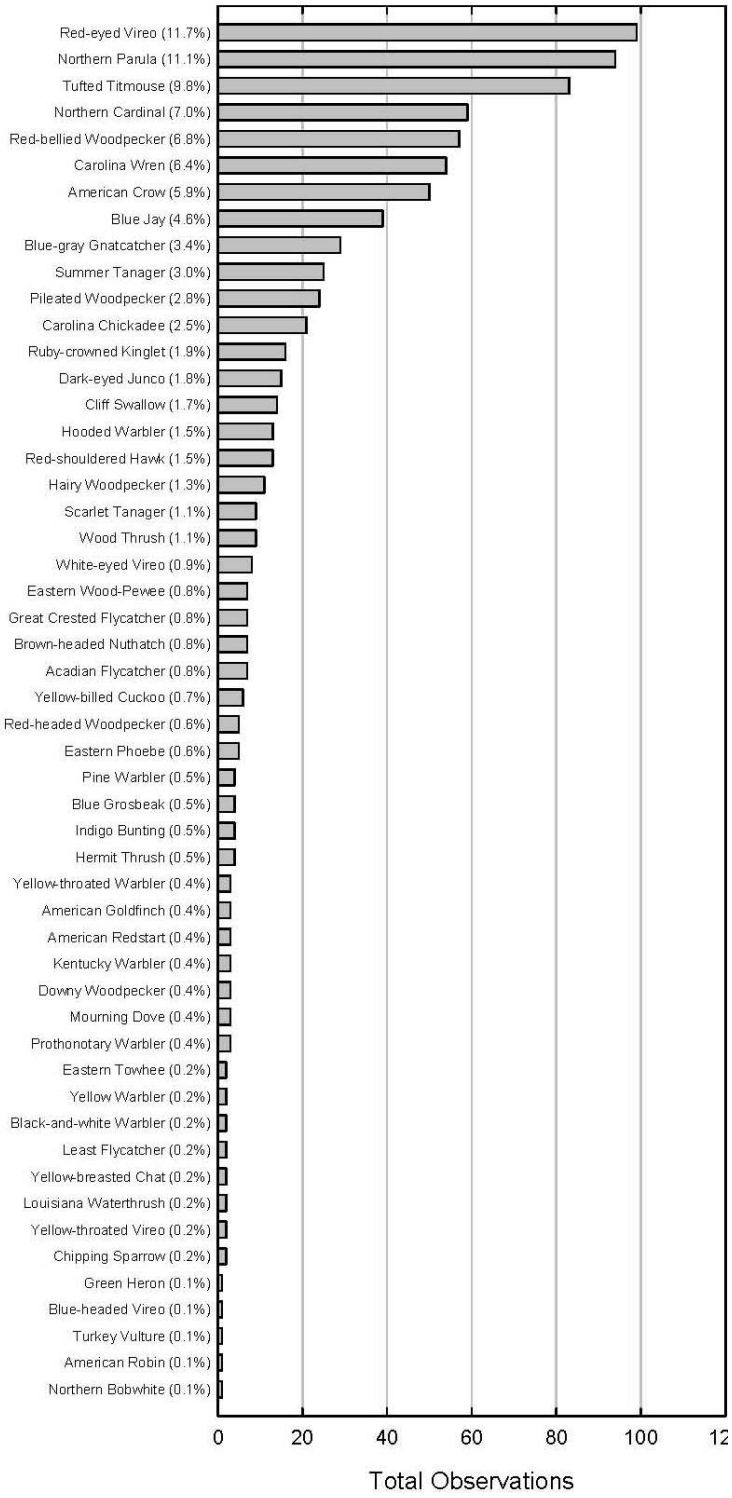


Figure 20. Example figure depicting the frequency of detection (i.e., relative detection frequency) of landbird vocalizations detected with automated recording devices at Fort Matanzas National Monument, 2009. *Data are for illustrative purposes only*.

Changes in Phenology

Phenology, the periodic life cycle events of plants and animals as they are influenced by changes in the seasons, is an increasingly useful tool in monitoring climate change and its potential effects on animal populations (Blaustein et al. 2001, Gibbs and Breisch 2001, Corn 2005, Parmesan 2007, Blaustein et al. 2010, Todd et al. 2011). The timing of landbird territorial and mating vocalizations can provide insight into the initiation of the breeding season for these animals, and tracking these dates may prove to be a robust method for monitoring climate change in the Southeastern United States. A hypothetical example of the earliest vocalization dates of select landbird species, based on their known annual vocalization pattern (i.e., to be determined based upon expert opinion and peer-review), are presented in Figure 21. The figure also includes all other dates the species was detected depicted within the recording window of our methodology. This analysis will be conducted when climate change funds are available.

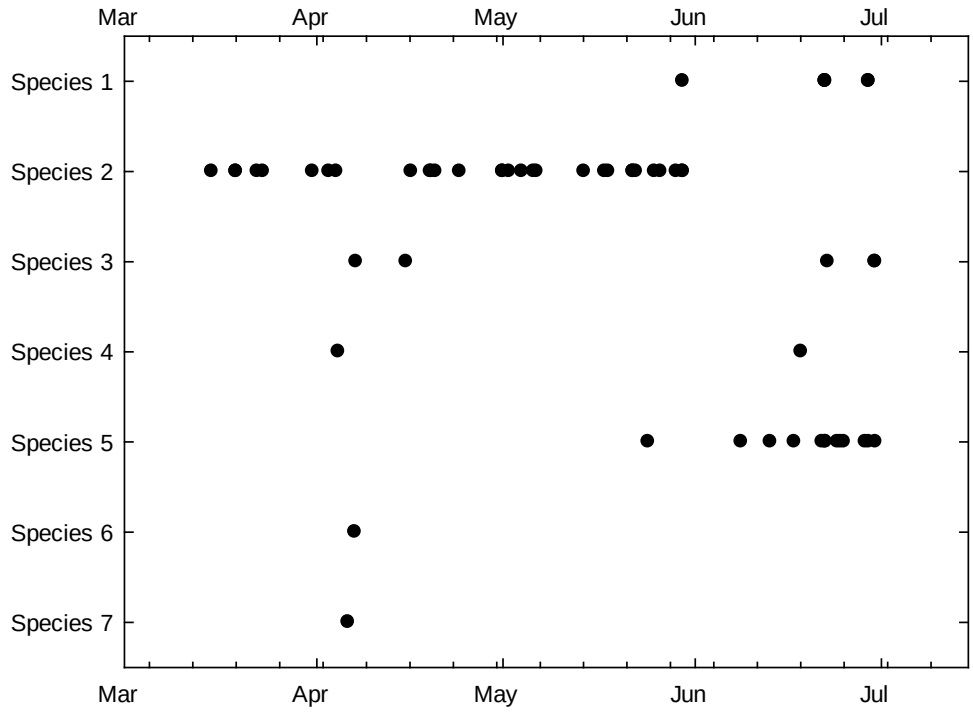


Figure 21. Example figure depicting vocalization phenology for species detected with automated recording devices (ARDs) at Canaveral National Seashore, from 25 March – 26 June 2010. *Data are for illustrative purposes only.*

ARD and VCP Dataset Similarity

Similarity indices are a type of beta-diversity estimate and generally used to compare species diversity or assemblages between areas (Magurran 2004). Similarity indices evaluate the extent of correspondence or resemblance in the species composition in two or more datasets. These indices can also be applied in this instance to compare the species assemblages detected by the two methods used in this protocol. Several incidence-based similarity indices exist; however, the widely used Jaccard similarity index provides a global view of all species assemblages of interest and compares the number of species shared among datasets to the total number of species in the combined assemblage (Magurran 2004). The Jaccard index can be used to compare two or multiple assemblages (Jaccard 1900, Koch 1957, Chao et al. 2005). Because of its computational simplicity and ease of interpretation, this index is used to evaluate the extent to which the ARD and VCP datasets differ. Specifically, the index identifies species that both methods detected, species detected by ARD only, and species detected by VCP only. A distinct advantage of the Jaccard index is the ease of interpretation. Values range from zero to one and values close to zero indicate heterogeneous datasets between the two methods, while index values approaching one indicating homogenous datasets among methods (i.e., the goal and expectation). The value also indicates the likelihood that a species selected at random is detected with both methodologies.

Conclusions can also be drawn based upon the properties and characteristics of the species that are exclusive to each method. Examples include infrequently vocalizing species detected by the ARD only, and species that are known to predominantly be detected visually, opposed to auditory detection, as part of the VCP. Species that do not vocalize regularly, have diminutive or subtle vocalizations (i.e., low relative amplitude), or are consistently detected visually during a point count of any sort are unlikely to be detected by the ARDs. As mentioned in Table 5, the majority of bird detections in preliminary datasets were auditory, with those bird detected visually are generally species for which the VCP is not the optimal method by which to monitor these species (i.e., shorebirds, waterfowl, raptors).

A hypothetical index of the Jaccard similarity index, species detected by both methods, and those unique to a specific method are presented in Table 11.

Table 11. Hypothetical comparison of variable radius circular plot point count (VCP) and automated recording device (ARD) methods, presenting the Jaccard similarity index and species detected with ARD or VCP methods.

Species Detected	ARD	VCP
Carolina Chickadee	x	x
Red-eyed Vireo	x	x
American Crow	x	x
Blue Jay	x	x
Red-bellied Woodpecker	x	x
Downy Woodpecker	x	x
Blue-gray Gnatcatcher	x	x
American Robin	x	x
Canada Goose	x	x
Ovenbird	x	x
White-breasted Nuthatch	x	x
Eastern Towhee	x	x
Northern Parula	x	x
Pileated Woodpecker	x	x
Dark-eyed Junco	x	x
Eastern Phoebe	x	x
Greater Yellowlegs		x
Red-shouldered Hawk		x
American Widgeon		x
Northern Shoveler		x
Yellow-breasted Chat	x	
Prothonotary Warbler	x	
Northern Bobwhite	x	
TOTAL	**19**	**20**
Species in Common	**16**	
Jaccard Similarity Index Value	**0.70**	

Synthesis Reports

In-depth synthesis reports may be completed through external contracts with universities or other agencies or by a collaborative effort of staff among key partners within the region. The SECN Program Manager will initiate discussion of the first regional synthesis report, and Program Managers from other programs will collaborate to secure funding, establish partnerships as needed with other agency staff, to produce the report, and provide programmatic oversight.

Sampling Adequacy

Exploratory analyses, such as generating sample-based taxon resampling curves to determine the sample size that corresponds to the asymptote (Walther and Martin 2001), are used as one tool to evaluate the adequacy or inadequacy of the sampling effort. Species accumulation curves will be

generated at three spatial or temporal scales to evaluate the sampling effort in terms of the number of sampling locations and the number of sampling events. Specifically, curves that depict sampling effort (1) across all sampling locations at a park relative to the sampling events, (2) across all sampling events relative to the sampling locations, and (3) within each sampling location relative to the sampling events, will be evaluated. Because recognizers and recording equipment are expected to improve we will be periodically reviewing detectability to determine which species are best suited for occupancy analysis.

Analysis of Trends

Time series analysis will provide us information regarding the extent to which measures change over time and facilitate forecasting and prediction. Based upon data from pilot implementation of this protocol, the authors assume the data will rarely be normally distributed with equal variance. In general nonparametric tests will be used for trend analysis. A Kendall trend test (Hirsh et al. 1982) or Mann Kendall test (Helsel and Hirsch 2002) will be used to evaluate trends in selected metrics or any pair of X, Y data. Also, parametric methods such as Poisson regression will be used to explore the variables that contribute to trends in species richness. Generalized linear mixed models will be used to determine trends for all phenology data grouped over space or time (Seavy et al. 2005, Gray and Burlew 2007). Various other methods may be used to detect trends and or progressive changes in landbird community data including methods that are optimized for parametric and nonparametric data sets.

Methods for trend assessment in species occupancy are a developing area, and in contrast with many other statistical procedures no standard or widely applied approach currently exists. Detection probability is a crucial component of occupancy estimation, and must be accounted for to develop unbiased occupancy estimates. Adams et al. (2013) presents a method using generalized linear mixed models to estimate annual mean occupancy and mean trends in occupancy for each time series of occupancy estimates.

As per our Climate Science Strategy, landbird data will be provided for input into occupancy models under development by USGS. These models have two general objectives, to assess potential impacts of climate change on habitats of priority species in the Southeastern U.S. by mapping and predicting cover dynamics, and to assess patch occupancy and range dynamics in response to land cover dynamics and climatic change. Using landbird data collected by the SECN, the USGS will expand its integrated terrestrial assessment to assess patch occupancy and range dynamics of avian species.

Because vocalization phenology varies geographically, this trend analysis will be conducted by pooling proximate parks (i.e., CHAT and KEMO, TIMU/FOCA and FOMA, CUIS and FOFR). Deviation from a long-term average vocalization (i.e., initialization and termination) date, in Julian date, is the target measure. The average vocalization date is not available for any SECN park, therefore the average of the vocalization dates of the first three monitoring events (i.e., once every three years covering nine years) will be used as the preliminary phenology baseline for comparison. Optimally, a 20-year average would be preferable, therefore a long-term average will be used for comparison as this monitoring program progresses. Because the initiation of vocalization behavior is not governed solely by date, generalized linear models will be used to explore the relationships of

climatic variable (i.e., temperature, relative humidity, precipitation) on first-detection dates. A generalized linear model approach with an ordered response, such as Gullet et al. (2013) or Knudsen et al. (2007) will be used to evaluate changes in phenology and associated variables.

Evaluating Ecosystem Conditions Based on Landbird Communities

Where appropriate, data will be interpreted in the context of existing resource condition criteria as defined by appropriate regulatory agencies at the national, regional, and state level. In time and in cooperation with partners (i.e., other networks, agencies, and academic institutions), and with a robust dataset in place, an explicit assessment component of this protocol based upon reference conditions in landbird community attributes will be developed. SECN will develop park- or habitat-based reference condition distributions (Stoddard et al. 2006) for species-, population-, or community-level response variables using our survey design data, data collected from other Vital Signs Monitoring efforts, and related research. In SECN small parks, reference conditions might—in some cases—be derived from data collected across the adjacent landscape including those data collected at other SECN parks, or by cooperating agencies also implementing this protocol. After reference conditions are established, SECN can assess landbird community integrity based on comparison of park estimates to referenced conditions.

Most parks are currently developing one or more Natural Resource Condition Assessments, Resource Stewardship Strategies, or State of the Park reports. These various NPS planning and assessment reports are peer-reviewed science-based efforts and are specifically designed to help park staff maintain and improve the condition of fundamental resources as spelled out in General Management Plans or supporting Resource Management Plans, and in most cases include indicators of resource condition. In cases where these reports have been completed, measures from Vital Signs Monitoring are typically used as a subset of the indicators of resource condition, facilitating the use of Vital Signs Monitoring data when reporting on a park's progress toward attaining management goals. Summary condition assessment tables will be included in the periodic data summary reports, synthesis reports, or other reports as appropriate.

Protocol Review and Revision

Additional synthesis reports will evaluate operational aspects of the monitoring program, such as whether sample-frame boundaries need to be changed or whether the sampling period remains appropriate (the optimal sampling season could conceivably change over time in response to climate change). The protocol review will also evaluate the design aspects of the monitoring protocol. For instance, does allocation of samples among parks appear to be adequate for all parks? Are there new management concerns that might dictate some reallocation of effort or additions to the indicator metrics that are routinely examined annually? Is the sampling time still appropriate?

Scientific Journal Articles and Conference Presentations

Other types of reports may be published by the SECN and will depend on resource management or monitoring issues and the nature of the target audience interested in the Network's monitoring effort. Publication of findings in scientific journals will allow the Network to reach a broader scientific community and promote investigation by members of the scientific community, either independently or in cooperation with the Network. Ultimately, publication in peer-reviewed publications and the

collaboration that ensues will foster a greater understanding of landbird communities and processes affecting Network parks. Similarly, the presentation of findings or subsets of data at conferences will allow the Network to reach the broader scientific community even at smaller regional venues. Attendance and presentation of data at these conferences often fosters partnership efforts. All journal article and conference presentations developed by the SECN will be made available to parks whose data are included with the report or presentation.

Data Integration and Publication

As a part of the Climate Science Strategy, the SECN is committed to facilitating the standardization of monitoring methods and data management among partners within the South Atlantic LCC and Atlantic Coast geographies so that data can be rapidly found, merged, explored, and analyzed for the purposes of adaptation planning and conservation design. To that end, the SECN is working with the USFWS Southeast Region I&M Network to standardize methods and make data available to USGS and LCC partners so that SECN and USFWS data can be used in climate change forecasting models.

Publication Standards

Annual reports will use the NPS Natural Resource Publications Natural Resource Data Series template, a pre-formatted Microsoft Word template document based on current NPS formatting standards. Periodic comprehensive reports and regional synthesis reports will use the Natural Resources Technical Report template. Template guidelines and documentation of the NPS publication standards are available at the following address: http://www.nature.nps.gov/publications/NRPM/.

Current versions of the protocol, resource briefs, annual reports, comprehensive reports, and regional synthesis reports will be made available on individual Network websites. The protocol and technical reports will also be available from the national NRPM website (http://www.nature.nps.gov/publications/nrpm/nrr.cfm). All NPS protocols are available from (http://science.nature.nps.gov/im/monitor/protocoldb.cfm).

Data Handling Procedures

As part of developing a long-term monitoring program, the SECN conducted an information needs assessment that achieved the following goals within the context of previously developed monitoring priorities: (1) identified critical information needs of Network parks, the SECN I&M Program, and for key partners; (2) developed a conceptual-object model that, in combination with SECN monitoring protocols, will serve as the foundation for SECN database and application development; and (3) identified a suite of information products necessary to support park, programmatic and partner needs within the context of SECN long-term monitoring objectives.

The general data model for landbird monitoring consists of metadata and field data. The data model used to support the SECN Landbird Monitoring Protocol data is part of an SECN program-wide object model in use to guide the development of data management applications for all Network Vital Signs Monitoring efforts (Wright et al. 2008). Proper linking of multiple Vital Signs Monitoring data sets is critical for effective long-term monitoring and analysis of amphibian data, and provides researchers and policy makers with information necessary for making decisions regarding the use and conservation of the park natural resources. Extensive documentation in the form of detailed user manuals for the landbird monitoring effort has been published in SOP 2.4.3 (Wright et al. 2013b) and SOP 2.4.4 (Wright et al. 2013a).

Data Acquisition

Data for this protocol are obtained from two sources, audio recordings and field data forms (i.e., paper). Data on paper forms are manually entered into SECN databases. Guidance for entering field data into SECN databases is detailed in SOP 2.4.3 (Wright et al. 2013b). The SECN Data Manager archives raw data files on the SECN data server, which has folder-level access controls to limit access to the archive and prevent accidental deletion of files.

Data Entry

Where manual data entry is required, data are entered by the SECN field crew lead or other designated personnel. Paper field forms are archived by the Protocol Lead following data entry (see below). After data have been entered, data verification and certification are completed by the Protocol Lead.

Data Verification

Data are verified during the data entry process by checking the accuracy of computerized records against the original source, mainly paper field records. Data entry personnel will check 100% of the records to the original field forms. The primary goal of data entry verification is to determine where errors are being introduced into the InfoPath forms. To the greatest extent possible, data entry errors are minimized through the use of automated methods within the InfoPath forms (i.e., range limits, pick lists, calendars etc.). After the computerized data are verified to accurately reflect the original field data, the paper forms are archived and the electronic version is used for all subsequent data activities. Certified data, as entered into the SECN data management system, will be archived on the SECN SharePoint (http://inpserosecn2/default.axpx) as InfoPath forms or stored in the data management system—marked as certified rather than provisional.

Data Certification

Prior to data publication, the SECN Protocol Lead must certify that all data have been validated and meet quality standards. Manual data certification is also performed during the verification process described above. The SECN Protocol Lead will certify the data after verification is complete. Certification procedures seek to identify generic errors (i.e., missing, mismatched, or duplicate records and comparison of QA/QC data with corresponding sample data).

Overview of Database Design

The conceptual-object model developed during the information needs assessment process, combined with SECN monitoring protocols provide the starting point for database and application development. The conceptual-object model was expanded upon and refined, and long-term monitoring protocols have been fully implemented over time (DataLOGIC 2005).

Because one of the goals of the I&M Program is to provide scientific knowledge on which to base management decisions, it is incumbent upon the SECN to develop tools that allow managers to make decisions on the most recent data available from as many relevant sources as possible. This necessitates the development of a single, integrated data management system that (a) efficiently and cost-effectively allows for concurrent analysis of data from multiple Vital Signs (i.e., amphibians and weather data), and (b) accommodates rapid retrieval of subsets of the Network's data to support hypothesis testing, modeling, reporting, and decision-making by managers and policymakers. This data management system has been operational for approximately five years with ongoing upgrades/enhancements to the system each year as long-term monitoring protocols have become operational.

All work on the SECN data management system has been within the following programmatic guidelines:

- Database and application development are compatible with NPS standards/requirements, and built upon the SECN conceptual-object model. To the greatest degree possible, the SECN conceptual-object model has followed the NPS I&M database standard - the Natural Resource Database Template (NRDT): http://science.nature.nps.gov/im/datamgmt/applications/template/index.cfm). Even though the NRDT standard was developed for MS Access the majority of the standard can be and has been applied to the SECN database in SQL Server.

- Database and applications must support both spatial (i.e., GIS data) and non-spatial (tabular) data. Currently all spatial components of the data management system are housed in the database using the geographic data type and/or linked to web-based mapping in NPMap (http://insidemaps.nps.gov/secnviewer/secn) or analyzed using ESRI ArcGIS software.

- SQL Server serves as the primary database repository. The current SECN development tools are Microsoft Office InfoPath 2007, Microsoft Visual Studio 2010 and Microsoft SQL Server 2008.

- User-friendly, front-end applications are available for users on the SECN SharePoint portal (NPS-only for approved users at http://inpserosecn2/DataReports/default.aspx).

As a protocol is implemented, it is added to the SECN data management system, beginning with data entry components and then analysis and reporting; which typically grow over time. There are three primary data management documents developed to assist current and future users: the database user manual, the database technical documentation, and the protocol-reporting manual. The database user manual provides SECN and park staff instructions on the use of data entry applications (i.e., getting data into the database) while the SOP for database technical documentation provides the data dictionary and entity-relationship diagram for the module pertaining to the protocol in question. The following data management SOPs are available for the SECN Landbird Monitoring Protocol:

1. SECN landbird community monitoring database user manual (SOP 2.4.3; Wright et al. 2013b)

2. Landbird Community Monitoring: Database and Technical Documentation (SOP 2.4.4; Wright et al. 2013a)

3. Data summary reporting guidelines (SOP 2.1.2; SECN 2013c)

4. Geospatial data archival and publication (SOP 2.1.8; SECN 2013a)

In addition to the standard reports available to NPS staff through the SECN data management system (http://inpserosecn2/DataReports/default.aspx), users may also utilize the SECN data exploration tool, which allows users to build simple or complex queries of the SECN data from multiple Vital Signs for analysis or visualization in other software, or to create custom user-defined reports. Another tool available to users is the SECN metadata editor, which uses information gleaned directly from the SECN data management system to facilitate the rapid development of FGDC-compliant metadata to accompany data sets posted to the NPS's Integrated Resource Management Application (https://irma.nps.gov/App/), for both internal and external (non-NPS) use, as appropriate.

Metadata

Metadata is defined as a description of a particular data set, in a standardized format, that ensures the proper use and utility of that data set from creation and throughout the data life cycle. While metadata development may be complex and time-consuming, the benefits for future data users are substantial. All data sets are accompanied by metadata documentation that includes the following components: data set identification information, data quality information, entity and attribute information, spatial reference information if applicable, distribution information, and contact information. Complete metadata documentation of a data set serves to facilitate data longevity, helps publicize the existence of all data sets produced, and facilitates access to, and use of, data by others into the future.

Metadata attributes are incorporated into the database design, and are a required component of data entry and/or data uploading into the data management system. By including metadata tools in the database design, there should be minimal additional effort required of project personnel to adequately and properly document data sets collected and analyzed as part of the SECN Landbird Monitoring Protocol.

Data Archiving

The SECN digitally archives all data received from landbird monitoring. These files are stored on the SECN server, which is included in the routine backup procedures of the Southeast Regional Office of the NPS. The SECN also archives all copies of the MS Access version of the database following any new data entry activities. Database backup files are named with a date and time stamp to account for versioning of the database over time. In addition, all files are write-protected to ensure against accidental deletion or editing over time.

Static, milestone products are electronically archived by one or more of these methods: SECN website or other online archives, offline archives (i.e., archival quality CDs and DVDs) or in the SECN bibliographic database (i.e., reports) or photo database (i.e., images). Protocol-specific QA/QC procedures are applied to ongoing datasets, and are then migrated into the SECN master database (i.e., SQL Server); including the standard archiving and backup procedures of the SECN data server. The SECN master database is write-protected so that users may access and copy records, but cannot make inadvertent changes. Raw data will be archived in their native format as described above.

All paper (i.e., hard copy) data sheets will be stored in collections of data sheets, immediately following data entry. Data entry of all field data sheets will produce an electronic copy of the data sheet which will also be archived (i.e., digitally) within the database, thus allowing future comparisons with the hard-copy field data sheet originals.

Personnel Requirements and Training

The staffing model for this protocol depends on Network staff to conduct the fieldwork, audio-file processing, manual evaluation, data entry, QA/QC, summary, analysis, reporting, metadata production, posting to IRMA, and archiving. The SECN will willingly cooperate with any park or agency personnel that desire to become involved in data collection to expand the sample size or collect data during the two years of the rotation when this protocol is not implemented at a specific park (i.e., all SECN parks are on a three-year rotation with five to six parks sampled per year [Table B-1]). Some protocol tasks may be delegated to other qualified groups, depending upon the expertise or oversight necessary and budgetary constraints. For example, some level of audio-file processing may be conducted by short-term undergraduate students through the SECN office at the University of Georgia. Table 12 shows estimated annual operating costs based upon FY 2012 data, however overlap exists with two other co-located monitoring protocols because these costs are difficult to separate (i.e., an intentional cost-savings measure).

Table 12. Estimated annual operating costs, based on FY 2014 data, for landbird monitoring in the Southeast Coast Network.

Category	Cost $ (FY 2014)		Notes
	Base	ECM	
Personnel			
Protocol Lead	32,000	32,000	0.3 FTE, GS-12
Wildlife Technician	17,500	17,500	0.3 FTE, GS-07
Graduate Research Associate	28,200	40,000	1.0 FTE, Intern
Data Manager[1]	12,150	12,150	0.1 FTE, GS-12
Personnel Total	**89,850**	**118,050**	
Landbird Monitoring			
ARD Maintenance	300		
ARD Replacement	4,000		
Other Equipment Replacement	300		
Travel - ARD Deployment & VCP Sur. 1 (5 parks)	4,500		2 People
Travel - ARD Retrieval (5 parks)	4,500		2 People
Travel - VCP Survey 2 (5 parks)	2,250		
Non-Personnel Landbird Monitoring Total	**15,850**	**15,850**	
Total Protocol Implementation Costs	**84,082**	**114,082**	

[1]A portion of all personnel's time is devoted to data management activities including data entry, analysis, and QA/QC as indicated in Figure 22. This is in accordance with NPS I&M policies recommending that at least 30% of monitoring resources be allocated to data management.

Four people are directly linked to this protocol: the SECN Terrestrial Ecologist, SECN Wildlife Technician, and two 1-FTE of an Ecological Intern (i.e., which may be used for three interns for three months, or two for 6 months) (Figure 22); however, the SECN Data Manager and the SECN Database Programmer also provide support. The Protocol Lead for this protocol is the Terrestrial Ecologist and is responsible for conducting all data analyses, revising the protocol and SOPs as

necessary, and ensuring data summaries are published. The SECN Wildlife Technician is in charge of equipment maintenance, training, protocol implementation, logistics, and data entry. The Wildlife

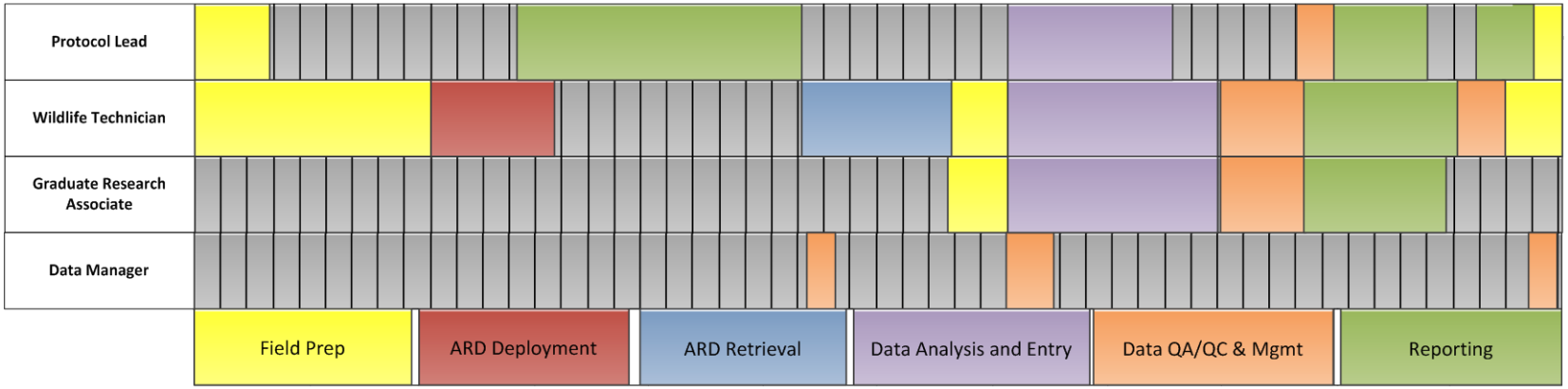


Figure 22. General staffing matrix for SECN Terrestrial Ecology Branch with approximate time periods required to complete major tasks associated with landbird monitoring. Time periods for specific tasks are outlined in color.

Biologist also leads the Ecological Interns in producing data summaries for each park monitored in a given year.

The field component of this protocol requires two people to implement, the Network Wildlife Technician and one Ecological Interns. The Ecological Intern must have a bachelor's degree in biological sciences, or a related field, and some taxonomic experience; however, the protocol is designed such that the intern does not need to have previous field experience. It is important to note that because this protocol is co-located with two other SECN protocols (i.e., amphibian community, vegetation community), the Wildlife Technician's and Graduate Research Associate / Intern's time is allocated across these three protocols.

Protocol Lead

The SECN Protocol Lead is responsible for overall implementation of the protocol, including the certification and analysis of data, revisions to SOPs as needed, and assisting park and partner staff with the interpretation of findings and incorporation of results into park management. The Lead must have the knowledge, skills, and abilities to apply known theories, principles and concepts of terrestrial and freshwater ecology sufficient to design and implement scientific studies related to terrestrial ecosystems, and the ability to statistically analyze data, synthesize information, write reports, and publish papers related to monitoring results. The Lead is also responsible for ensuring the collection of high quality data and interpretation of findings within the context of established assessment criteria, regulatory requirements, and management targets. The Protocol Lead will routinely be required to perform statistical tests and analysis, use geographic information systems and modeling procedures to analyze and synthesize data, and communicate and interact effectively with a wide variety of audiences, in both technical and non-technical language, for the presentation and preparation of complex letters, memoranda, reports, management plans, environmental assessments, briefings, and peer-reviewed scientific papers. The Protocol Lead and biologist share VCP surveys, and the Protocol Lead, biologist, and interns share manual evaluation of audio files, and the subset review manual evaluation.

Wildlife Technician

The Wildlife Technician is the lead for all field operations, serves as the authority for species identification and methodological implementation in the field, manages and maintains all field equipment, optimizes travel and time expenditures to implement all stages of the annual field schedule, leads in annual-report production, and organizes travel/lodging for field team. The Technician and Protocol Lead share VCP surveys, and the Technician, Protocol Lead, and interns share manual evaluation of audio files and the subset review manual evaluation of ARD files.

Graduate Research Associate(s) / Interns

The principal duties of the graduate research associates or interns are to assist with fieldwork and data collection as necessary, perform quality assurance and quality control procedures on all data collected and entered, manage the field equipment, and assist or lead in annual-report production. The interns share manual evaluation of audio files, and the subset review manual evaluation of ARD files with the Protocol Lead and Technician. As previously stated, the interns must have a bachelor's

degree in biological sciences, or a related field, and some taxonomic experience; however, previous field experience is not required.

Data Manager

The SECN Data Manager is responsible for ensuring that the SECN data management meets NPS and federal information management standards, including but not limited to: security, data quality, data documentation, database structure, reporting and linkages to other NPS information management systems. The Data Manager applies knowledge of programming, data management, database applications, GIS, Network priorities, and national I&M guidelines and directives, to plan, develop, and support application programs and systems to meet Network I&M needs. This position synthesizes a wide range of data types including biological, physical, and bibliographical in both tabular and spatial formats to ensure that metadata for these data sets is complete, current, and in compliance with FGDC standards. This position also provides coordination and oversight for the population and maintenance of national information management systems (i.e., IRMA). Finally, the incumbent develops documentation for current and future users of the Network's information management system, in the form of user manuals and overall technical documentation (i.e., roles and responsibilities, workflows, data dictionaries, data models, and entity-relationship diagrams). The Data Manager oversees and works in conjunction with the Database Programmer to provide specific needs.

Training

The Protocol Lead is responsible for ensuring all personnel are trained to implement the protocol. Training is required of those conducting VCP surveys. The identification bird vocalizations is not a skill that can be trained in a short period of time, and takes the most astute learner many years of practice to ensure the capability of collecting a reliable, repeatable, defendable dataset. Therefore, only personnel with extensive experience, as determined by the Protocol Lead and Wildlife Technician, will collect any form of landbird data. Because the fieldwork by the SECN for this protocol is limited to deployment, retrieval, and management of the ARDs, training needs are minimal. Non-permanent field staff begin training in January of each year. Training generally consists of an extensive treatment of safety policies and procedures, an overview of the I&M Program and the Vital Signs selection process, equipment maintenance, and protocol implementation; which is conducted by the Protocol Lead and Wildlife Technician. The Wildlife Technician schedules pre-field season excursions where field personnel test skills and are evaluated. The Wildlife Technician must approve all field personnel prior to initiation of field operations.

Operational Requirements

Annual Workload

Some aspect of implementing this protocol (i.e., preparation, fieldwork, data entry and summary) requires dedicated time throughout the year (Figure 22). Major tasks are (a) preparation, which includes equipment maintenance/testing/programming, sampling location evaluation, map production, scheduling, logistics (i.e., ferry reservations, hotels or non-standard lodging), and hiring Ecological Interns, (b) training, which includes safety (i.e., first aid/CPR, vehicle operation, watercraft training), compass/GPS use, species identification, and instruction on protocol implementation, (c) fieldwork and data collection, and (d) data entry and audio-file processing (Figure 22). As previously mentioned, because this protocol is co-located with the amphibian community and vegetation community protocols, many of the duties are shared across the three protocols.

Fieldwork generally begins in March and concludes in July (Table B-1, Figure 22). Prior to fieldwork, ARDs are prepared. Preparation includes ARD programming, firmware updates, testing, battery charging, reformatting data-storage cards, testing weather seals, and re-applying/installing camouflaging and microphone guards as necessary. ARDs are deployed at all parks in that year's rotation, and then all sampling locations are revisited to implement the vegetation community monitoring protocol. Permanent sampling locations are installed at this time, or maintenance of existing permanent markers occurs as necessary. The return visit to the majority of sampling locations is planned to occur after the previously deployed ARD has collected all 38 sampling events (i.e., over 77 days), however some parks or sampling locations warrant an additional return trip to retrieve the ARDs.

Upon returning from the field (Figure 22), the field crew evaluates all of the ARDs for damage (i.e., human-, animal-, weather-, or otherwise-induced) and sends any device in need of servicing or repair to the manufacturer. During this time, the field crew downloads the audio files from the ARDs and begins processing the files. Because the Wildlife Technician terms ends, these duties are conducted by a student/intern staff (n=2) at the University of Georgia SECN office. The Technician reviews all of the results of the audio-file processing and conducts QA/QC procedures to certify these data. The data are entered into the SECN data management system by the Wildlife Technician, and certified by the Protocol Lead. Report production begins once all data are certified and are generally published prior to the commencement of the next field season.

Permitting Requirements

No state, federal or park permitting or compliance is required to implement this protocol.

In situations where the sampling locations identified in this protocol currently coincide with, or do so in the future, other potentially conflicting management priorities, then park managers will be consulted prior to conducting any fieldwork in these areas. For example, some of the permanent sampling at CALO occur in areas that are frequently used by nesting shorebirds, specifically piping plover (*Charadrius melodus*). While piping plover management zones or target areas would not be a reason to exclude a sampling location, unless specifically requested by park management, monitoring

activities conducted under this protocol will be conducted in a manner that has no impact on the species or management priority. Work at these locations would occur before or after periods of highest use and not cause any disturbance to the target species or management priority (Jon Altman, pers. comm.). All monitoring activities implemented as part of this protocol, however, would be discussed with managers prior to conducting fieldwork in order to accommodate all management concerns and precautions in these situations.

Facilities and Equipment

Because of an optimized travel schedule (i.e., multiple parks per trip, long-duration, combined tasks) and the voluminous characteristics of some of the field equipment (i.e., audio recorders and accessories), personal and work equipment requires a sizeable amount of moveable storage. This requires two large vehicles (i.e., SUVs) or one vehicle towing a storage trailer (i.e., 5 × 8 ft). To further maximize efficiency (i.e., shorten travel duration), the field team of four people splits into two teams of two for some activities, which warrants two vehicles during these periods. Four-wheel drive is necessary at four SECN parks (i.e., CALO, CANA, CUIS, HOBE), but two-wheel drive vehicles are adequate at the remainder of SECN parks. A shallow-water boat capable of carrying personnel and equipment is necessary at CONG and CANA, and a vehicle to tow the boat.

Although the audio recorders are of relatively solid construction, the recorders and all accessories (i.e., data cards, battery chargers) are stored and serviced in a climate-controlled environment to protect and prolong the investment. An adequate amount of indoor space (i.e., two 3 × 6 ft tables) is necessary to service, maintain, and prepare the devices for deployment each year.

Operational Costs

Implementation of the Landbird Monitoring Protocol costs approximately $84,082 per year, FY12 dollars, with personnel representing the majority of costs (81%) required (Table 12). Of the remaining costs, annual travel costs (i.e., lodging per diem and miscellaneous expenses) to five parks for ARD deployment (i.e., combines with the first VCP survey) and retrieval, for two people, and the second VCP survey trip, are approximately $11,250. Annual equipment replacement and maintenance costs are less than $5,000 per year.

Startup equipment and software costs for implementation of this protocol are, if 100 units are used, $73,200. This includes the ARDs, rechargeable D-cell batteries, battery chargers, 16GB SD cards, and one software license.

Operational costs include 1.7-FTE split across four positions. The Biologist and Protocol Lead share in VCP monitoring, manual evaluation of ARD files, and the subset review of ARD files, and share with the intern staff manual evaluation of ARD files and the subset review of ARD files. The ARD work involves a data processing period, which varies based upon the interns' experience and abilities, but takes approximately six months to complete after the end of the field season; therefore work in support of this protocol is conducted year-round.

Safety

A Green-Amber-Red (GAR) risk analysis was performed to determine whether implementation of this protocol could be accomplished within an acceptable level of risk (Appendix D). Based on the job hazard analysis of the protocol and the identified risk abatement measures, it was determined that the protocol can be safely implemented provided that SECN staff implement the protocol in accordance with the referenced SOPs and risk abatement measures that have been identified.

Specific safety concerns include:

- Crew members will spend many hours (and miles) driving to, between, and from sampling locations to conduct the requisite sampling design.
- Crew members will be regularly working in park areas outside of communications range (either by park radio or by cell phone).

Injury or loss of life while in transit to and from field sites are the most significant risks encountered when conducting this activity.

General Safety Procedures

SECN staff will be expected to follow the general guidelines set forth in the NPS Occupational Safety and Health Program (Directors order #50B, September 2008). Generally outlined as follows:

1. Adhere to established occupational safety and health procedures, including those contained within Reference Manual 50B.
2. Develop and use Job Hazard Analyses or equivalent for all routine tasks, and develop and use site-specific safety plans for non-routine, complex, multi-phase jobs.
3. Properly use and maintain required clothing and/or personal protective equipment.
4. Maintain a level of personal wellness and fitness as needed for assigned work tasks.
5. Identify and, where appropriate, correct unsafe conditions and work practices.
6. Report unsafe/unhealthful conditions and/or operations to the immediate supervisor or the appropriate chain of command.
7. Report mishaps, including minor accidents and "near-hits," to a supervisor as soon as possible, but in no case later than the end of the work shift.
8. Participate in establishing a safe working culture, and practice safe work procedures, even when working alone.

Protocol-Specific Safety Measures

Specific safety SOPs (i.e., SOP 3.1.1–3.1.8, Appendix A) have been developed that cover issues and common activities conducted by SECN staff in the implementation of this protocol that may include procedures and/or requirements in addition to those promulgated by NPS Occupational Safety and Health Program (Reference Manual 50B, 2008) (Appendix A, Appendix D). Furthermore, to increase

overall level of safety and awareness, basic first aid training is required of all field staff, and additional safety training beyond basic certifications listed in Appendix D will be encouraged.

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Appendix A. Standard Operating Procedures for Landbird Monitoring Protocol

To ensure consistent procedures Network-wide as Standard Operating Procedures (SOPs are revised, updated, and re-published, the Southeast Coast Network (SECN) maintains a single library of SOPs that are shared across all Network protocols and operations. All approved SOPs are published in the NPS Natural Resource Report series and the latest approved versions of operational SOPs are always available for download at the NPS Integrated Resource Management Applications portal at http://irma.nps.gov.

All SECN SOPs conform to a standard three-part numbering system to aid in the identification of the portion(s) of the program to which the procedures apply (Table A-1). Because SOPs are regularly updated, the SECN maintains the complete collection of the most recent and working versions of all SOPs in the SECN Operations Manual, housed on the SECN SharePoint at: http://inpserosecn2/staff/Lists/Network%20Operations%20Manual/Tree.aspx.

Table A-1. Numbering system and categories for Standard Operating Procedures (SOPs) used by the Southeast Coast Network. Within each category, SOPs are numbered sequentially as they are produced.

Level 1	Level 2	Topic
1	1.1.x	General field methods shared by multiple branches of the SECN (i.e., those related to GIS, GPS location, photopoints, or use of shared instrumentation).
	1.2.x	Field methods for water resource monitoring.
	1.3.x	Field methods for coastal resource monitoring.
	1.4.x	Field methods for terrestrial resource monitoring (plants and animals).
2	2.1.x	Data management procedures shared by multiple branches of the SECN, such as those pertaining to reporting, file management.
	2.2.x	Data management procedures related to water resource monitoring.
	2.3.x	Data management procedures related to coastal resource monitoring.
	2.4.x	Data management procedures related to terrestrial resource monitoring (plants and animals).
3	3.1.x	Field Safety.
	3.2.x	Equipment use and maintenance.
4	4.1.x	Network administration.
5	5.1.x	User Manuals.

The following subset of the SECN's SOPs are necessary for the implementation of the SECN Landbird Monitoring Protocol (Table A-2). All SOPs are subject modification with changes made in accordance with standard procedures documented in SOP 2.1.1 (Table A-2).

Table A-2. Standard Operating Procedures required to implement the SECN Landbird Monitoring Protocol. The subject category, SOP number, title, and Integrated Resources Management Applications (IRMA) record numbers are provided.

Subject	SOP#	Citation	IRMA Record Number
Monitoring	1.1.1	Byrne, M. W. 2013. Generating a spatially-balanced random sample with the RRQRR tool in ArcGIS 9.1 and ArcGIS 9.3.1 and applying selection criteria to select sampling locations, Version 2. Southeast Coast Network Standard Operating Procedure NPS/SECN/SOP-1.1.1. National Park Service, Athens, Georgia.	2215882
	1.1.2	Byrne, M. W., and B. D. Smrekar. 2013. Uploading points to GPS units. Southeast Coast Network Standard Operating Procedure NPS/SECN/SOP-1.1.2. National Park Service, Athens, Georgia.	2197052
	1.1.7	Byrne, M. W., and B. A. Blankley. 2012. Sampling-grid creation, grid-cell surface analysis, and two-class image classification for Southeast Coast Network parks. Southeast Coast Network Standard Operating Procedure NPS/SECN/SOP-1.1.7. National Park Service, Athens, Georgia.	2188654
	1.4.1	Byrne, M. W., and B. D. Smrekar. 2013. Programming and maintenance of automated recording devices for vocal anuran and bird monitoring. Southeast Coast Network Standard Operating Procedure NPS/SECN/SOP-1.4.1. National Park Service, Athens, Georgia.	2197053
	1.4.2	Byrne, M. W., and B. D. Smrekar. 2012. Creating and applying vocalization recognizers to audio files. Southeast Coast Network Standard Operating Procedure NPS/SECN/SOP-1.4.2. National Park Service, Athens, Georgia.	2187575
	1.4.6	Byrne, M. W. 2012. Conducting a variable circular plot point count. Southeast Coast Network Standard Operating Procedure NPS/SECN/SOP-1.4.6. National Park Service, Athens, Georgia.	2215876
	1.4.19	Byrne, M. W., S. L. Corbett, and B. D. Smrekar. 2013. Installation and relocation of permanent terrestrial monitoring sampling locations. Southeast Coast Network Standard Operating Procedure NPS/SECN/SOP-1.4.19. National Park Service, Athens, Georgia.	2197059
	1.4.20	Byrne, M. W., and C. D. Jones 2014. Manual evaluation of automated recording device files. Southeast Coast Network Standard Operating Procedure NPS/SECN/SOP-1.4.20. National Park Service, Athens, Georgia.	2197062
	1.4.21	Byrne, M. W., and B. D. Smrekar. 2012. Vocalization identification quality assurance and quality control procedures. Southeast Coast Network Standard Operating Procedure NPS/SECN/SOP-1.4.21. National Park Service, Athens, Georgia.	2188726
	1.4.22	Byrne, M. W., and B. D. Smrekar. 2013. Deployment and retrieval of automated recording devices for vocal anuran and land bird monitoring. Southeast Coast Network Standard Operating Procedure NPS/SECN/SOP-1.4.22. National Park Service, Athens, Georgia.	2197061
	1.4.31	Smrekar, B., and M. W. Byrne. 2013. Navigation to Southeast Coast Network terrestrial monitoring sampling locations. Southeast Coast Network Standard Operating Procedure NPS/SECN/SOP-1.4.31. National Park Service, Athens, Georgia.	RESTRICTED
Data Management	2.1.1	Southeast Coast Network (SECN). 2013. Revision of Southeast Coast Network protocols and standard operating procedures. Southeast Coast Network Standard Operating Procedure NPS/SECN/SOP-2.1.1. National Park Service, Athens, Georgia.	2192669

Table A-2. Continued.

Subject	SOP#	Citation	IRMA Record Number
Data Management (continued)	2.1.2	Southeast Coast Network (SECN). 2013. Southeast Coast Network Reporting Guidelines. Southeast Coast Network Standard Operating Procedure NPS/SECN/SOP-2.1.2. National Park Service, Athens, Georgia.	2192670
	2.1.8	Southeast Coast Network (SECN). 2013. Dataset and metadata publication. Standard Operating Procedure NPS/SECN/SOP-2.1.8. National Park Service, Athens, Georgia.	2197066
	2.4.3	Wright, C. J., E. Thompson, M. W. Byrne, and B. D. Smrekar. 2014. Southeast Coast Network Landbird Community Monitoring Database User Manual, Version 2. Southeast Coast Network Standard Operating Procedure NPS/SECN/SOP-2.4.3. National Park Service, Athens, Georgia.	2215874
	2.4.4	Wright, C. J., M. W. Byrne and E. Thompson. 2013. Landbird community monitoring: Database and technical documentation, Version 2. Southeast Coast Network Standard Operating Procedure NPS/SECN/SOP-2.4.4. National Park Service, Athens, Georgia.	2215875
	2.4.12	Wright, C. J., M. W. Byrne, T. Curtis and J. C. DeVivo. 2012. NPSpecies and NPSpecies certification guidance. Southeast Coast Network Standard Operating Procedure NPS/SECN/SOP-2.4.12. National Park Service, Athens, Georgia.	2185542
Safety	3.1.1	Corbett, S. L., B. D. Smrekar, M. Moore, and J. Pressnell. 2013. Identification, treatment, and reporting of on-duty injury and illness. Southeast Coast Network Standard Operating Procedure NPS/SECN/SOP-3.1.1. National Park Service, Athens, Georgia.	2192734
	3.1.2	Asper, J. R., and A. C. Curtis. 2013. Safe operation of Southeast Coast Network Watercraft. Southeast Coast Network Standard Operating Procedure NPS/SECN/SOP-3.1.2. National Park Service, Athens, Georgia.	2192642
	3.1.3	Southeast Coast Network (SECN). 2013. Vehicle use and operation. Southeast Coast Network Standard Operating Procedure NPS/SECN/SOP-3.1.3. National Park Service, Athens, Georgia.	2192735
	3.1.4	Corbett, S. L., and B. Smrekar. 2013. Motor vehicle accident reporting procedures. Southeast Coast Network Standard Operating Procedure NPS/SECN/SOP-3.1.4. National Park Service, Athens, Georgia.	2192736
	3.1.6	Corbett, S. C. 2012. Logistics for camping while conducting field work. Southeast Coast Network Standard Operating Procedure NPS/SECN/SOP-3.1.6. National Park Service, Athens, Georgia.	2183550
	3.1.7	DeVivo, J. C., and S. L. Corbett. 2013. Communicating field operations with SECN Parks. Southeast Coast Network Standard Operating Procedure NPS/SECN/SOP-3.1.7. National Park Service, Athens, Georgia.	2192737
	3.1.8	Southeast Coast Network (SECN). 2013. Safe operations of off-highway vehicles (OHV). Southeast Coast Network Standard Operating Procedure NPS/SECN/SOP-3.1.8. National Park Service, Athens, Georgia.	2184913

Appendix B. Unified Sampling Design for Vegetation, Landbird, and Amphibian Community Vital Signs Monitoring in the Southeast Coast Network

Overview

This appendix details the design-based approach of the spatial and temporal-sampling design for the Southeast Coast Network's (SECN) *Vegetation Community*, *Landbird Community*, and *Amphibian Community* Vital Signs Monitoring protocols. All three of these Vital Signs are co-located, thus the spatial-sampling designs are identical. Across-year temporal-sampling designs also are identical, but specific components of some monitoring protocols differ slightly seasonally and are accommodated by variations in the within-year sampling designs. These differences are briefly mentioned in the following text in detail sufficient for the reader to understand the two components of the within-year temporal-sampling design, and elaborated upon in the Standard Operating Procedures (SOPs) for each respective monitoring protocol.

As recommended by National Park Service (NPS) Inventory and Monitoring (I&M) Program (Fancy et al. 2009), the SECN has initially chosen a design-based approach of permanent sampling locations to address the objectives the Landbird Community Monitoring Protocol. Definitions of design-based and model-based approaches follow those set forth by Olsen et al. (1999). The design-based approach is based upon substantially fewer assumptions and results in more reliable estimates for inference to the target population(s) than a model-based approach or non-randomly selected sampling locations (i.e., judgment sampling) (Neusser et al. 1998, Olsen et al. 1999, Schreuder et al. 2004). Further, data upon which to base or derive assumptions for a model-based design do not currently exist for the terrestrial Vital Signs in any SECN park. A model-based approach with sentinel locations may be explored in the future.

General Monitoring Objectives

Although different measures are monitored under each of the terrestrial Vital Signs protocols, each has four general monitoring objectives:

1. Determine the status and trends in measures of community structure, function, or composition at multiple locations within each park.

2. Determine the variability of those community measures within and among parks and in relationship to covariates.

3. Determine the condition of each park, subunit, or management area based on a subset of those community measures that respond predictably to one or more environmental variables and for which assessment criteria can be or have been developed.

4. Determine the trends in park-, subunit-, or management-area-wide condition over time.

During the initial 3–6 years of protocol implementation, the SECN will focus on the first two objectives for all terrestrial monitoring protocols. Data collected during this phase of implementation

will be used to identify the most informative community measures and associated assessment criteria to be used to determine status and trends of park-wide conditions.

Applicable Vital Signs Overview

The SECN's three terrestrial Vital Signs include *vegetation communities*, *landbird communities*, and *amphibian communities*, which are monitored at all SECN parks. Data collection for these Vital Signs is co-located in 0.5-ha grid cells (i.e., sampling locations); the foundation for inference to the sampling frame. The 0.5-ha grid-cell size was determined the most advantageous for the following reasons: (a) SECN park sizes and arrangement, (b) to avoid the bias inherent in a design using larger grid cells that increases the likelihood of missing small patches of vegetation types (i.e., adequate characterization of the population of interest), (c) the compatibility with the response designs of the terrestrial Vital Signs (i.e., based upon SECN field testing, all landbirds and vocal anurans that vocalize within the cell can be detected), and (d) 0.5-ha was chosen as the minimum mapping unit of the SECN vegetation mapping inventory. The following field methods (i.e., response design) for each Vital Sign are a direct reflection of the design considerations. To assist the reader in the relevance, necessity, and applicability of the decision for co-locating the vegetation, landbird, and amphibian communities Vital Signs sampling locations, a brief summary of the field methods and measures collected for each Vital Sign is presented.

Vegetation Communities

The field methods for the vegetation community monitoring protocol consist of an adaptation of the peer-reviewed and widely applied Forest Inventory Analysis (FIA) protocol and North Carolina Vegetation Survey protocol (Bechtold and Patterson 2005, Peet et al. 1998). Briefly, the adapted methods used by the SECN consist of a circular plot with nested subplots. Measures are collected in three structural strata: canopy (midstory/overstory), shrub, and groundcover. Specific measures collected include: (a) relative cover across canopy species, (b) canopy species size (i.e., diameter at breast height) and frequency, and (c) cover and frequency of shrub- and groundcover-strata vegetation identified to the finest taxonomic resolution possible given available identifying characteristics, groundcover nested frequency, and a macroplot species list. Data from this Vital Sign are summarized to characterize the vegetation community within the sample area and habitat characteristics for functional, compositional, or structural wildlife species aggregates/metrics.

Fire fuels, specifically dead-downed materials, are also collected as part of this protocol. The field methods for the fire fuels monitoring protocol are a direct application of the peer-reviewed and widely applied NPS fire effects monitoring program and the Forest Inventory and Analysis program for duff/litter, fine-woody debris, and coarse-woody debris (USDA Forest Service 2004, Woodall and Monleon 2008, Lutes 2010). Fine-woody and coarse-woody debris measures are collected along 10-m transects, and duff/litter measures are collected in 4- m^2 plots. The fire fuels plots and transects extend beyond the circular plot established for the vegetation community monitoring protocol to avoid the effects of trampling and subsequent bias. The measures include duff depth, litter depth, counts in three size classes of fine-woody debris, and the length, size class, decay class, and diameter of coarse-woody debris. Data from this Vital Sign are summarized to characterize the dead-downed

materials within the sample area and for habitat components for functional, compositional, or structural wildlife species aggregates/metrics.

Landbird Communities

The field methods consist of two techniques: automated recording devices (ARD) (Veneir et al. 2012) and variable radius circular plot point counts (VCP) with distance estimation (Reynolds et al. 1980, Buckland et al. 1993, Ralph et al. 1995, Nelson and Fancy 1999, Buckland et al. 2001) at a subset (i.e., 20%, but no fewer than three) of sampling locations (Table 3). ARDs are deployed once every three years and collect data during 38 discrete sampling events over a continuous 77-day deployment. These devices are programmed to record two 12-minute intervals at dawn (i.e., 0730 and 0800). The advantages of ARDs are outlined in Table 5. The deployment time is constant across years but varies across parks to most adequately reflect the vocalization phenology of the target taxa (i.e., deployment at Cape Canaveral National Seashore [CANA] begins in February, whereas deployment at Kennesaw Mountain National Battlefield Park [KEMO] begins in March). The recordings capture both spring migrants and breeding birds. During each monitoring event, VCPs are conducted twice during the breeding season, separated by at least three weeks, at a subset of 20% but no fewer than three of the permanent sampling locations (Table 3). This subset serves as a quality control procedure for the ARD methodology and as a tool to crosswalk the ARD and VCP datasets for use in other monitoring programs (i.e., Breeding Bird Survey). Measures of the VCPs include detection/non-detection, and abundance estimates for the common species (i.e., those with 60-80 distance estimates and a detection function can be generated). The ARDs collect measures of detection/non-detection. VCPs were the only method implemented from 2009–2010, but ARDs were added in 2011 and will continue to be the basis of our bird monitoring activities given the design considerations detailed in the following sections.

Vocal Anuran Communities

The field methods for the Vocal Anuran Monitoring Protocol consist of using ARDs to monitor vocal anurans. The ARDs are programmed to record 30-seconds every 10 minutes from dusk to dawn (i.e., 1800 – 0650) during 38 discrete sampling events over a continuous 77-day deployment period. This method detects only vocal amphibians (i.e., anurans and not members of Caudata) and nocturnal birds, and collects measures on detection/non-detection. The devices collect data during the same sampling window for vocal amphibians and landbirds. The deployment time is constant across years but varies across parks to most adequately reflect the calling behavior of the target taxa (i.e., deployment at CANA being in February, whereas deployment at KEMO begins in March).

Study Area

The SECN consists of 20 parks, 17 of which contain significant natural resources (Figure B-1). SECN parks encompass more than 75,000 hectares (185,000 acres) of federally-managed land across North Carolina, South Carolina, Georgia, Alabama, and Florida. The parks span a wide range of cultural and natural resource missions, and include four National Seashores, two national historic sites, two national memorials, seven national monuments, two national military parks, a national recreation area, national battlefield, and an ecological and historic preserve. The parks range in size from slightly more than 8 hectares (20 acres) to nearly 60,000 acres (25,000 ha), and when

considered with non-federal lands jointly managed with SECN parks, the Network encompasses more than 102,000 hectares (253,000 acres).

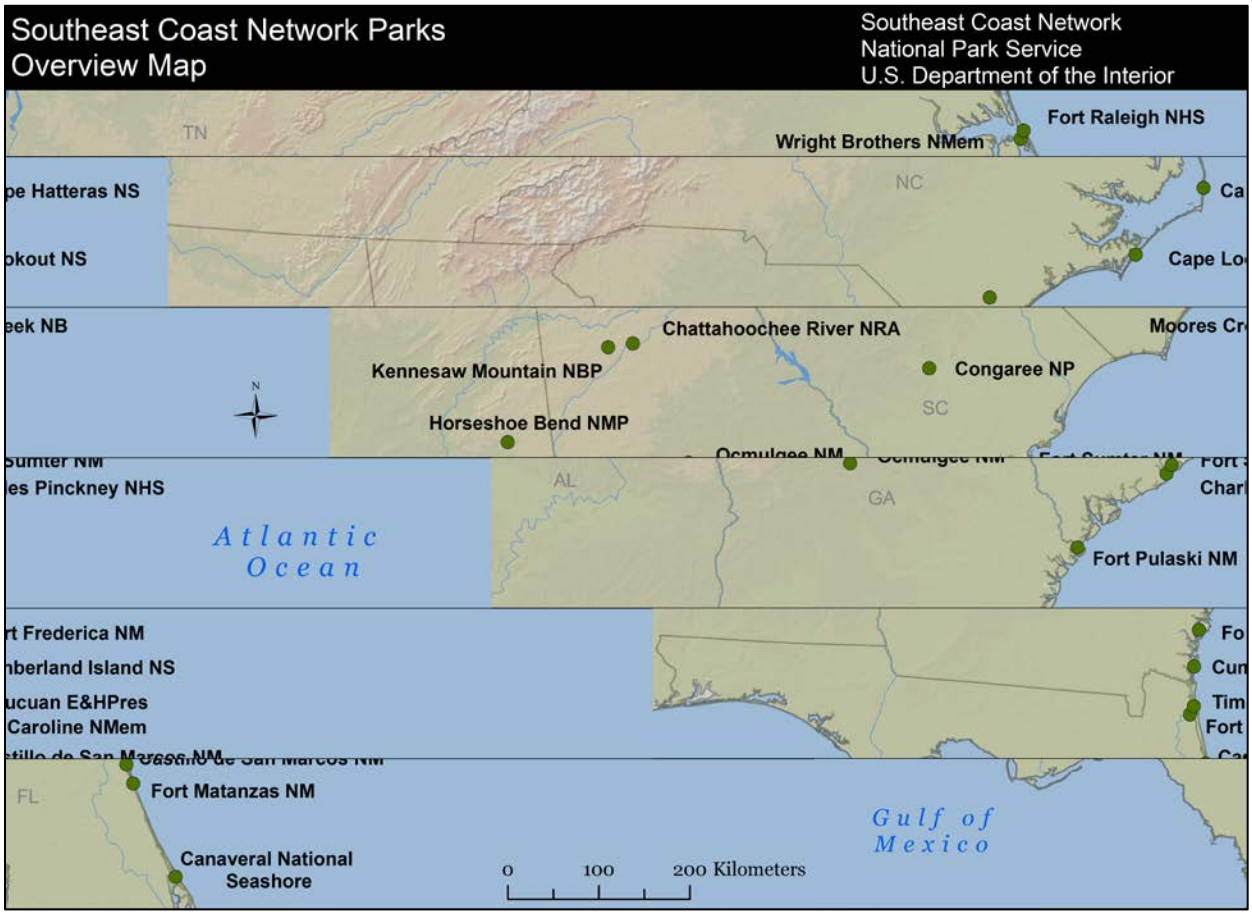


Figure B-1. Parks of the Southeast Coast Network where terrestrial Vital Signs are monitored.

Sampling Design

Design Considerations

Minimizing Variability

The sampling design is driven by specific monitoring and sampling objectives, hypothesized variability in the estimation of proposed measures and the ability to detect meaningful trends (i.e., precision), simulations of target elements, knowledge of park lands, safety issues, and available funds. A flexible, adaptable, and relevant sampling design is integral to the continuity and success of any long-term monitoring program.

To maximize the likelihood of detecting a trend, the design balances available resources with the allocation of sampling effort and allows differentiation among several sources of variability. Further, the sample size chosen for each SECN park is estimated to account for the known variability of some measures, and the estimated variability of others.

Sources of variability include those occurring within and across years. Expected within-year variability, or residual variability (Larsen et al. 2001), is the variation observed during the sampling period across all sampling locations. This component of variance is minimized in the design of the amphibian community (i.e., vocal anuran) and landbird community monitoring protocols because the monitoring equipment (i.e., ARDs) collects 20 sampling events during a 77-day deployment period. The herbaceous stratum of a vegetation community generally exhibits the greatest expected within-year variability in species cover and frequency. Because many of SECN vegetation communities are shrub dominated or have a strong canopy component, however, the herbaceous stratum exhibits low within-year variability with the exception of the occurrences of a few spring ephemeral species. Little or no detectable within-year variability exists in canopy species size or species composition and cover in the canopy or shrub strata. Although dune communities are the primary herbaceous-dominated community in the SECN, the saline environment results in generally slow-growing species. Therefore, little or no detectable within-year changes in herbaceous cover exist in this community during the growing season. Dead-downed materials (i.e., large component of fire fuels) also have a small within-year variance.

Expected across-year variability includes coherent variation, or when a measure is affected consistently across sampling locations (Larsen et al. 2001) (i.e., precipitation), and interaction variation, or when a measure is affected by location-specific factors (Larsen et al. 2001; i.e., fire, tornado). This component of variance is minimized with permanent sampling locations. Another source of variability, non-sampling error, is often found in observer error or observer bias. Although this is generally difficult to measure, several steps are undertaken to minimize this source of variability. Efforts include extensive pre-data collection training and training evaluation, double-blind observer procedures, data collection methods that minimize the potential incorrect and unintentional influence of the observer (i.e., automated vocalization identification with analysis software; vegetation-cover coverage class ranges proven to maximize precision and reduce error), use of detection/non-detection measures, and quality assurance/quality control procedures as part of the data entry and management process. Although retention of field personnel can minimize non-sampling error, it can also become a source of variability as their experience, efficiency, and expertise improves over time; thus introducing this form of variability even in within-observer comparisons across years. Despite our best efforts to prevent and control for non-sampling error, we acknowledge it exists and, given our adherence to the aforementioned efforts to control non-sampling error mentioned above, make the assumption it will remain consistent across years in a long-term monitoring program.

Additional efforts to reduce variability are to pool measures into “metrics”, or aggregate measures based on logical aggregations of functional, structural, and compositional attributes of monitored taxa (i.e., ground-nesting birds, native shrub cover, members of Hylidae). This is expected to be part of future data analysis and is based on the critical assumptions that detectable and measureable metrics exist in SECN park ecosystems, perform consistently, reliably reflect natural and anthropogenic influences on variation, and can be used as indicators of resource condition.

Co-location

In an effort to maximize the utility of the data and minimize sampling costs, data collection efforts of this protocol are co-located with the SECN's *Vegetation Community* and *Amphibian Community* Vital Signs Monitoring protocols (Figure B-2). Vegetation communities and landbirds are likely to occur at all sampling locations, thus maximizing the utility of data collected in a co-located monitoring structure. Further, a distinct advantage of amphibian community monitoring in the Southeastern U.S. is that, due to the high species diversity, amphibians are generally ubiquitous outside of saline systems (i.e., salt marsh and dune communities). Despite this advantage, however, habitat is species-specific and not all amphibians, landbirds, or plants known to occur in SECN parks are likely to occur at all sampling locations. As with amphibians, not all sampling locations support all targeted Vital Signs (i.e., dune communities are generally not fire adapted nor possess various types of woody debris and do not warrant dead-downed material monitoring) or all components of a particular Vital Sign (i.e., dune communities generally do not host canopy species). Therefore, not all Vital Signs are implemented at all sampling locations, nor are all components of the methods for each Vital Sign. This is either pre-determined during the application of sampling location selection criteria phase, the consideration or application of ancillary data (i.e., non-SECN research at a park), data from other Vital Signs, or the expert opinion of our field crew and Principal Investigator.

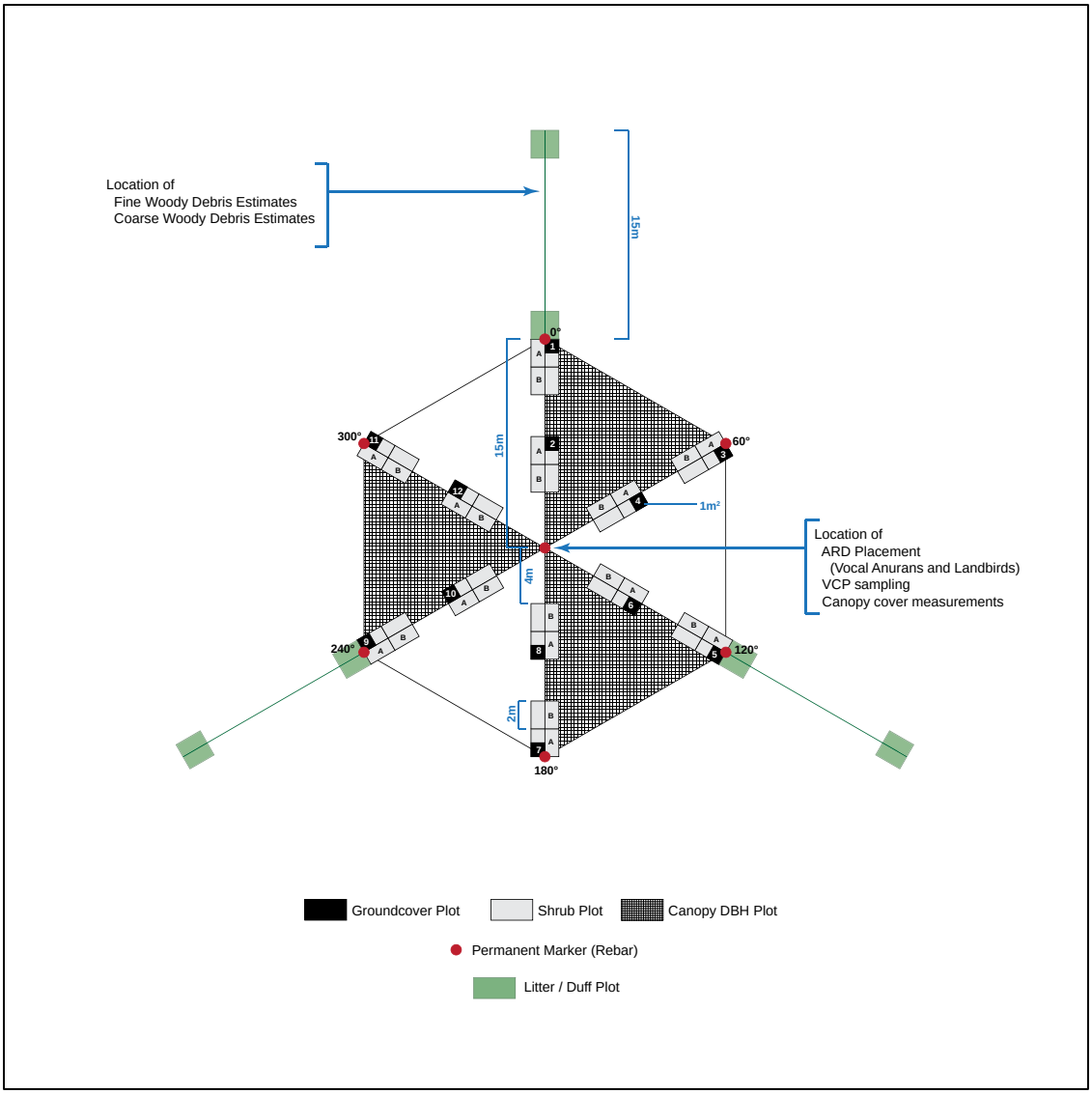


Figure B-2. Sampling array within each 0.5-hectare sampling location for the co-located Amphibian Community, Landbird Community, and Vegetation Community Vital Signs Monitoring protocols.

Strata

Given the overall goal of the I&M Program to determine the health of park lands (Fancy 2009), it is not prudent to base the spatial-sampling design of a long-term monitoring program on potentially dynamic strata (i.e., vegetation, soils). Because the boundaries of potentially dynamic strata are unlikely to remain constant over time, this can invalidate or complicate the design (Fancy et al. 2009). Although Fancy et al. (2009) suggests that in certain geographic locations it is legitimate to stratify by physical characteristics, such as terrain, that correspond to an area of interest (i.e., riparian areas), geospatial data with an acceptable level of resolution, however, are generally not available for precise delineation of strata in SECN parks. McDonald and Geissler (2004) suggest that areas deemed dangerous, inaccessible, or remote with high travel costs are defined and sampling locations that occur within these areas are excluded.

Because management interest exists for all vegetation communities and wildlife habitats in SECN parks, the sampling design utilizes stratification only to eliminate areas from consideration that are non-natural, open water, or natural areas not used by amphibians or where researcher presence and traffic would cause irreparable harm to the area, henceforth referred to as unsampled areas. Specifically, non-natural areas include building footprints, parking areas, roads, and borrow pits. Open water areas include the interior of non-wadeable rivers, lakes, and ponds. Salt marshes are the only naturally vegetated area where researcher presence and foot traffic would cause extensive damage, consequently this Vital Sign is not implemented in salt marshes. Salt marshes are defined as low salt marshes that are periodically (i.e., tidally) or permanently inundated with salt water. Beaches from the surf zone up the beach to the top of the primary dune are not used by amphibians, and are therefore excluded. As previously mentioned, GIS data are generally unavailable for the unsampled areas, therefore these areas are eliminated through the application of selection criteria elaborated in the following section (Theobald et al. 2007). Inference does not apply to the unsampled areas.

Safety

The safety of field personnel supersedes all other design considerations. Given the varied potential hazards in SECN parks, the spatial distribution of the sampling locations, and the field methods to be employed at those locations, have been selected to minimize potential hazards to personnel. Extensive Job Hazard Analyses have been prepared by the SECN Safety Officer in conjunction with the combined experience and opinions of all the SECN staff, national I&M Program staff, regional personnel, park managers, and other land-management agencies to minimize the risk of potential hazards to personnel during sampling. The sampling designs presented herein, and the field methods (i.e., response designs) detailed in each protocol, reflect the collaborative effort to establish the safety of all field personnel as the top priority.

Design Limitations

The SECN design strategy consists of monitoring a suite of permanent sampling locations. Although permanent sampling locations are a well-accepted means to reduce variability between sampling events, limitations exist in the long-term integrity of permanent locations. Further, concern exists regarding the appropriateness of using data from non-independent locations when comparing data among sampling periods (Williams et al. 2002). We acknowledge additional challenges specific to SECN park units that a design approach consisting of permanent sampling locations entails, and these include:

- Coastal SECN parks are very dynamic and large portions of these parks are in a constant state of change (i.e., dune communities). Due to storm events and other known influences on the local landscapes, sampling location attrition (i.e., the complete loss of permanently marked sampling locations) is expected, thus reducing the sample size of a static suite of permanent sampling locations.

- The number of sampling locations sampled at each park across time may fluctuate based on budgetary influences, staff attrition, or issues that affect travel to sampling locations.

- Several SECN parks are actively acquiring news lands. Because the park boundary is used as the sampling frame, a changing sampling frame would alter the level of inference and

complicate data analysis procedures. Professional statisticians will be consulted to assist in addressing the issues this situation presents.

- Despite a concerted effort on the part of a field crew, repeated return visits to a specific location might have inadvertent detrimental effects on sampling locations. Observer bias of permanent sampling locations occurs in several forms, including trail formation, soil disturbance, surface hydrology alterations, transmission vector for non-native and native species, and influencing animal behavior of the area. While some of these effects may be subtle, their cumulative effects can potentially change the trajectory of a location and consequently bias the data.

Each park's initial suite of permanent sampling locations will be used until such a time as conditions necessitate a location's "retirement." Sampling locations will be replaced after a determination that locations have been altered to the point of no longer meeting selection criteria, such as conversion of terrestrial habitat to open water following a hurricane, if persistent observer influences are observed at a location, or if further monitoring cannot be conducted at a location without causing damage.

In the case of sampling location attrition or retirement, sampling locations will be replaced with pre-existing sampling locations where baseline data exist (i.e., those sampling locations monitored during the protocol-development process), alternate sampling locations generated as part of the initial design, or new locations generated that account for and build upon the existing suite of sampling locations. Despite the use of permanent sampling locations, however, within-location variability is expected to be high in sampling locations in dynamic areas.

Sampling Location Selection

Sampling Location Draw

Each park's administrative boundary was used as the sampling frame. SECN parks do not have large areas that are inaccessible, defined by unrealistic access time or hazardous terrain (i.e., slopes > 35%). The sampling frame for each park was divided into a systematic 0.5-ha grid; the area of the grid-cell served as the potential sampling location (Figure B-3; SOP 1.1.7; Byrne and Blankley 2012). The 0.5-ha grid-cell size was chosen to provide an adequate number of sampling locations given the size and shape of SECN parks, to avoid the bias inherent in a design using larger grid cells that increases the likelihood of missing small patches of vegetation types, and because 0.5-ha is the minimum mapping unit of the SECN vegetation mapping inventory. A spatially-balanced sample was drawn from this grid using the Reversed Randomized Quadrant-Recursive Raster (RRQRR) algorithm (Theobald et al. 2006; Byrne 2013a; SOP 1.1.1). The RRQRR algorithm provides a discrete sample (Theobald et al. 2007), thus inferences will be expressed relative to the number of grid-cell center points within the sampling frame. The sample draw included primary sampling locations and an "over-sample" to provide alternate sampling locations (Figure B-4).

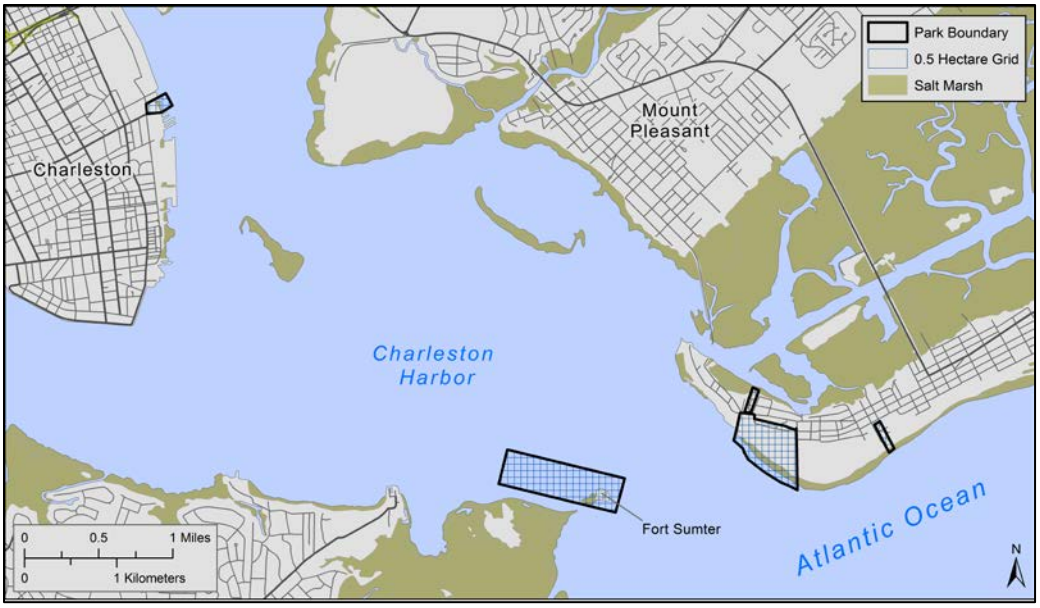


Figure B-3. Example of 0.5-ha grid, superimposed across the administrative boundary of Fort Sumter National Monument (i.e., the sampling frame), which serves as the foundation of the Southeast Coast Network's (SECN) SBRS process for the vegetation, landbird, and amphibian community monitoring protocols.

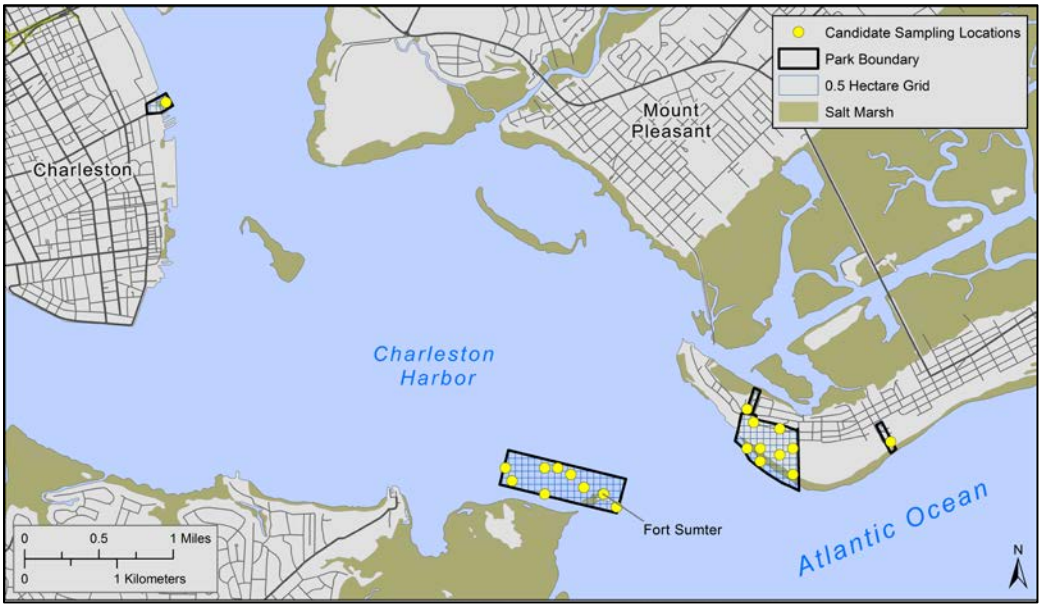


Figure B-4. Example of a hypothetical initial sample draw of sampling locations at Fort Sumter National Monument, where the GIS-based selection criteria have not been applied to the sampling locations.

Sampling locations that fall within unsampled areas are excluded. For example, if locations fall within the salt marsh, those locations are excluded because implementation of the terrestrial protocols in salt marsh areas would have an irreversible negative impact (i.e., trail formation from soft sediment). Further, key characteristics of salt marshes, as determined by park managers and SECN staff during the scoping process, are monitored under other SECN Vital Sign monitoring

protocols. Other pre-determined and excluded unsampled areas include non-natural areas, such as parking lots and building footprints, and the interior of large bodies of water, devoid of emergent vegetation, that encompass the 0.5-ha grid-cell in its entirety and do not allow for foot travel. As expected, inference does not apply to these areas. Potential sampling locations from the initial sample draw that occur in these unsampled areas were excluded during the preliminary sampling location selection criteria application process.

Sample size was determined after consideration of park size, hypothesized variability in the Vital Sign measures, statistical power (ability to detect trend), safety concerns, and the logistical issues regarding travel time and conducting monitoring activities in five to six park units per year. To maintain the integrity of the spatially-balanced properties of the RRQRR draw, the initial draw consisted of approximately 1.5*n*, where *n* is the desired number of sampling locations [i.e., less than the 2*n* used by Stevens and Olsen (2004)]. Alternate sampling locations were used when selection criteria (see next section) were not met; approximately eight to 10 alternate sampling locations are provided for each park-specific sampling design.

The SECN uses an equal inclusion probability design for all sampling locations within the sampling frame. Unequal probability sampling, however, will be explored in the future if managers or ecologists identify domains or strata of interest that are unique or of management importance and should be sampled disproportionately to their availability. As previously mentioned, currently no areas in SECN parks are considered high-priority or of specific management interest.

Selection Criteria

Selection criteria are applied to all sampling locations in lieu of *a priori* categorization of some grid cells as “exclusion zones” (Theobald et al. 2007), or unsampled areas as previously referred. Creating GIS-based exclusion zones can bias the design because of imprecision, spatially or temporally, in the geospatial data used as the foundation of the sample draw process or our lack of location-specific knowledge that could influence sampling location inclusion (Theobald et al. 2007). Therefore, two levels of selection criteria are applied to all sampling locations: (1) those applied in a GIS where relevant data layers were available, accurate, and reliable, and (2) those applied in the field (Figure B-5). As previously mentioned, field evaluation is necessary because the resolution in available GIS data is too imprecise for a determination of the sample-ability or applicability of any given sampling location.

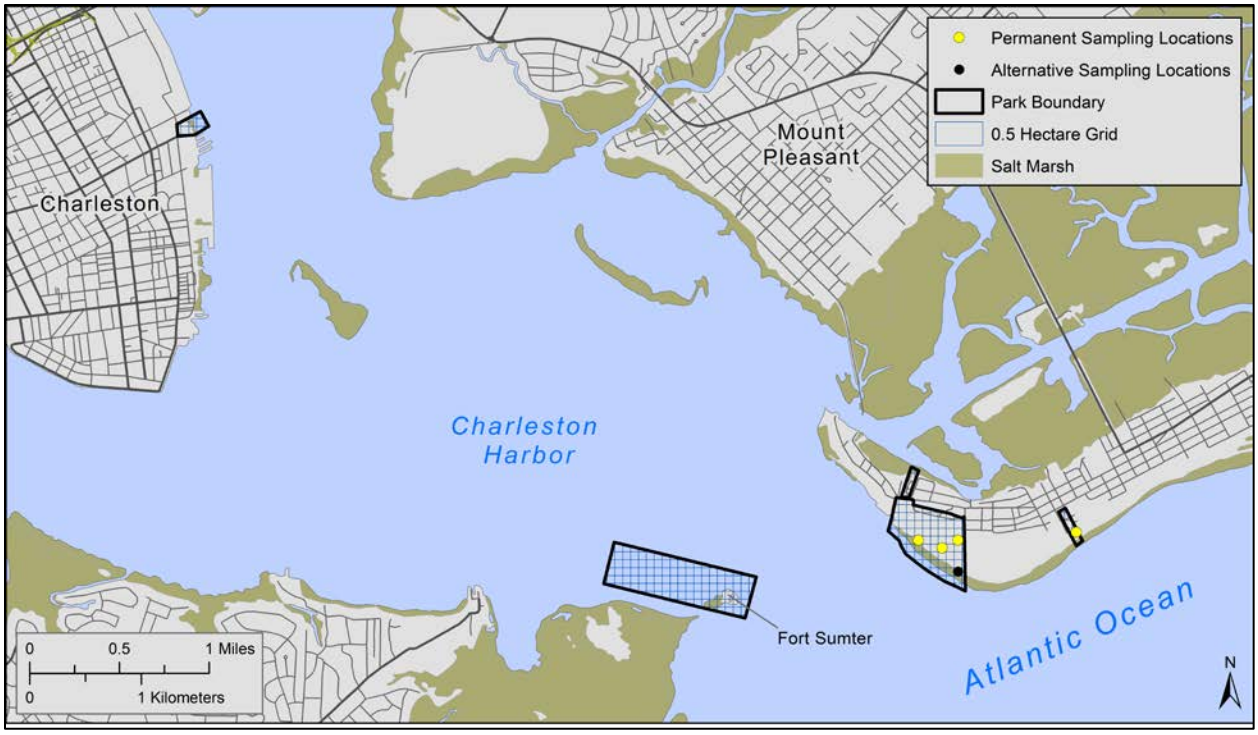


Figure B-5. Example of the hypothetical suite of permanent sampling locations at Fort Sumter National Monument after the application of GIS-based selection criteria. Because of the small size of the park, only one alternate sampling location is available. In this example, potential locations within the sampling frame are omitted because they occur in downtown Charleston and are in 100% non-natural areas (top left park unit) or are in open water (center park unit). The final suite of sampling locations is determined after the field team has travelled to each sampling location and applied the field-based selection criteria.

Sampling locations are evaluated in the sampling order in which they were generated. For example, dune communities are the predominant community at CALO. Although amphibians do not occur in these areas, these areas would not be excluded from the suite of sampling locations at CALO because of their predominance and relative importance to evaluating the overall condition of the park and "health" in dune communities is unlikely to be related to a diverse amphibian community. In this example, the amphibian Vital Sign would simply not be monitored in these areas. Alternatively, a suite of sampling locations that was *only* located in dune ecosystems would also be an unacceptable sample draw; although very unlikely in a spatially-balanced random sample. Third, if a park has delineations or units within its boundary based upon an individual or suite of attributes (i.e., defined management units with different management strategies, different fire-return intervals, different adjacent land use and stressors), sampling locations will be chosen to provide an adequate representation of these units.

Characteristics Evaluated in a GIS

Sampling locations are excluded from the sampling draw if:

- The sampling location is potentially unsafe (i.e., in the middle of a roadway).
- The sampling location occurs in open water.

- The location occurs in marsh or other areas that cannot be sampled without significant impact to the area.
- The entire 0.5-ha plot falls completely within a non-natural area such as a parking lot, building, etc. However, sampling locations that include portions of a park's cultural landscape are retained in the sample draw to adequately characterize the entire spectrum of this Vital Sign on park lands.
- The sampling location occurs on private in-holdings where access is not permitted.
- The sampling location is <200m from another sampling location in large parks (i.e., Cape Hatteras National Seashore [CAHA], Cape Lookout National Seashore [CALO], CANA, Chattahoochee River National Recreation Area [CHAT], Congaree National Park [CONG], Cumberland Island National Seashore [CUIS], Horseshoe Bend National Military Park [HOBE], KEMO, Timucuan Ecological and Historic Preserve [TIMU], Fort Caroline National Memorial [FOCA]), or <150m in small parks (i.e., Fort Frederica National Monument [FOFR], Fort Matanzas National Monument [FOMA], Fort Pulaski National Monument [FOPU], Fort Sumter National Monument [FOSU], Moores Creek National Battlefield [MOCR], Ocmulgee National Monument [OCMU]). This distance was determined based upon the response design of the landbird and amphibian Vital Signs (i.e., observer detection of vocalizations during pilot visual-encounter surveys and VCP counts and automated detection of vocalizations by the ARDs) to avoid double-counting of landbirds and vocal anurans during data collection. Further, this was evaluated through field testing of various vocalizations, observed attenuation of the vocalizations due to the structural effects of vegetation, and the detectable range of the ARDs.

Characteristics Evaluated in the Field

Sampling locations are also excluded in the field if upon inspection:

- The sampling location is potentially unsafe (i.e., high risk of equipment vandalism, crew harassment, unsafe terrain, high number of snags present).
- 100% of the plot cannot be sampled due to impenetrable vegetation, manmade obstructions, or open water or non-natural habitats.
- The GIS used as part of the initial evaluation were of inappropriate resolution or incorrect.

In the event a sampling location is omitted, the first alternate sampling location is selected, the aforementioned criteria are applied, the sampling location is accepted or rejected, and if rejected the next consecutive alternate sampling location is evaluated with the same process.

Temporal Design

The three protocols addressed by this appendix have two temporal design components: within and across years. As previously mentioned, safety of field personnel is paramount. Pre-dawn and nighttime work has been deemed unsafe in SECN parks. The application of ARDs to collect both vocal anuran and landbird detection/non-detection data has remedied many safety concerns, and allowed for a robust within-year sample. Because of the monitoring times necessary to conduct VCPs, where travel to a sampling location often occurs during the dark, and increased safety

concerns in urban SECN parks, VCPs are limited to later times in the day when birds are less vocal/active and could bias results.

The within-year design component of the Vocal Anuran Monitoring Protocol only applies to the vocal anurans, and not members of Caudata (i.e., non-vocal amphibians). Vocal anurans are monitored with ARDs 20 times at each sampling location, except those that occur in saline areas, over a 77-day period. The vegetation community protocols are collected during a single daytime visit; where daytime is defined as post-sunrise and the field crew plans accordingly to return to the vehicle before sunset. The within-year design for landbirds monitored with the ARDs is identical to that of the vocal anurans. Landbirds monitored with the VCP method have two within-year sampling events, separated by approximately four weeks. The vegetation community monitoring protocol has no within-year design component.

Across years, all parks are on a three-year sampling-return interval. Parks are aggregated into annual suites that maintain consistency in travel costs, the number of sampling locations sampled annually, and the relative difficulty of working at particular parks. Table B-1 outlines the number of permanent sampling locations associated with each park (Figures B-6 – B-19) and the annual suites of parks sampled.

Table B-1. Proposed annual monitoring suites of parks, sampling timing, level of difficulty, and the estimated number of permanent sampling locations.

Year	Month	Park	Relative Difficulty	Total Number of Sampling Locations
2014	March	FOMA	Moderate	14
2014	Mar–April	TIMU/FOCA	Difficult	30
2014	April-May	CHAT	Easy	30
2014	May	FOPU	Easy	6
2014	June	CAHA	Difficult	30
2014			***Totals***	***110***
2015	March	CUIS	Difficult	30
2015	April	KEMO	Moderate	30
2015	May	HOBE	Moderate	30
2015	May–June	FOSU	Easy	4
2015	June	CALO	Difficult	30
2015			***Totals***	***124***
2016	Feb	CANA	Difficult	30
2016	March	FOFR	Moderate	10
2016	Mar–April	OCMU	Moderate	22
2016	May	CONG	Difficult	30
2016	June	MOCR	Moderate	11
2016			***Totals***	***104***

Park-specific Sampling Designs

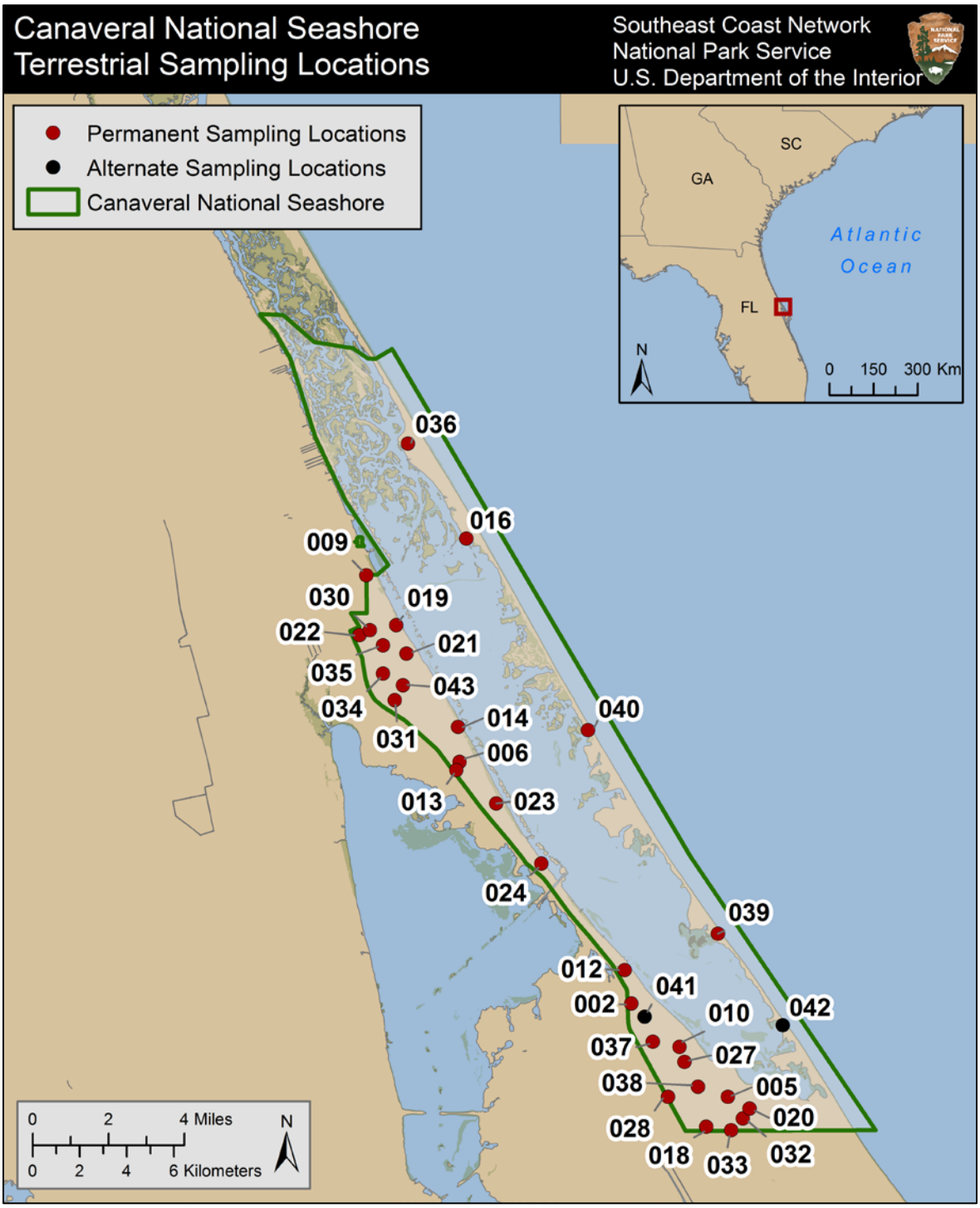


Figure B-6. Permanent sampling locations, and alternates (i.e., over-sample), at Canaveral National Seashore.

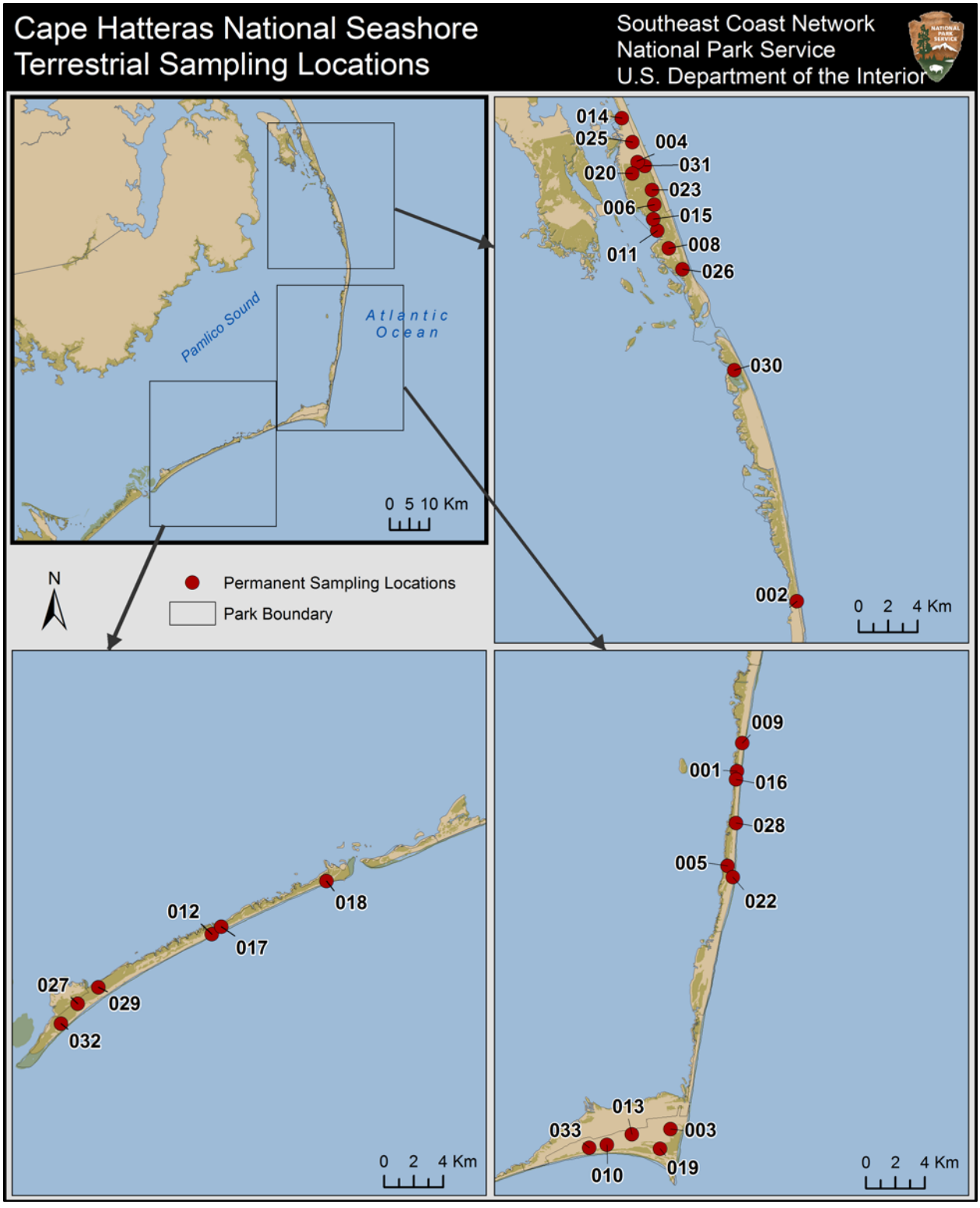


Figure B-7. Permanent sampling locations at Cape Hatteras National Seashore.

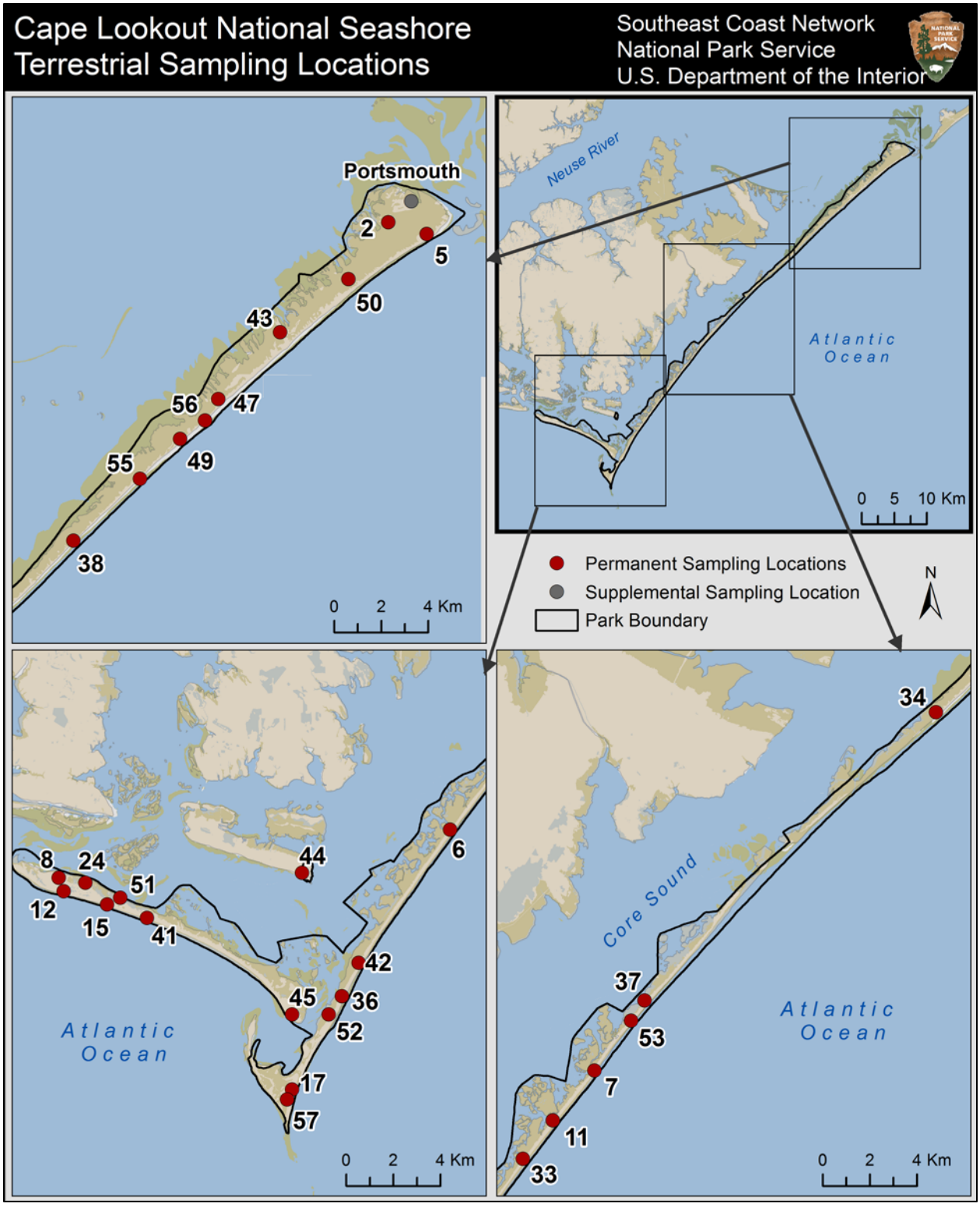


Figure B-8. Permanent sampling locations, and alternates (i.e., over-sample), at Cape Lookout National Seashore. Locations such as 2, 5, and 50 occur in piping plover nesting areas, and no activities will be conducted at these locations without first consulting park management.

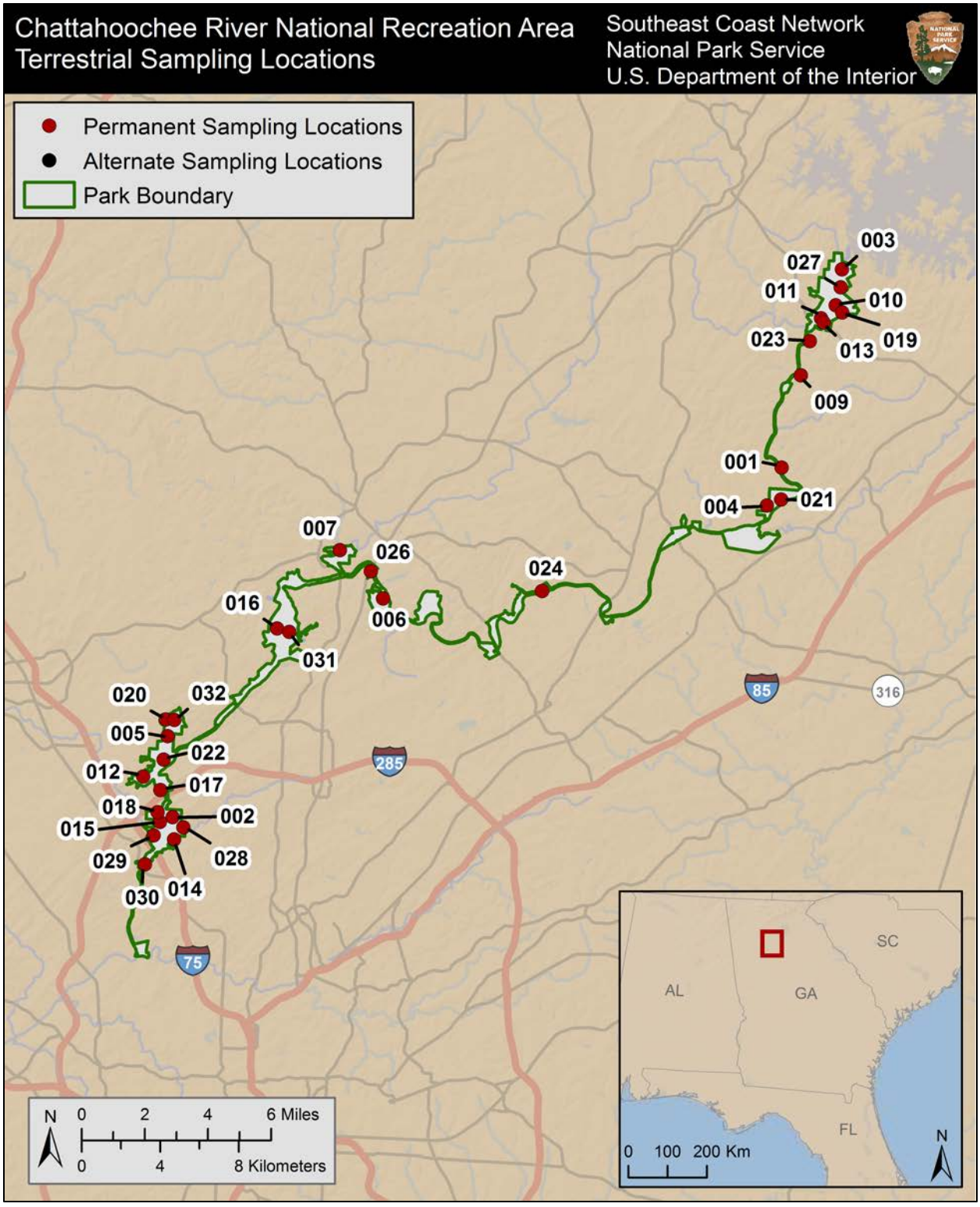


Figure B-9. Permanent sampling locations, and alternates (i.e., over-sample), at Chattahoochee River National Recreation Area.

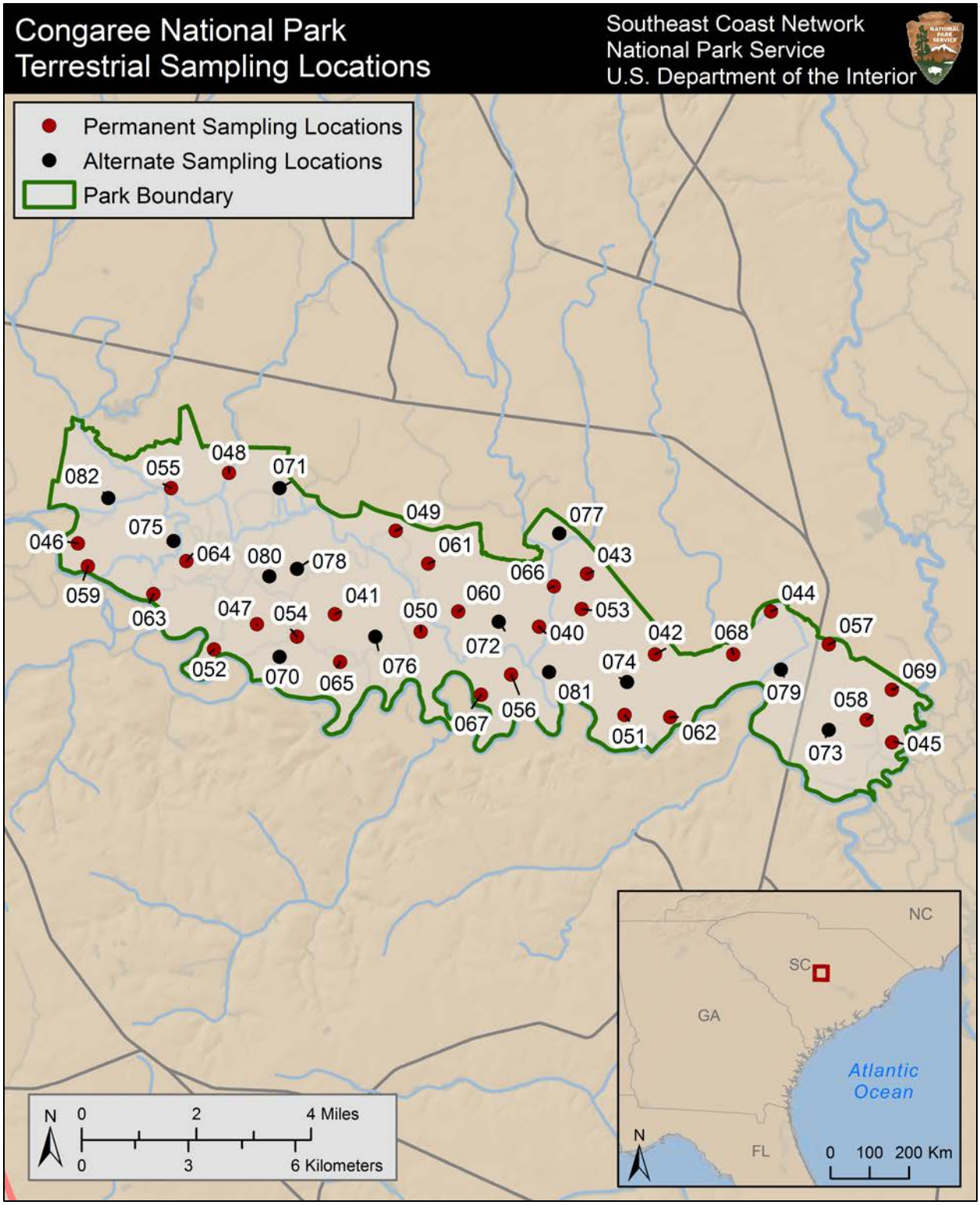


Figure B-10. Permanent sampling locations, and alternates (i.e., over-sample), at Congaree National Park.

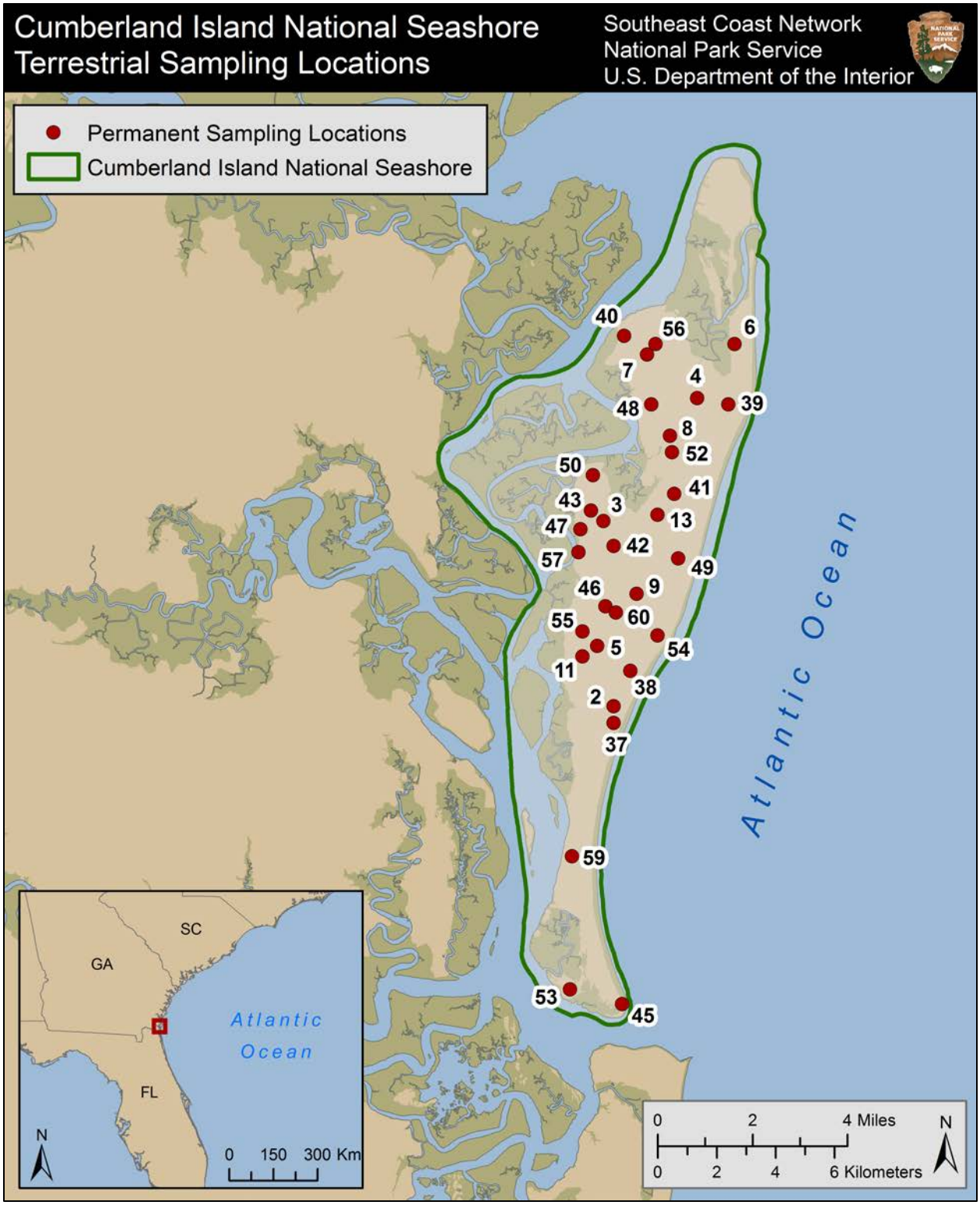


Figure B-11. Permanent sampling locations, and alternates (i.e., over-sample), at Cumberland Island National Seashore.

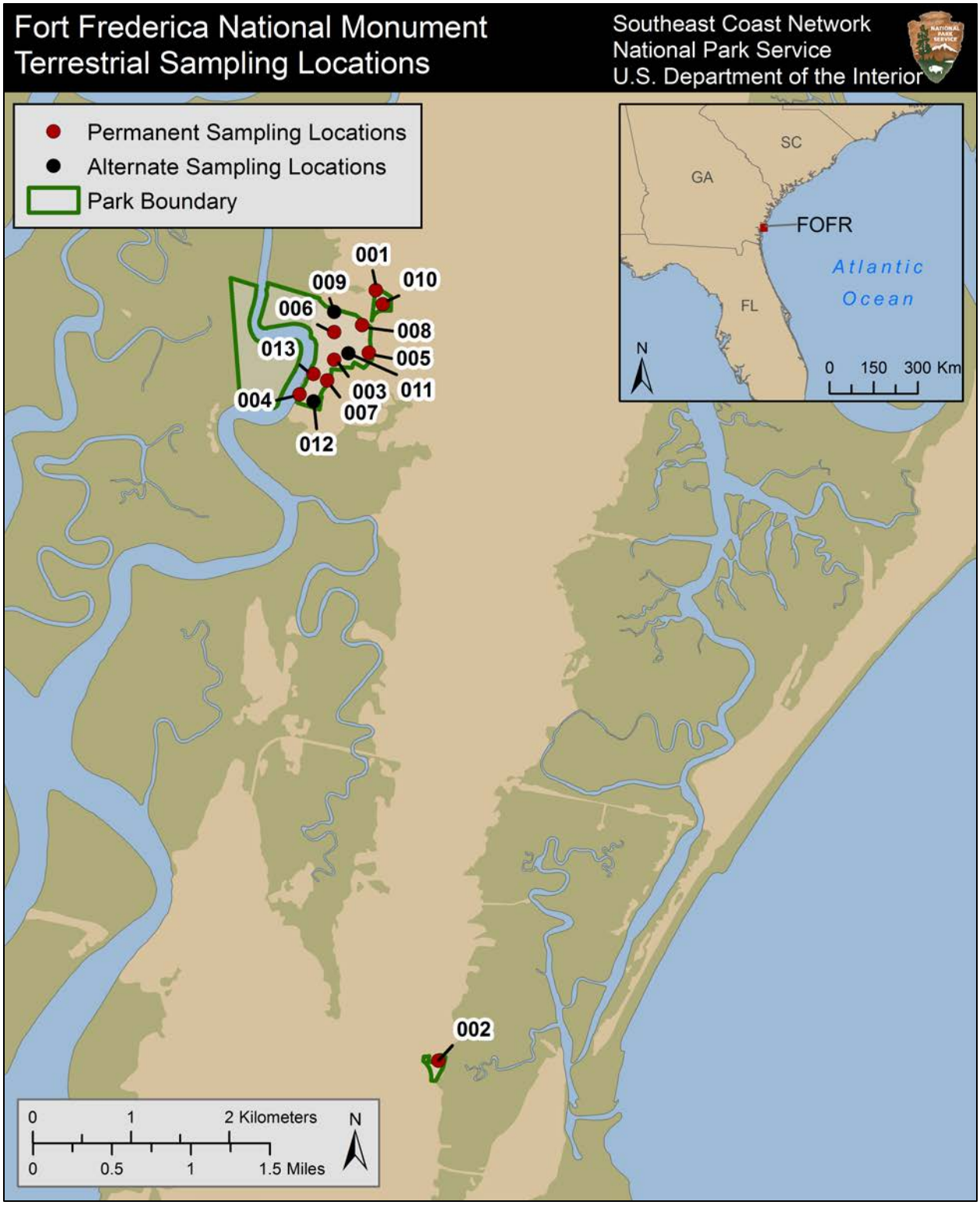


Figure B-12. Permanent sampling locations, and alternates (i.e., over-sample), at Fort Frederica National Monument.

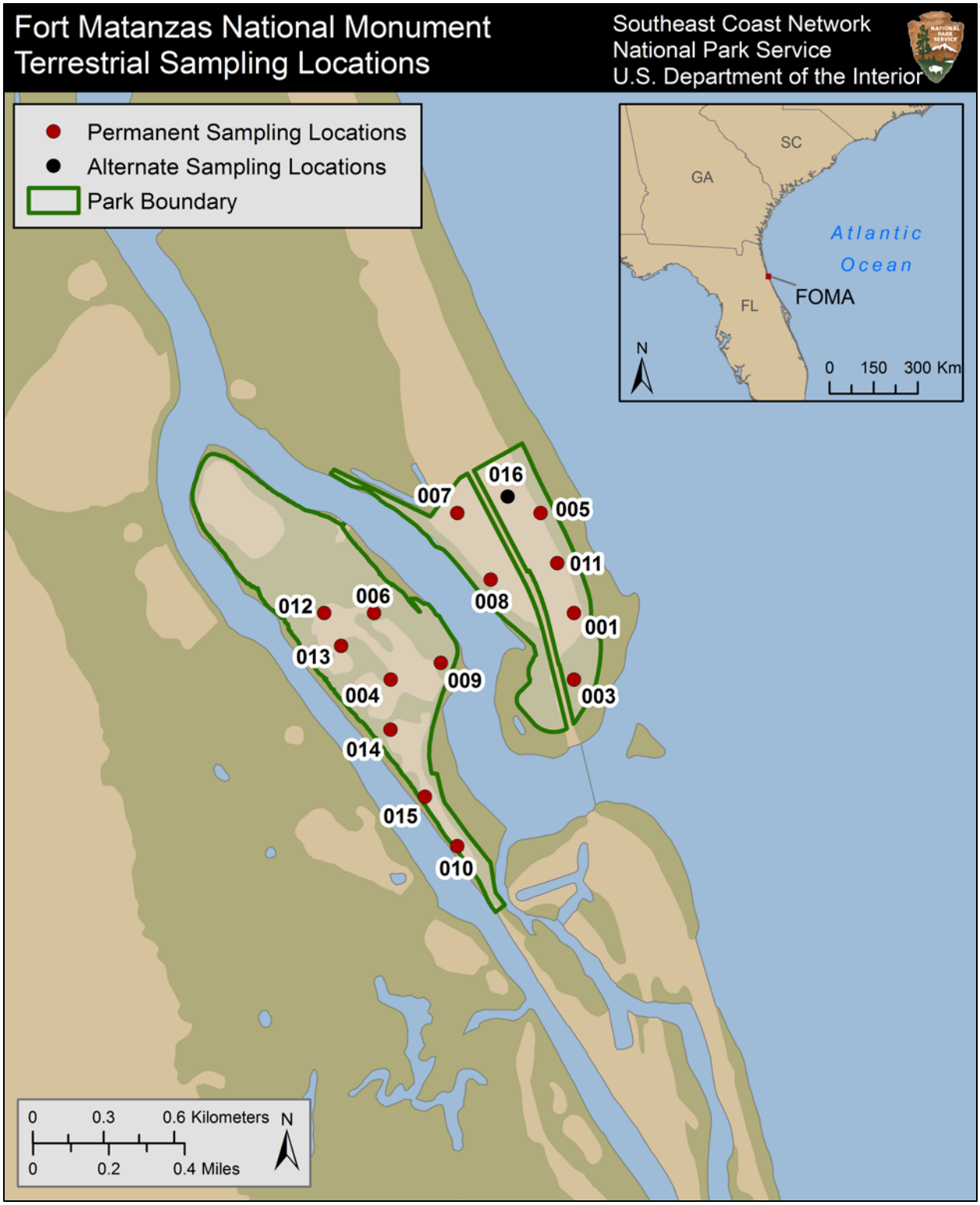


Figure B-13. Permanent sampling locations, and alternates (i.e., over-sample), at Fort Matanzas National Monument.

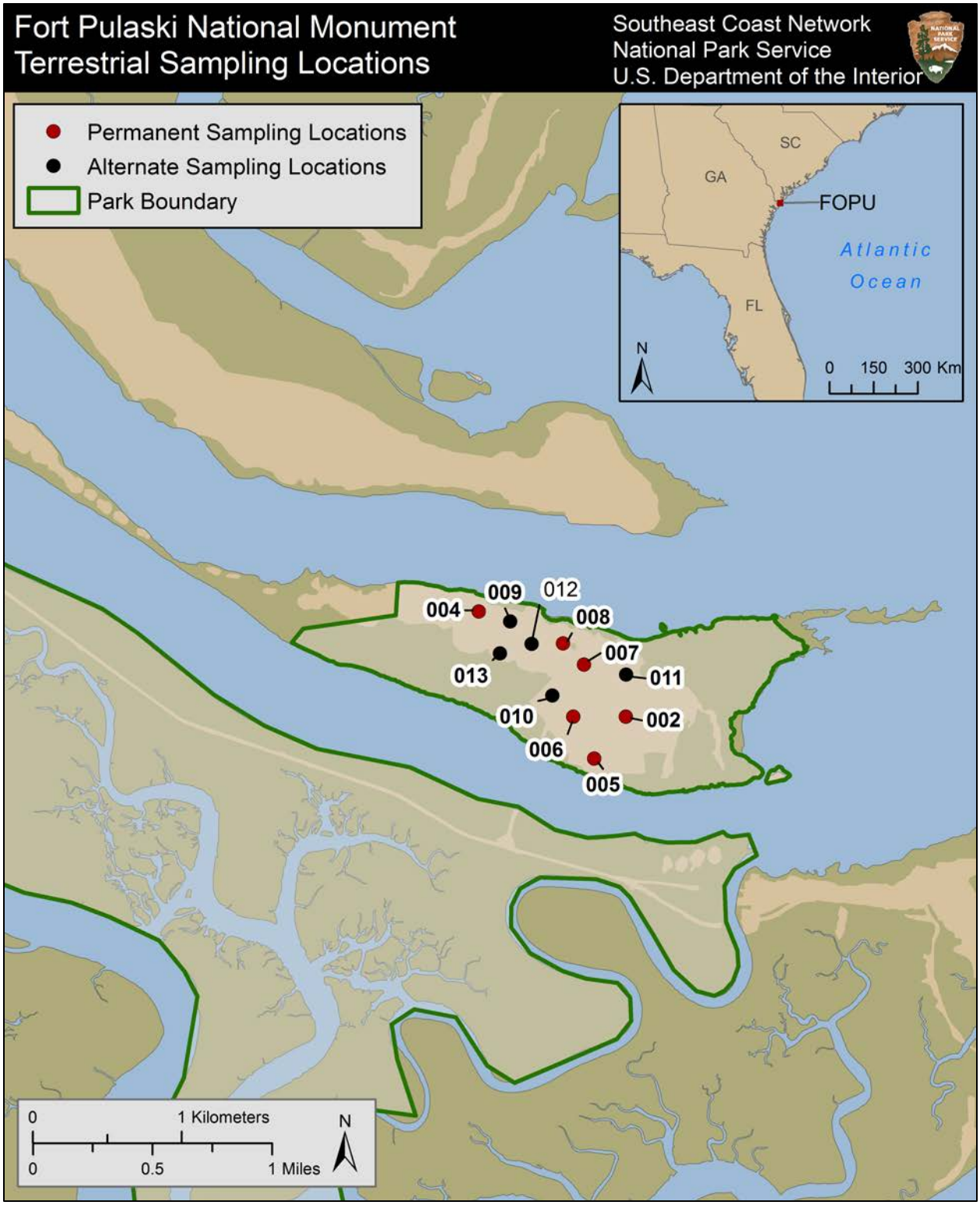


Figure B-14. Permanent sampling locations, and alternates (i.e., over-sample), at Fort Pulaski National Monument.

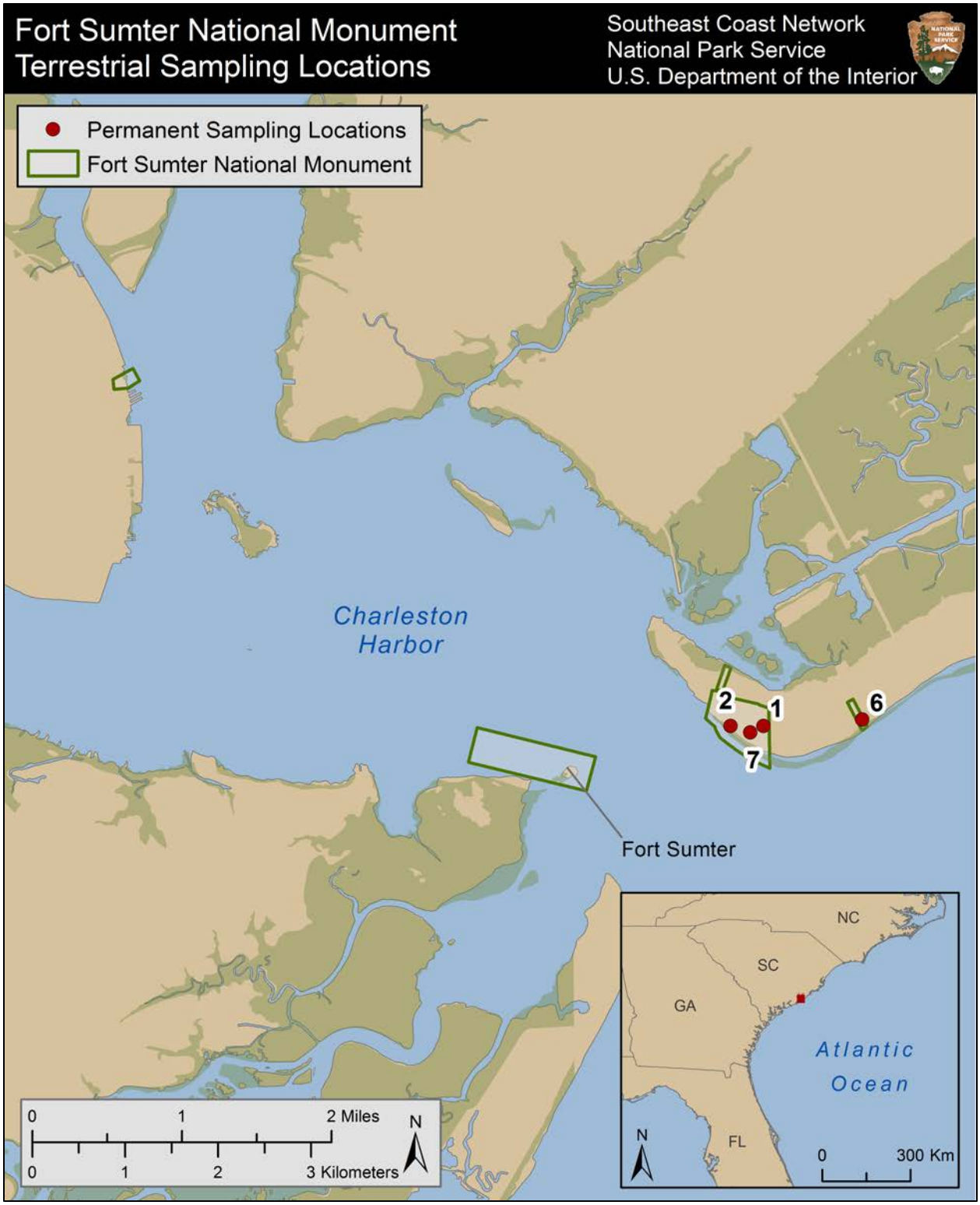


Figure B-15. Permanent sampling locations, and alternates (i.e., over-sample), at Fort Sumter National Monument.

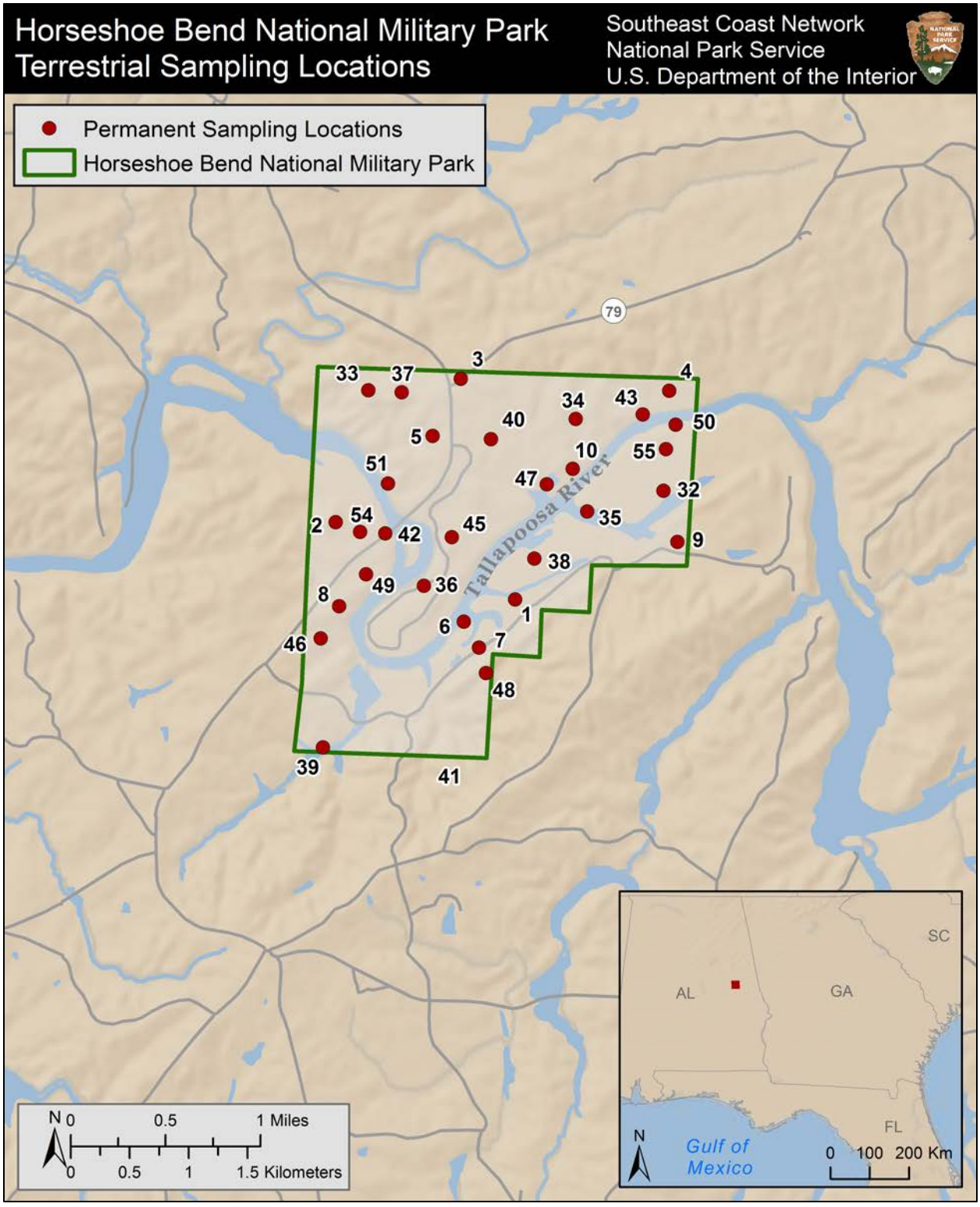


Figure B-16. Permanent sampling locations, and alternates (i.e., over-sample), at Horseshoe Bend National Military Park.

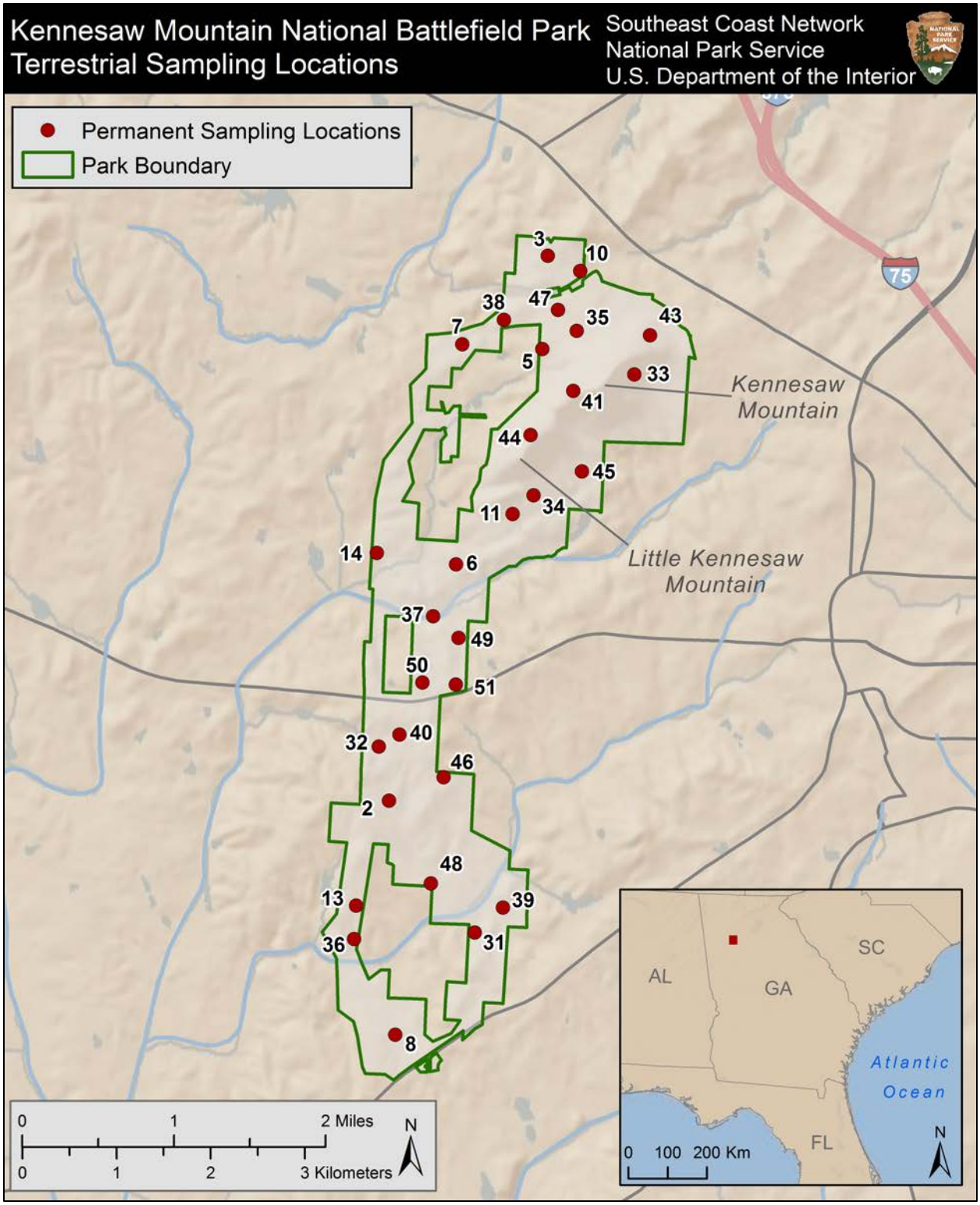


Figure B-17. Permanent sampling locations at Kennesaw Mountain National Battlefield Park.

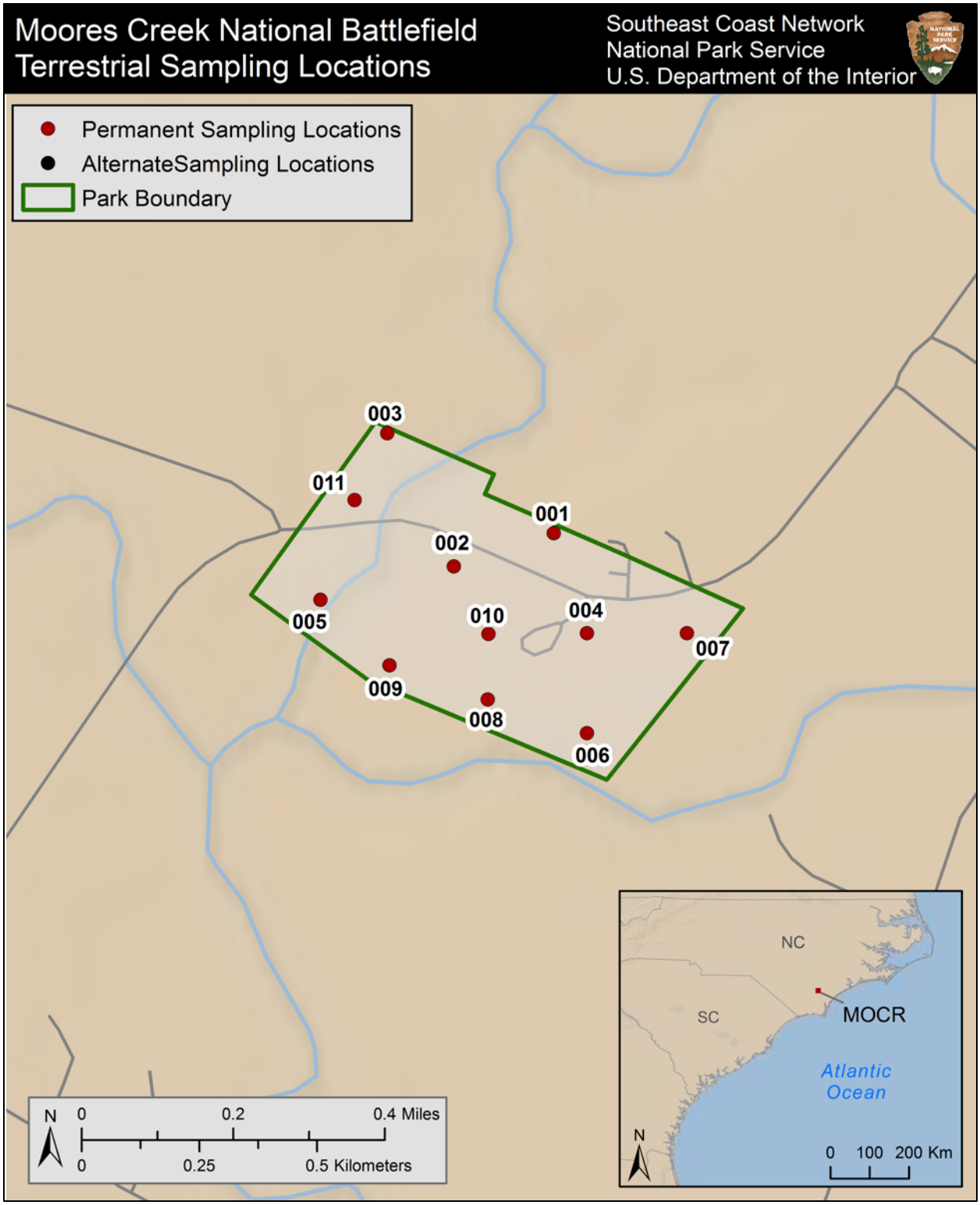


Figure B-18. Permanent sampling locations, and alternates (i.e., over-sample), at Moores Creek National Battlefield.

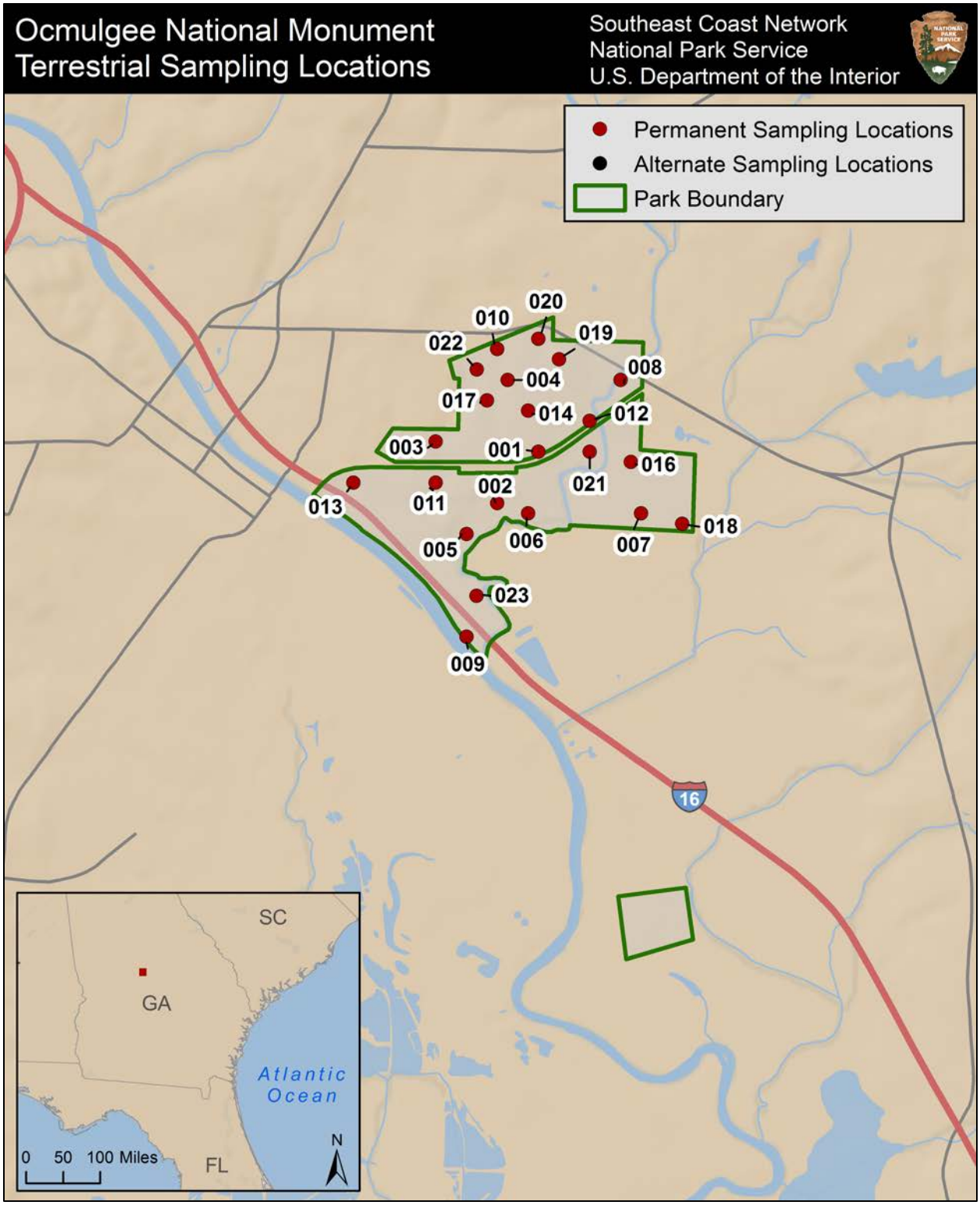


Figure B-19. Permanent sampling locations, and alternates (i.e., over-sample), at Ocmulgee National Monument.

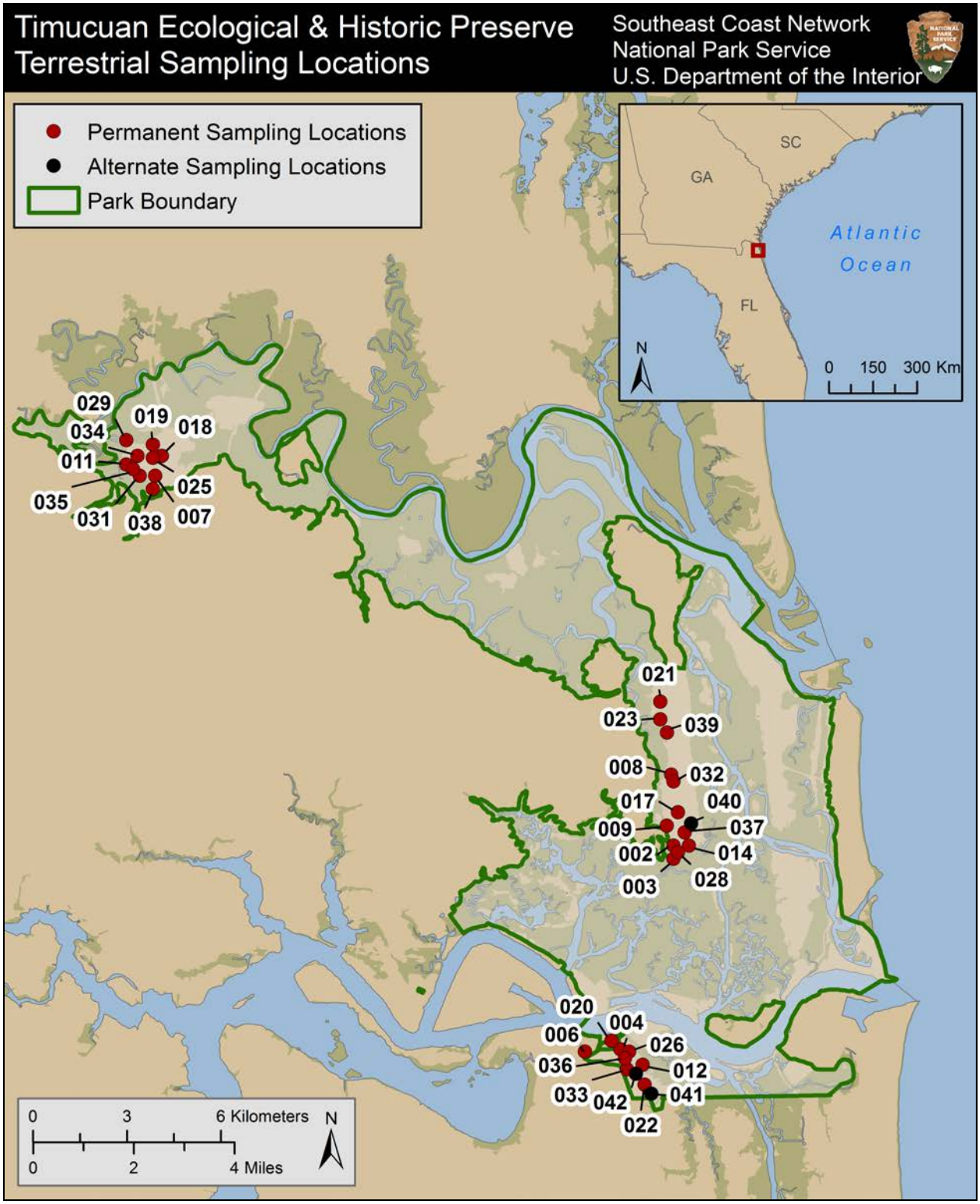


Figure B-20. Permanent sampling locations, and alternates (i.e., over-sample), at Timucuan Ecological and Historic Preserve.

Appendix C. Bird Species Known to Occur in SECN Parks

Table C-1. Bird species known or likely to occur at Canaveral National Seashore. This species list reflects all NPSpecies/IRMA entries and updates through October 2013, and are currently undergoing review and update.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Accipitriformes/Accipitridae				
Accipiter cooperii	Cooper's Hawk	Present	Occasional	Native
Accipiter striatus	Sharp-shinned Hawk	Present	Uncommon	Native
Buteo jamaicensis	Red-tailed Hawk	Present	Common	Native
Buteo lineatus	Red-shouldered Hawk	Present	Common	Native
Buteo platypterus	Broad-winged Hawk	Present	Rare	Native
Buteo swainsoni	Swainson's Hawk	Present	Rare	Native
Circus cyaneus	Northern Harrier	Present	Common	Native
Elanoides forficatus	Swallow-tailed Kite	Present	Occasional	Native
Haliaeetus leucocephalus	Bald Eagle	Present	Uncommon	Native
Accipitriformes/Cathartidae				
Cathartes aura	Turkey Vulture	Present	Common	Native
Coragyps atratus	Black Vulture	Present	Common	Native
Accipitriformes/Pandionidae				
Pandion haliaetus	Osprey	Present	Common	Native
Anseriformes/Anatidae				
Aix sponsa	Wood Duck	Present	Occasional	Native
Anas acuta	Northern Pintail	Present	Common	Native
Anas americana	American Wigeon	Present	Common	Native
Anas clypeata	Northern Shoveler	Present	Common	Native
Anas crecca	Green-winged Teal	Present	Common	Native
Anas discors	Blue-winged Teal	Present	Common	Native
Anas fulvigula	Mottled Duck	Present	Common	Native
Anas penelope	Eurasian Wigeon	Present	Rare	Native
Anas platyrhynchos	Mallard	Present	Rare	Native
Anas rubripes	American Black Duck	Present	Rare	Native
Anas strepera	Gadwall	Present	Uncommon	Native
Aythya affinis	Lesser Scaup	Present	Common	Native
Aythya americana	Redhead	Present	Uncommon	Native
Aythya collaris	Ring-necked Duck	Present	Common	Native
Aythya marila	Greater Scaup	Present	Occasional	Native
Aythya valisineria	Canvasback	Present	Uncommon	Native
Branta bernicla	Brant	Present	Rare	Native
Branta canadensis	Canada Goose	Present	Rare	Native
Bucephala albeola	Bufflehead	Present	Occasional	Native
Bucephala clangula	Common Goldeneye	Present	Rare	Native
Chen caerulescens	Snow Goose	Present	Rare	Native

Table C-1. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Clangula hyemalis	Long-tailed Duck	Present	Rare	Native
Dendrocygna bicolor	Fulvous Whistling-Duck	Present	Occasional	Native
Lophodytes cucullatus	Hooded Merganser	Present	Common	Native
Melanitta fusca	White-winged Scoter	Present	Rare	Native
Melanitta nigra	Black Scoter	Present	Rare	Native
Melanitta perspicillata	Surf Scoter	Present	Rare	Native
Mergus serrator	Red-breasted Merganser	Present	Common	Native
Oxyura jamaicensis	Ruddy Duck	Present	Common	Native
Apodiformes/Apodidae				
Chaetura pelagica	Chimney Swift	Present	Uncommon	Native
Apodiformes/Trochilidae				
Archilochus colubris	Ruby-throated Hummingbird	Present	Occasional	Native
Charadriiformes/Charadriidae				
Charadrius melodus	Piping Plover	Present	Occasional	Native
Charadrius semipalmatus	Semipalmated Plover	Present	Occasional	Native
Charadrius vociferus	Killdeer	Present	Common	Native
Charadrius wilsonia	Wilson's Plover	Present	Occasional	Native
Pluvialis squatarola	Black-bellied Plover	Present	Common	Native
Charadriiformes/Haematopodidae				
Haematopus palliatus	American Oystercatcher	Present	Occasional	Native
Charadriiformes/Laridae				
Chlidonias niger	Black Tern	Present	Uncommon	Native
Larus argentatus	Herring Gull	Present	Common	Native
Larus atricilla	Laughing Gull	Present	Common	Native
Larus delawarensis	Ring-billed Gull	Present	Common	Native
Larus marinus	Great Black-backed Gull	Present	Occasional	Native
Larus philadelphia	Bonaparte’s Gull	Present	Uncommon	Native
Rissa tridactyla	Black-legged Kittiwake	Present	Rare	Native
Rynchops niger	Black Skimmer	Present	Common	Native
Sterna anaethetus	Bridled Tern	Present	Rare	Native
Sterna antillarum	Least Tern	Present	Common	Native
Sterna caspia	Caspian Tern	Present	Common	Native
Sterna dougallii	Roseate Tern	Present	Rare	Native
Sterna forsteri	Forster’s Tern	Present	Common	Native
Sterna fuscata	Sooty Tern	Present	Rare	Native
Sterna hirundo	Common Tern	Present	Rare	Native
Sterna maxima	Royal Tern	Present	Common	Native
Sterna nilotica	Gull-billed Tern	Present	Occasional	Native
Sterna sandvicensis	Sandwich Tern	Present	Occasional	Native

Table C-1. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Charadriiformes/Recurvirostridae				
Himantopus mexicanus	Black-necked Stilt	Present	Uncommon	Native
Recurvirostra americana	American Avocet	Present	Common	Native
Charadriiformes/Scolopacidae				
Actitis macularia	Spotted Sandpiper	Present	Uncommon	Native
Arenaria interpres	Ruddy Turnstone	Present	Common	Native
Bartramia longicauda	Upland Sandpiper	Present	Rare	Native
Calidris alba	Sanderling	Present	Common	Native
Calidris alpina	Dunlin	Present	Common	Native
Calidris canutus	Red Knot	Present	Occasional	Native
Calidris fuscicollis	White-rumped Sandpiper	Present	Rare	Native
Calidris himantopus	Stilt Sandpiper	Present	Occasional	Native
Calidris mauri	Western Sandpiper	Present	Common	Native
Calidris melanotos	Pectoral Sandpiper	Present	Rare	Native
Calidris minutilla	Least Sandpiper	Present	Common	Native
Calidris pusilla	Semipalmated Sandpiper	Present	Common	Native
Catoptrophorus semipalmatus	Willet	Present	Common	Native
Gallinago gallinago	Common Snipe	Present	Uncommon	Native
Limnodromus griseus	Short-billed Dowitcher	Present	Common	Native
Limosa fedoa	Marbled Godwit	Present	Occasional	Native
Numenius americanus	Long-billed Curlew	Present	Rare	Native
Numenius phaeopus	Whimbrel	Present	Occasional	Native
Phalaropus lobatus	Red-necked Phalarope	Present	Rare	Native
Phalaropus tricolor	Wilson's Phalarope	Present	Rare	Native
Scolopax minor	American Woodcock	Present	Rare	Native
Tringa flavipes	Lesser Yellowlegs	Present	Common	Native
Tringa melanoleuca	Greater Yellowlegs	Present	Common	Native
Tringa solitaria	Solitary Sandpiper	Present	Occasional	Native
Charadriiformes/Stercorariidae				
Stercorarius parasiticus	Parasitic Jaeger	Present	Rare	Native
Stercorarius pomarinus	Pomarine Jaeger	Present	Occasional	Native
Ciconiiformes/Ciconiidae				
Mycteria americana	Wood Stork	Present	Common	Native
Columbiformes/Columbidae				
Columba livia	Rock Dove	Present	Uncommon	Non-native
Columbina passerina	Common Ground-dove	Present	Common	Native
Zenaida macroura	Mourning Dove	Present	Common	Native
Coraciiformes/Alcedinidae				
Ceryle alcyon	Belted Kingfisher	Present	Common	Native

Table C-1. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Cuculiformes/Cuculidae				
Coccyzus americanus	Yellow-billed Cuckoo	Present	Occasional	Native
Coccyzus erythropthalmus	Black-billed Cuckoo	Present	Rare	Native
Crotophaga ani	Smooth-billed Ani	Present	Rare	Native
Falconiformes/Falconidae				
Falco columbarius	Merlin	Present	Occasional	Native
Falco peregrinus	Peregrine Falcon	Present	Occasional	Native
Falco sparverius	American Kestrel	Present	Common	Native
Galliformes/Odontophoridae				
Colinus virginianus	Northern Bobwhite	Present	Common	Native
Galliformes/Phasianidae				
Meleagris gallopavo	Wild Turkey	Present	Occasional	Native
Gaviiformes/Gaviidae				
Gavia immer	Common Loon	Present	Uncommon	Native
Gavia stellata	Red-throated Loon	Present	Rare	Native
Gruiformes/Aramidae				
Aramus guarauna	Limpkin	Present	Rare	Native
Gruiformes/Rallidae				
Fulica americana	American Coot	Present	Common	Native
Gallinula chloropus	Common Moorhen	Present	Common	Native
Laterallus jamaicensis	Black Rail	Present	Rare	Native
Porzana carolina	Sora	Present	Uncommon	Native
Rallus elegans	King Rail	Present	Occasional	Native
Rallus limicola	Virginia Rail	Present	Rare	Native
Rallus longirostris	Clapper Rail	Present	Occasional	Native
Passeriformes/Bombycillidae				
Bombycilla cedrorum	Cedar Waxwing	Present	Occasional	Native
Passeriformes/Cardinalidae				
Cardinalis cardinalis	Northern Cardinal	Present	Common	Native
Guiraca caerulea	Blue Grosbeak	Present	Occasional	Native
Passerina ciris	Painted Bunting	Present	Occasional	Native
Passerina cyanea	Indigo Bunting	Present	Occasional	Native
Pheucticus ludovicianus	Rose-breasted Grosbeak	Present	Occasional	Native
Spiza americana	Dickcissel	Present	Rare	Native
Passeriformes/Certhiidae				
Polioptila caerulea	Blue-gray Gnatcatcher	Present	Rare	Native
Passeriformes/Corvidae				
Aphelocoma coerulescens	Florida Scrub-jay	Present	Common	Native

Table C-1. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Corvus ossifragus	Fish Crow	Present	Common	Native
Cyanocitta cristata	Blue Jay	Present	Common	Native
Passeriformes/Emberizidae				
Aimophila aestivalis	Bachman's Sparrow	Present	Rare	Native
Ammodramus caudacutus	Saltmarsh Sharp-tailed Sparrow	Present	Occasional	Native
Ammodramus henslowii	Henslow's Sparrow	Present	Rare	Native
Ammodramus maritimus	Seaside Sparrow	Present	Occasional	Native
Ammodramus savannarum	Grasshopper Sparrow	Present	Occasional	Native
Chondestes grammacus	Lark Sparrow	Present	Rare	Native
Melospiza georgiana	Swamp Sparrow	Present	Common	Native
Melospiza lincolnii	Lincoln's Sparrow	Present	Rare	Native
Melospiza melodia	Song Sparrow	Present	Occasional	Native
Passerculus sandwichensis	Savannah Sparrow	Present	Common	Native
Passerella iliaca	Fox Sparrow	Present	Rare	Native
Pipilo erythrophthalmus	Eastern Towhee	Present	Common	Native
Pooecetes gramineus	Vesper Sparrow	Present	Rare	Native
Spizella passerina	Chipping Sparrow	Present	Occasional	Native
Spizella pusilla	Field Sparrow	Present	Rare	Native
Zonotrichia albicollis	White-throated Sparrow	Present	Rare	Native
Passeriformes/Fringillidae				
Carduelis pinus	Pine Siskin	Present	Rare	Native
Carduelis tristis	American Goldfinch	Present	Uncommon	Native
Passeriformes/Hirundinidae				
Hirundo rustica	Barn Swallow	Present	Common	Native
Petrochelidon pyrrhonota	Cliff Swallow	Present	Occasional	Native
Progne subis	Purple Martin	Present	Uncommon	Native
Riparia riparia	Bank Swallow	Present	Occasional	Native
Stelgidopteryx serripennis	Northern Rough-winged Swallow	Present	Occasional	Native
Tachycineta bicolor	Tree Swallow	Present	Common	Native
Passeriformes/Icteridae				
Agelaius phoeniceus	Red-winged Blackbird	Present	Common	Native
Dolichonyx oryzivorus	Bobolink	Present	Uncommon	Native
Euphagus carolinus	Rusty Blackbird	Present	Rare	Native
Icterus galbula	Baltimore, Oriole, Northern Oriole	Present	Occasional	Native
Icterus spurius	Orchard Oriole	Present	Rare	Native
Molothrus ater	Brown-headed Cowbird	Present	Uncommon	Native
Quiscalus major	Boat-tailed Grackle	Present	Common	Native

Table C-1. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Quiscalus quiscula	Common Grackle	Present	Common	Native
Sturnella magna	Eastern Meadowlark	Present	Common	Native
Passeriformes/Laniidae				
Lanius ludovicianus	Loggerhead Shrike	Present	Uncommon	Native
Passeriformes/Mimidae				
Dumetella carolinensis	Gray Catbird	Present	Common	Native
Mimus polyglottos	Northern Mockingbird	Present	Common	Native
Toxostoma rufum	Brown Thrasher	Present	Occasional	Native
Passeriformes/Motacillidae				
Anthus rubescens	American Pipit	Present	Rare	Native
Passeriformes/Paridae				
Baeolophus bicolor	Tufted Titmouse	Present	Occasional	Native
Passeriformes/Parulidae				
Dendroica caerulescens	Black-throated Blue Warbler	Present	Uncommon	Native
Dendroica castanea	Bay-breasted Warbler	Present	Rare	Native
Dendroica coronata	Yellow-rumped Warbler	Present	Common	Native
Dendroica discolor	Prairie Warbler	Present	Uncommon	Native
Dendroica dominica	Yellow-throated Warbler	Present	Occasional	Native
Dendroica fusca	Blackburnian Warbler	Present	Occasional	Native
Dendroica magnolia	Magnolia Warbler	Present	Occasional	Native
Dendroica palmarum	Palm Warbler	Present	Common	Native
Dendroica pensylvanica	Chestnut-sided Warbler	Present	Occasional	Native
Dendroica petechia	Yellow Warbler	Present	Occasional	Native
Dendroica pinus	Pine Warbler	Present	Occasional	Native
Dendroica striata	Blackpoll Warbler	Present	Uncommon	Native
Dendroica tigrina	Cape May Warbler	Present	Uncommon	Native
Dendroica virens	Black-throated Green Warbler	Present	Occasional	Native
Geothlypis trichas	Common Yellowthroat	Present	Common	Native
Helmitheros vermivorus	Worm-eating Warbler	Present	Occasional	Native
Icteria virens	Yellow-breasted Chat	Present	Rare	Native
Limnothlypis swainsonii	Swainson's Warbler	Present	Rare	Native
Mniotilta varia	Black-and-white Warbler	Present	Common	Native
Oporornis agilis	Connecticut Warbler	Present	Rare	Native
Oporornis formosus	Kentucky Warbler	Present	Rare	Native
Parula americana	Northern Parula	Present	Occasional	Native
Protonotaria citrea	Prothonotary Warbler	Present	Occasional	Native
Seiurus aurocapillus	Ovenbird	Present	Uncommon	Native
Seiurus motacilla	Louisiana Waterthrush	Present	Rare	Native

Table C-1. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Seiurus noveboracensis	Northern Waterthrush	Present	Uncommon	Native
Setophaga ruticilla	American Redstart	Present	Uncommon	Native
Vermivora celata	Orange-crowned Warbler	Present	Occasional	Native
Vermivora chrysoptera	Golden-winged Warbler	Present	Rare	Native
Vermivora peregrina	Tennessee Warbler	Present	Occasional	Native
Vermivora pinus	Blue-winged Warbler	Present	Occasional	Native
Vermivora ruficapilla	Nashville Warbler	Present	Rare	Native
Wilsonia citrina	Hooded Warbler	Present	Occasional	Native
Wilsonia pusilla	Wilson's Warbler	Present	Rare	Native
Passeriformes/Passeridae				
Passer domesticus	House Sparrow	Present	Common	Non-native
Passeriformes/Regulidae				
Regulus calendula	Ruby-crowned Kinglet	Present	Occasional	Native
Passeriformes/Sturnidae				
Sturnus vulgaris	European Starling	Present	Common	Non-native
Passeriformes/Thraupidae				
Piranga olivacea	Scarlet Tanager	Present	Occasional	Native
Piranga rubra	Summer Tanager	Present	Occasional	Native
Passeriformes/Troglodytidae				
Cistothorus palustris	Marsh Wren	Present	Occasional	Native
Cistothorus platensis	Sedge Wren	Present	Uncommon	Native
Thryothorus ludovicianus	Carolina Wren	Present	Common	Native
Troglodytes aedon	House Wren	Present	Common	Native
Passeriformes/Turdidae				
Catharus fuscescens	Veery	Present	Occasional	Native
Catharus guttatus	Hermit Thrush	Present	Occasional	Native
Catharus minimus	Gray-cheeked Thrush	Present	Occasional	Native
Catharus ustulatus	Swainson's Thrush	Present	Occasional	Native
Hylocichla mustelina	Wood Thrush	Present	Rare	Native
Turdus migratorius	American Robin	Present	Common	Native
Passeriformes/Tyrannidae				
Empidonax alnorum	Alder Flycatcher	Present	Rare	Native
Empidonax minimus	Least Flycatcher	Present	Rare	Native
Empidonax virescens	Acadian Flycatcher	Present	Rare	Native
Myiarchus crinitus	Great Crested Flycatcher	Present	Uncommon	Native
Sayornis phoebe	Eastern Phoebe	Present	Common	Native
Tyrannus dominicensis	Gray Kingbird	Present	Occasional	Native
Tyrannus tyrannus	Eastern Kingbird	Present	Uncommon	Native

Table C-1. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Tyrannus verticalis	Western Kingbird	Present	Rare	Native
Passeriformes/Vireonidae				
Vireo altiloquus	Black-whiskered Vireo	Present	Uncommon	Native
Vireo flavifrons	Yellow-throated Vireo	Present	Uncommon	Native
Vireo griseus	White-eyed Vireo	Present	Common	Native
Vireo olivaceus	Red-eyed Vireo	Present	Occasional	Native
Vireo solitarius	Blue-headed Vireo	Present	Occasional	Native
Pelecaniformes/Ardeidae				
Ardea alba	Great Egret	Present	Common	Native
Ardea herodias	Great Blue Heron	Present	Common	Native
Botaurus lentiginosus	American Bittern	Present	Occasional	Native
Bubulcus ibis	Cattle Egret	Present	Common	Native
Butorides virescens	Green Heron	Present	Common	Native
Egretta caerulea	Little Blue Heron	Present	Common	Native
Egretta rufescens	Reddish Egret	Present	Uncommon	Native
Egretta thula	Snowy Egret	Present	Common	Native
Egretta tricolor	Tricolored Heron	Present	Common	Native
Ixobrychus exilis	Least Bittern	Present	Uncommon	Native
Nyctanassa violacea	Yellow-crowned Night-heron	Present	Occasional	Native
Nycticorax nycticorax	Black-crowned Night-heron	Present	Common	Native
Pelecaniformes/Pelecanidae				
Pelecanus erythrorhynchos	American White Pelican	Present	Uncommon	Native
Pelecanus occidentalis	Brown Pelican	Present	Common	Native
Pelecaniformes/Threskiornithidae				
Eudocimus albus	White Ibis	Present	Common	Native
Platalea ajaja	Roseate Spoonbill	Present	Uncommon	Native
Plegadis falcinellus	Glossy Ibis	Present	Common	Native
Phoenicopteriformes/Phoenicopteridae				
Phoenicopterus ruber	Greater Flamingo	Present	Occasional	Native
Piciformes/Picidae				
Colaptes auratus	Northern Flicker	Present	Uncommon	Native
Dryocopus pileatus	Pileated Woodpecker	Present	Uncommon	Native
Melanerpes carolinus	Red-bellied Woodpecker	Present	Common	Native
Melanerpes erythrocephalus	Red-headed Woodpecker	Present	Rare	Native
Picoides pubescens	Downy Woodpecker	Present	Uncommon	Native
Picoides villosus	Hairy Woodpecker	Present	Rare	Native
Sphyrapicus varius	Yellow-bellied Sapsucker	Present	Uncommon	Native

Table C-1. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Podicipediformes/Podicipedidae				
Podiceps auritus	Horned Grebe	Present	Common	Native
Podilymbus podiceps	Pied-billed Grebe	Present	Common	Native
Procellariiformes/Hydrobatidae				
Oceanites oceanicus	Wilson's Storm-petrel	Present	Rare	Native
Procellariiformes/Procellariidae				
Puffinus gravis	Greater Shearwater	Present	Rare	Native
Puffinus lherminieri	Audubon’s Shearwater	Present	Rare	Native
Strigiformes/Caprimulgidae				
Caprimulgus carolinensis	Chuck-will's-widow	Present	Common	Native
Caprimulgus vociferus	Whip-poor-will	Present	Rare	Native
Chordeiles minor	Common Nighthawk	Present	Common	Native
Strigiformes/Strigidae				
Asio flammeus	Short-eared Owl	Present	Occasional	Native
Bubo virginianus	Great Horned Owl	Present	Uncommon	Native
Megascops asio	Eastern Screech Owl	Present	Common	Native
Strix varia	Barred Owl	Present	Occasional	Native
Strigiformes/Tytonidae				
Tyto alba	Barn Owl	Present	Occasional	Native
Suliformes/Anhingidae				
Anhinga anhinga	Anhinga	Present	Common	Native
Suliformes/Fregatidae				
Fregata magnificens	Magnificent Frigatebird	Present	Rare	Native
Suliformes/Phalacrocoracidae				
Phalacrocorax auritus	Double-crested Cormorant	Present	Common	Native
Suliformes/Sulidae				
Morus bassanus	Northern Gannet	Present	Uncommon	Native

Table C-2. Bird species known or likely to occur at Cape Hatteras National Seashore. This species list reflects all NPSpecies/IRMA entries and updates through October 2013, and are currently undergoing review and update.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Accipitriformes/Accipitridae				
Accipiter cooperii	Cooper's Hawk	Present	Occasional	Native
Accipiter striatus	Sharp-shinned Hawk	Present	Common	Native
Aquila chrysaetos	Golden Eagle	Present	Occasional	Native
Buteo jamaicensis	Red-tailed Hawk	Present	Uncommon	Native
Buteo lagopus	Rough-legged Hawk	Present	Rare	Native
Buteo lineatus	Red-shouldered Hawk	Present	Common	Native
Buteo platypterus	Broad-winged Hawk	Present	Rare	Native
Buteo swainsoni	Swainson's Hawk	Present	Occasional	Native
Circus cyaneus	Northern Harrier	Present	Common	Native
Elanoides forficatus	American Swallow-tailed Kite	Present	Rare	Native
Haliaeetus leucocephalus	Bald Eagle	Present	Rare	Native
Ictinia mississippiensis	Mississippi Kite	Present	Occasional	Native
Accipitriformes/Cathartidae				
Cathartes aura	Turkey Vulture	Present	Rare	Native
Coragyps atratus	Black Vulture	Present	Occasional	Native
Accipitriformes/Pandionidae				
Pandion haliaetus	Osprey	Present	Common	Native
Anseriformes/Anatidae				
Aix sponsa	Wood Duck	Present	Uncommon	Native
Anas acuta	Northern Pintail	Present	Common	Native
Anas americana	American Wigeon	Present	Common	Native
Anas clypeata	Northern Shoveler	Present	Common	Native
Anas crecca	Green-winged Teal	Present	Common	Native
Anas discors	Blue-winged Teal	Present	Uncommon	Native
Anas penelope	Eurasian Wigeon	Present	Occasional	Native
Anas platyrhynchos	Mallard	Present	Common	Native
Anas rubripes	American Black Duck	Present	Common	Native
Anas strepera	Gadwall	Present	Common	Native
Anser albifrons	Greater White-fronted Goose	Present	Occasional	Native
Aythya affinis	Lesser Scaup	Present	Uncommon	Native
Aythya americana	Redhead	Present	Common	Native
Aythya collaris	Ring-necked Duck	Present	Common	Native
Aythya marila	Greater Scaup	Present	Uncommon	Native
Aythya valisineria	Canvasback	Present	Common	Native
Branta bernicla	Brant	Present	Common	Native
Branta canadensis	Canada Goose	Present	Common	Native

Table C-2. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Bucephala albeola	Bufflehead	Present	Common	Native
Bucephala clangula	Common Goldeneye	Present	Uncommon	Native
Chen caerulescens	Snow Goose	Present	Occasional	Native
Chen rossii	Ross's Goose	Present	Rare	Native
Clangula hyemalis	Oldsquaw	Present	Uncommon	Native
Cygnus columbianus	Tundra Swan	Present	Occasional	Native
Cygnus olor	Mute Swan	Present	Occasional	Native
Dendrocygna bicolor	Fulvous Whistling-Duck	Present	Occasional	Native
Histrionicus histrionicus	Harlequin Duck	Present	Occasional	Native
Lophodytes cucullatus	Hooded Merganser	Present	Common	Native
Melanitta fusca	White-winged Scoter	Present	Uncommon	Native
Melanitta nigra	Black Scoter	Present	Common	Native
Melanitta perspicillata	Surf Scoter	Present	Common	Native
Mergus merganser	Common Merganser	Present	Rare	Native
Mergus serrator	Red-breasted Merganser	Present	Common	Native
Oxyura jamaicensis	Ruddy Duck	Present	Unknown	Native
Somateria mollissima	Common Eider	Present	Occasional	Native
Somateria spectabilis	King Eider	Present	Occasional	Native
Apodiformes/Apodidae				
Chaetura pelagica	Chimney Swift	Present	Common	Native
Apodiformes/Trochilidae				
Archilochus colubris	Ruby-throated Hummingbird	Present	Uncommon	Native
Charadriiformes/Alcidae				
Alca torda	Razorbill	Present	Rare	Native
Alle alle	Dovekie	Present	Rare	Native
Uria lomvia	Thick-billed Murre	Present	Occasional	Native
Charadriiformes/Charadriidae				
Charadrius melodus	Piping Plover	Present	Uncommon	Native
Charadrius semipalmatus	Semipalmated Plover	Present	Common	Native
Charadrius vociferus	Killdeer	Present	Uncommon	Native
Charadrius wilsonia	Wilson's Plover	Present	Uncommon	Native
Pluvialis dominica	American Golden Plover	Present	Rare	Native
Pluvialis squatarola	Black-bellied Plover	Present	Uncommon	Native
Charadriiformes/Haematopodidae				
Haematopus palliatus	American Oystercatcher	Present	Common	Native
Charadriiformes/Laridae				
Anous stolidus	Brown Noddy	Present	Occasional	Native
Chlidonias niger	Black Tern	Present	Rare	Native
Larus argentatus	Herring Gull	Present	Common	Native

Table C-2. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Larus atricilla	Laughing Gull	Present	Common	Native
Larus canus	Mew Gull	Present	Occasional	Native
Larus delawarensis	Ring-billed Gull	Present	Common	Native
Larus fuscus	Lesser Black-backed Gull	Present	Occasional	Native
Larus glaucoides	Iceland Gull	Present	Occasional	Native
Larus hyperboreus	Glaucous Gull	Present	Occasional	Native
Larus marinus	Great Black-backed Gull	Present	Common	Native
Larus minutus	Little Gull	Present	Occasional	Native
Larus philadelphia	Bonaparte’s Gull	Present	Common	Native
Larus pipixcan	Franklin's Gull	Present	Occasional	Native
Larus ridibundus	Black-headed Gull	Present	Rare	Native
Larus thayeri	Thayer's Gull	Present	Occasional	Native
Rissa tridactyla	Black-legged Kittiwake	Present	Uncommon	Native
Rynchops niger	Black Skimmer	Present	Common	Native
Sterna anaethetus	Bridled Tern	Present	Common	Native
Sterna antillarum	Least Tern	Present	Common	Native
Sterna caspia	Caspian Tern	Present	Uncommon	Native
Sterna dougallii	Roseate Tern	Present	Rare	Native
Sterna forsteri	Forster's Tern	Present	Common	Native
Sterna fuscata	Sooty Tern	Present	Uncommon	Native
Sterna hirundo	Common Tern	Present	Common	Native
Sterna maxima	Royal Tern	Present	Common	Native
Sterna nilotica	Gull-billed Tern	Present	Common	Native
Sterna paradisaea	Arctic Tern	Present	Occasional	Native
Sterna sandvicensis	Sandwich Tern	Present	Common	Native
Xema sabini	Sabine's Gull	Present	Rare	Native
Charadriiformes/Recurvirostridae				
Himantopus mexicanus	Black-nested Stilt	Present	Common	Native
Recurvirostra americana	American Avocet	Present	Uncommon	Native
Charadriiformes/Scolopacidae				
Actitis macularia	Spotted Sandpiper	Present	Common	Native
Arenaria interpres	Ruddy Turnstone	Present	Common	Native
Bartramia longicauda	Upland Sandpiper	Present	Occasional	Native
Calidris alba	Sanderling	Present	Common	Native
Calidris alpina	Dunlin	Present	Common	Native
Calidris bairdii	Baird’s Sandpiper	Present	Occasional	Native
Calidris canutus	Red Knot	Present	Uncommon	Native
Calidris ferruginea	Curlew Sandpiper	Present	Rare	Native
Calidris fuscicollis	White-rumped Sandpiper	Present	Uncommon	Native
Calidris himantopus	Stilt Sandpiper	Present	Uncommon	Native

Table C-2. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Calidris maritima	Purple Sandpiper	Present	Occasional	Native
Calidris mauri	Western Sandpiper	Present	Common	Native
Calidris melanotos	Pectoral Sandpiper	Present	Uncommon	Native
Calidris minuta	Little Stint	Present	Occasional	Native
Calidris minutilla	Least Sandpiper	Present	Common	Native
Calidris pusilla	Semipalmated Sandpiper	Present	Common	Native
Catoptrophorus semipalmatus	Willet	Present	Common	Native
Gallinago gallinago	Common Snipe	Present	Uncommon	Native
Limnodromus griseus	Short-billed Dowitcher	Present	Common	Native
Limnodromus scolopaceus	Long-billed Dowitcher	Present	Uncommon	Native
Limosa fedoa	Marbled Godwit	Present	Uncommon	Native
Limosa haemastica	Hudsonian Godwit	Present	Uncommon	Native
Limosa lapponica	Bar-tailed Godwit	Present	Occasional	Native
Limosa limosa	Black-tailed Godwit	Present	Occasional	Native
Numenius americanus	Long-billed Curlew	Present	Rare	Native
Numenius phaeopus	Whimbrel	Present	Rare	Native
Phalaropus fulicaria	Red Phalarope	Present	Common	Native
Phalaropus lobatus	Red-necked Phalarope	Present	Common	Native
Phalaropus tricolor	Wilson's Phalarope	Present	Rare	Native
Philomachus pugnax	Ruff	Present	Rare	Native
Scolopax minor	American Woodcock	Present	Uncommon	Native
Tringa erythropus	Spotted Redshank	Present	Occasional	Native
Tringa flavipes	Lesser Yellowlegs	Present	Common	Native
Tringa melanoleuca	Greater Yellowlegs	Present	Common	Native
Tringa solitaria	Solitary Sandpiper	Present	Occasional	Native
Tryngites subruficollis	Buff-breasted Sandpiper	Present	Occasional	Native
Charadriiformes/Stercorariidae				
Stercorarius longicaudus	Long-tailed Jaeger	Present	Occasional	Native
Stercorarius maccormicki	South Polar Skua	Probably Present		Native
Stercorarius parasiticus	Parasitic Jaeger	Present	Uncommon	Native
Stercorarius pomarinus	Pomarine Jaeger	Present	Common	Native
Stercorarius skua	Great Skua	Probably Present		Native
Ciconiiformes/Ciconiidae				
Mycteria americana	Wood Stork	Present	Occasional	Native
Columbiformes/Columbidae				
Columba livia	Rock Dove	Present	Uncommon	Non-native
Zenaida asiatica	White-winged Dove	Present	Occasional	Native
Zenaida macroura	Mourning Dove	Present	Common	Native

Table C-2. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Coraciiformes/Alcedinidae				
Megaceryle alcyon	Belted Kingfisher	Present	Common	Native
Cuculiformes/Cuculidae				
Coccyzus americanus	Yellow-billed Cuckoo	Present	Uncommon	Native
Coccyzus erythropthalmus	Black-billed Cuckoo	Present	Occasional	Native
Falconiformes/Falconidae				
Falco columbarius	Merlin	Present	Uncommon	Native
Falco peregrinus	Peregrine Falcon	Present	Uncommon	Native
Falco sparverius	American Kestrel	Present	Common	Native
Galliformes/Odontophoridae				
Colinus virginianus	Northern Bobwhite	Present	Uncommon	Native
Galliformes/Phasianidae				
Phasianus colchicus	Ring-necked Pheasant	Present	Uncommon	Native
Gaviiformes/Gaviidae				
Gavia immer	Common Loon	Present	Common	Native
Gavia pacifica	Pacific Loon	Present	Occasional	Native
Gavia stellata	Red-throated Loon	Present	Common	Native
Gruiformes/Gruidae				
Grus canadensis	Sandhill Crane	Present	Rare	Native
Gruiformes/Rallidae				
Coturnicops noveboracensis	Yellow Rail	Present	Occasional	Native
Fulica americana	American Coot	Present	Uncommon	Native
Gallinula chloropus	Common Moorhen	Present	Common	Native
Laterallus jamaicensis	Black Rail	Present	Uncommon	Native
Porphyrula martinica	Purple Gallinule	Present	Occasional	Native
Porzana carolina	Sora	Present	Uncommon	Native
Rallus elegans	King Rail	Present	Common	Native
Rallus limicola	Virginia Rail	Present	Common	Native
Rallus longirostris	Clapper Rail	Present	Common	Native
Passeriformes/Alaudidae				
Eremophila alpestris	Horned Lark	Present	Rare	Native
Passeriformes/Bombycillidae				
Bombycilla cedrorum	Cedar Waxing	Present	Common	Native
Passeriformes/Cardinalidae				
Cardinalis cardinalis	Northern Cardinal	Present	Common	Native
Guiraca caerulea	Blue Grosbeak	Present	Uncommon	Native
Passerina ciris	Painted Bunting	Present	Rare	Native
Passerina cyanea	Indigo Bunting	Present	Common	Native
Pheucticus ludovicianus	Rose-breasted Grosbeak	Present	Uncommon	Native

Table C-2. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Spiza americana	Dickcissel	Present	Rare	Native
Passeriformes/Certhiidae				
Certhia americana	Brown Creeper	Present	Uncommon	Native
Polioptila caerulea	Blue-gray Gnatcatcher	Present	Occasional	Native
Passeriformes/Corvidae				
Corvus brachyrhynchos	American Crow	Present	Common	Native
Corvus ossifragus	Fish Crow	Present	Common	Native
Cyanocitta cristata	Blue Jay	Present	Common	Native
Passeriformes/Emberizidae				
Aimophila aestivalis	Bachman's Sparrow	Present	Occasional	Native
Ammodramus caudacutus	SaltmarshSharp-tailed Sparrow	Present	Common	Native
Ammodramus leconteii	Le Conte’s Sparrow	Present	Occasional	Native
Ammodramus maritimus	Seaside Sparrow	Present	Common	Native
Ammodramus savannarum	Grasshopper Sparrow	Present	Occasional	Native
Calamospiza melanocorys	Lark Bunting	Present	Occasional	Native
Calcarius lapponicus	Lapland Longspur	Present	Occasional	Native
Chondestes grammacus	Lark Sparrow	Present	Rare	Native
Junco hyemalis	Dark-eyed Junco	Present	Occasional	Native
Melospiza georgiana	Swamp Sparrow	Present	Uncommon	Native
Melospiza lincolnii	Lincoln's Sparrow	Present	Rare	Native
Melospiza melodia	Song Sparrow	Present	Common	Native
Passerculus sandwichensis	Savannah Sparrow	Present	Common	Native
Passerella iliaca	Fox Sparrow	Present	Uncommon	Native
Pipilo erythrophthalmus	Eastern Towhee	Present	Common	Native
Plectrophenax nivalis	Snow Bunting	Present	Occasional	Native
Pooecetes gramineus	Vesper Sparrow	Present	Rare	Native
Spizella arborea	American Tree Sparrow	Present	Occasional	Native
Spizella pallida	Clay-colored Sparrow	Present	Rare	Native
Spizella passerina	Chipping Sparrow	Present	Occasional	Native
Spizella pusilla	Field Sparrow	Present	Common	Native
Zonotrichia albicollis	White-throated Sparrow	Present	Common	Native
Zonotrichia leucophrys	White-crowned Sparrow	Present	Rare	Native
Passeriformes/Fringillidae				
Carduelis flammea	Common Redpoll	Present	Occasional	Native
Carduelis pinus	Pine Siskin	Present	Common	Native
Carduelis tristis	American Goldfinch	Present	Uncommon	Native
Carpodacus mexicanus	House Finch	Present	Occasional	Non-native
Carpodacus purpureus	Purple Finch	Present	Uncommon	Native
Coccothraustes vespertinus	Evening Grosbeak	Present	Occasional	Native

Table C-2. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Loxia curvirostra	Red Crossbill	Present	Occasional	Native
Passeriformes/Hirundinidae				
Hirundo rustica	Barn Swallow	Present	Common	Native
Petrochelidon pyrrhonota	Cliff Swallow	Present	Occasional	Native
Progne subis	Purple Martin	Present	Common	Native
Riparia riparia	Bank Swallow	Present	Occasional	Native
Stelgidopteryx serripennis	Northern Rough-winged Swallow	Present	Rare	Native
Tachycineta bicolor	Tree Swallow	Present	Uncommon	Native
Passeriformes/Icteridae				
Agelaius phoeniceus	Red-winged Blackbird	Present	Common	Native
Dolichonyx oryzivorus	Bobolink	Present	Uncommon	Native
Euphagus carolinus	Rusty Blackbird	Present	Rare	Native
Euphagus cyanocephalus	Brewer's Blackbird	Present	Occasional	Native
Icterus galbula	Baltimore Oriole, Northern Oriole	Present	Uncommon	Native
Icterus spurius	Orchard Oriole	Present	Uncommon	Native
Molothrus ater	Brown-headed Cowbird	Present	Common	Native
Quiscalus major	Boat-tailed Grackle	Present	Common	Native
Quiscalus quiscula	Common Grackle	Present	Common	Native
Sturnella magna	Eastern Meadowlark	Present	Common	Native
Sturnella neglecta	Western Meadowlark	Present	Occasional	Native
Xanthocephalus xanthocephalus	Yellow-headed Blackbird	Present	Rare	Native
Passeriformes/Laniidae				
Lanius excubitor	Northern Shrike	Present	Occasional	Native
Lanius ludovicianus	Loggerhead Shrike	Present	Rare	Native
Passeriformes/Mimidae				
Dumetella carolinensis	Gray Catbird	Present	Common	Native
Mimus polyglottos	Northern Mockingbird	Present	Common	Native
Oreoscoptes montanus	Sage Thrasher	Present	Occasional	Native
Toxostoma rufum	Brown Thrasher	Present	Common	Native
Passeriformes/Motacillidae				
Anthus rubescens	American Pipit	Present	Uncommon	Native
Anthus spragueii	Sprague's Pipit	Present	Occasional	Native
Passeriformes/Muscicapidae				
Oenanthe oenanthe	Northern Wheatear	Present	Occasional	Native
Passeriformes/Paridae				
Baeolophus bicolor	Tufted Titmouse	Present	Rare	Native
Poecile carolinensis	Carolina Chickadee	Present	Common	Native
Passeriformes/Parulidae				

Table C-2. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Dendroica caerulescens	Black-throated Blue Warbler	Present	Occasional	Native
Dendroica castanea	Bay-breasted Warbler	Present	Occasional	Native
Dendroica cerulea	Cerulean Warbler	Present	Rare	Native
Dendroica coronata	Yellow-rumped Warbler	Present	Common	Native
Dendroica discolor	Prairie Warbler	Present	Common	Native
Dendroica dominica	Yellow-throated Warbler	Present	Rare	Native
Dendroica fusca	Blackburnian Warbler	Present	Rare	Native
Dendroica magnolia	Magnolia Warbler	Present	Common	Native
Dendroica palmarum	Palm Warbler	Present	Uncommon	Native
Dendroica pensylvanica	Chestnut-sided Warbler	Present	Rare	Native
Dendroica petechia	Yellow Warbler	Present	Uncommon	Native
Dendroica pinus	Pine Warbler	Present	Common	Native
Dendroica striata	Blackpoll Warbler	Present	Uncommon	Native
Dendroica tigrina	Cape May Warbler	Present	Uncommon	Native
Dendroica virens	Black-throated Green Warbler	Present	Uncommon	Native
Geothlypis trichas	Common Yellowthroat	Present	Common	Native
Helmitheros vermivorus	Worm-eating Warbler	Present	Occasional	Native
Icteria virens	Yellow-breasted Chat	Present	Rare	Native
Mniotilta varia	Black-and-white Warbler	Present	Occasional	Native
Oporornis agilis	Connecticut Warbler	Present	Rare	Native
Oporornis philadelphia	Mourning Warbler	Present	Occasional	Native
Parula americana	Northern Parula	Present	Occasional	Native
Protonotaria citrea	Prothonotary Warbler	Present	Uncommon	Native
Seiurus aurocapillus	Ovenbird	Present	Occasional	Native
Seiurus motacilla	Louisiana Waterthrush	Present	Occasional	Native
Seiurus noveboracensis	Northern Waterthrush	Present	Uncommon	Native
Vermivora celata	Orange-crowned Warbler	Present	Uncommon	Native
Vermivora chrysoptera	Golden-winged Warbler	Present	Rare	Native
Vermivora peregrina	Tennessee Warbler	Present	Occasional	Native
Vermivora pinus	Blue-winged Warbler	Present	Rare	Native
Vermivora ruficapilla	Nashville Warbler	Present	Rare	Native
Wilsonia canadensis	Canada Warbler	Present	Rare	Native
Wilsonia citrina	Hooded Warbler	Present	Occasional	Native
Wilsonia pusilla	Wilson's Warbler	Present	Occasional	Native
Passeriformes/Passeridae				
Passer domesticus	House Sparrow	Present	Common	Native
Passeriformes/Regulidae				
Regulus calendula	Ruby-crowned Kinglet	Present	Common	Native
Regulus satrapa	Golden-crowned Kinglet	Present	Common	Native

Table C-2. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Passeriformes/Sittidae				
Sitta canadensis	Red-breasted Nuthatch	Present	Uncommon	Native
Sitta carolinensis	White-breasted Nuthatch	Present	Occasional	Native
Sitta pusilla	Brown-headed Nuthatch	Present	Occasional	Native
Passeriformes/Sturnidae				
Sturnus vulgaris	European Starling	Present	Unknown	Non-native
Passeriformes/Thraupidae				
Piranga ludoviciana	Western Tanager	Present	Occasional	Native
Piranga olivacea	Scarlet Tanager	Present	Occasional	Native
Piranga rubra	Summer Tanager	Present	Occasional	Native
Passeriformes/Troglodytidae				
Cistothorus palustris	Marsh Wren	Present	Common	Native
Cistothorus platensis	Sedge Wren	Present	Common	Native
Thryomanes bewickii	Bewick's Wren	Present	Occasional	Native
Thryothorus ludovicianus	Carolina Wren	Present	Common	Native
Troglodytes aedon	House Wren	Present	Common	Native
Troglodytes troglodytes	Winter Wren	Present	Uncommon	Native
Passeriformes/Turdidae				
Catharus fuscescens	Veery	Present	Rare	Native
Catharus guttatus	Hermit Thrush	Present	Common	Native
Catharus minimus	Gray-cheeked Thrush	Present	Occasional	Native
Catharus ustulatus	Swainson’s Thrush	Present	Uncommon	Native
Hylocichla mustelina	Wood Thrush	Present	Occasional	Native
Sialia sialis	Eastern Bluebird	Present	Occasional	Native
Turdus migratorius	American Robin	Present	Common	Native
Passeriformes/Tyrannidae				
Contopus cooperi	Olive-sided Flycatcher	Present	Occasional	Native
Contopus virens	Eastern Wood-pewee	Present	Uncommon	Native
Empidonax flaviventris	Yellow-bellied Flycatcher	Present	Uncommon	Native
Empidonax minimus	Least Flycatcher	Present	Uncommon	Native
Empidonax virescens	Acadian Flycatcher	Present	Rare	Native
Myiarchus crinitus	Great Crested Flycatcher	Present	Common	Native
Pyrocephalus rubinus	Vermilion Flycatcher	Present	Occasional	Native
Sayornis phoebe	Eastern Phoebe	Present	Uncommon	Native
Tyrannus dominicensis	Gray Kingbird	Present	Rare	Native
Tyrannus forficatus	Scissor-tailed Flycatcher	Present	Rare	Native
Tyrannus tyrannus	Eastern Kingbird	Present	Common	Native
Tyrannus verticalis	Western Kingbird	Present	Occasional	Native
Passeriformes/Vireonidae				

Table C-2. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Vireo flavifrons	Yellow-throated Vireo	Present	Rare	Native
Vireo griseus	White-eyed Vireo	Present	Common	Native
Vireo olivaceus	Red-eyed Vireo	Present	Uncommon	Native
Vireo philadelphicus	Philadelphia Vireo	Present	Occasional	Native
Vireo solitarius	Blue-headed Vireo	Present	Occasional	Native
Pelecaniformes/Ardeidae				
Ardea alba	Great Egret	Present	Common	Native
Ardea herodias	Great Blue Heron	Present	Common	Native
Botaurus lentiginosus	American Bittern	Present	Uncommon	Native
Bubulcus ibis	Cattle Egret	Present	Common	Native
Butorides virescens	Green Heron	Present	Common	Native
Egretta caerulea	Little Blue Heron	Present	Common	Native
Egretta rufescens	Reddish Egret	Present	Occasional	Native
Egretta thula	Snowy Egret	Present	Common	Native
Egretta tricolor	Tricolored Heron	Present	Common	Native
Ixobrychus exilis	Least Bittern	Present	Occasional	Native
Nyctanassa violacea	Yellow-crowned Night-heron	Present	Uncommon	Native
Nycticorax nycticorax	Black-crowned Night-heron	Present	Common	Native
Pelecaniformes/Pelecanidae				
Pelecanus erythrorhynchos	American White Pelican	Present	Occasional	Native
Pelecanus occidentalis	Brown Pelican	Present	Common	Native
Pelecaniformes/Threskiornithidae				
Ajaia ajaja	Roseate Spoonbill	Present	Occasional	Native
Eudocimus albus	White Ibis	Present	Common	Native
Plegadis falcinellus	Glossy Ibis	Present	Common	Native
Phaethontiformes/Phaethontidae				
Phaethon aethereus	Red-billed Tropicbird	Present	Occasional	Native
Phaethon lepturus	White-tailed Tropicbird	Present	Occasional	Native
Phoenicopteriformes/Phoenicopteridae				
Phoenicopterus ruber	American Flamingo	Present	Occasional	Native
Piciformes/Picidae				
Colaptes auratus	Northern Flicker	Present	Common	Native
Dryocopus pileatus	Pileated Woodpecker	Present	Occasional	Native
Melanerpes carolinus	Red-Bellied Woodpecker	Present	Uncommon	Native
Picoides pubescens	Downy Woodpecker	Present	Uncommon	Native
Picoides villosus	Hairy Woodpecker	Present	Rare	Native
Sphyrapicus varius	Yellow-bellied Sapsucker	Present	Uncommon	Native
Podicipediformes/Podicipedidae				
Aechmophorus occidentalis	Western Grebe	Present	Occasional	Native

Table C-2. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Podiceps auritus	Horned Grebe	Present	Common	Native
Podiceps grisegena	Red-necked Grebe	Present	Rare	Native
Podiceps nigricollis	Eared Grebe	Present	Rare	Native
Podilymbus podiceps	Pied-billed Grebe	Present	Common	Native
Procellariiformes/Hydrobatidae				
Oceanites oceanicus	Wilson's Storm-petrel	Present	Common	Native
Oceanodroma castro	Band-rumped Storm-petrel	Present	Uncommon	Native
Oceanodroma leucorhoa	Leach's Storm-petrel	Present	Uncommon	Native
Pelagodroma marina	White-faced Storm-petrel	Present	Rare	Native
Procellariiformes/Procellariidae				
Calonectris diomedea	Cory's Shearwater	Present	Common	Native
Fulmarus glacialis	Northern Fulmar	Present	Uncommon	Native
Pterodroma hasitata	Black-capped Petrel	Present	Common	Native
Puffinus gravis	Greater Shearwater	Present	Uncommon	Native
Puffinus griseus	Sooty Shearwater	Present	Rare	Native
Puffinus lherminieri	Audubon's Shearwater	Present	Common	Native
Puffinus puffinus	Manx Shearwater	Present	Common	Native
Strigiformes/Caprimulgidae				
Caprimulgus carolinensis	Chuck-will's-widow	Present	Uncommon	Native
Caprimulgus vociferus	Whip-poor-will	Present	Unknown	Native
Chordeiles minor	Common Nighthawk	Present	Occasional	Native
Strigiformes/Strigidae				
Aegolius acadicus	Northern Saw-whet Owl	Present	Common	Native
Asio flammeus	Short-eared Owl	Present	Uncommon	Native
Athene cunicularia	Burrowing Owl	Present	Occasional	Native
Bubo virginianus	Great-horned Owl	Present	Occasional	Native
Megascops asio	Eastern Screech Owl	Present	Common	Native
Strigiformes/Tytonidae				
Tyto alba	Barn Owl	Present	Occasional	Native
Suliformes/Fregatidae				
Fregata magnificens	Magnificent Frigatebird	Probably Present		Native
Suliformes/Phalacrocoracidae				
Phalacrocorax auritus	Double-crested Cormorant	Present	Common	Native
Phalacrocorax carbo	Great Cormorant	Present	Occasional	Native
Suliformes/Sulidae				
Morus bassanus	Northern Gannet	Present	Common	Native
Sula dactylatra	Masked Booby	Present	Occasional	Native
Sula leucogaster	Brown Booby	Probably Present		Native

Table C-3. Bird species known or likely to occur at Cape Lookout National Seashore. This species list reflects all NPSpecies/IRMA entries and updates through October 2013, and are currently undergoing review and update.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Accipitriformes/Accipitridae				
Accipiter cooperii	Cooper's Hawk	Present	Uncommon	Native
Accipiter striatus	Sharp-shinned Hawk	Present	Common	Native
Buteo jamaicensis	Red-tailed Hawk	Present	Rare	Native
Buteo lineatus	Red-shouldered Hawk	Present	Rare	Native
Buteo platypterus	Broad-winged Hawk	Present	Rare	Native
Circus cyaneus	Northern Harrier	Present	Common	Native
Elanoides forficatus	Swallow-tailed Kite	Present	Rare	Native
Haliaeetus leucocephalus	Bald Eagle	Present	Rare	Native
Accipitriformes/Cathartidae				
Cathartes aura	Turkey Vulture	Present	Rare	Native
Coragyps atratus	Black Vulture	Present	Rare	Native
Accipitriformes/Pandionidae				
Pandion haliaetus	Osprey	Present	Common	Native
Anseriformes/Anatidae				
Aix sponsa	Wood Duck	Present	Rare	Native
Anas acuta	Northern Pintail	Present	Common	Native
Anas americana	American Wigeon	Present	Common	Native
Anas clypeata	Northern Shoveler	Present	Uncommon	Native
Anas crecca	Green-winged Teal	Present	Common	Native
Anas discors	Blue-winged Teal	Present	Uncommon	Native
Anas platyrhynchos	Mallard	Present	Uncommon	Native
Anas rubripes	American Black Duck	Present	Common	Native
Anas strepera	Gadwall	Present	Common	Native
Aythya affinis	Lesser Scaup	Present	Common	Native
Aythya americana	Redhead	Present	Common	Native
Aythya collaris	Ring-necked Duck	Present	Rare	Native
Aythya marila	Greater Scaup	Present	Uncommon	Native
Aythya valisineria	Canvasback	Present	Uncommon	Native
Branta bernicla	Brant	Present	Uncommon	Native
Branta canadensis	Canada Goose	Present	Uncommon	Native
Bucephala albeola	Bufflehead	Present	Common	Native
Bucephala clangula	Common Goldeneye	Present	Uncommon	Native
Chen caerulescens	Snow Goose	Probably Present		Native
Clangula hyemalis	Oldsquaw	Present	Uncommon	Native
Cygnus columbianus	Tundra Swan	Present	Uncommon	Native
Lophodytes cucullatus	Hooded Merganser	Present	Common	Native

Table C-3. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Melanitta fusca	White-winged Scoter	Present	Uncommon	Native
Melanitta nigra	Black Scoter	Present	Common	Native
Melanitta perspicillata	Surf Scoter	Present	Uncommon	Native
Mergus serrator	Red-breasted Merganser	Present	Common	Native
Oxyura jamaicensis	Ruddy Duck	Present	Uncommon	Native
Somateria mollissima	Common Eider	Present	Rare	Native
Apodiformes/Apodidae				
Chaetura pelagica	Chimney Swift	Present	Uncommon	Native
Apodiformes/Trochilidae				
Archilochus colubris	Ruby-throated Hummingbird	Present	Rare	Native
Charadriiformes/Alcidae				
Alca torda	Razorbill	Present	Occasional	Native
Alle alle	Dovekie	Present	Rare	Native
Charadriiformes/Charadriidae				
Charadrius melodus	Piping Plover	Present	Common	Native
Charadrius semipalmatus	Semipalmated Plover	Present	Common	Native
Charadrius vociferus	Killdeer	Present	Uncommon	Native
Charadrius wilsonia	Wilson's Plover	Present	Common	Native
Pluvialis dominica	American Golden-plover	Present	Uncommon	Native
Pluvialis squatarola	Black-bellied Plover	Present	Common	Native
Charadriiformes/Haematopodidae				
Haematopus palliatus	American Oystercatcher	Present	Common	Native
Charadriiformes/Laridae				
Anous stolidus	Brown Noddy	Probably Present		Native
Chlidonias niger	Black Tern	Present	Common	Native
Larus argentatus	Herring Gull	Present	Common	Native
Larus atricilla	Laughing Gull	Present	Common	Native
Larus delawarensis	Ring-billed Gull	Present	Common	Native
Larus fuscus	Lesser Black-backed Gull	Present	Uncommon	Native
Larus glaucoides	Iceland Gull	Present	Rare	Native
Larus hyperboreus	Glaucous Gull	Present	Rare	Native
Larus marinus	Great Black-backed Gull	Present	Common	Native
Larus minutus	Little Gull	Present	Rare	Native
Larus philadelphia	Bonaparte's Gull	Present	Common	Native
Rissa tridactyla	Black-legged Kittiwake	Present	Uncommon	Native
Rynchops niger	Black Skimmer	Present	Common	Native
Sterna antillarum	Least Tern	Present	Common	Native

Table C-3. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Sterna caspia	Caspian Tern	Present	Common	Native
Sterna dougallii	Roseate Tern	Present	Uncommon	Native
Sterna forsteri	Forster's Tern	Present	Common	Native
Sterna fuscata	Sooty Tern	Present	Rare	Native
Sterna maxima	Royal Tern	Present	Common	Native
Sterna nilotica	Gull-billed Tern	Present	Common	Native
Sterna sandvicensis	Sandwich Tern	Present	Common	Native
Charadriiformes/Recurvirostridae				
Himantopus mexicanus	Black-necked Stilt	Present	Rare	Native
Recurvirostra americana	American Avocet	Present	Rare	Native
Charadriiformes/Scolopacidae				
Actitis macularia	Spotted Sandpiper	Present	Common	Native
Arenaria interpres	Ruddy Turnstone	Present	Common	Native
Bartramia longicauda	Upland Sandpiper	Present	Rare	Native
Calidris alba	Sanderling	Present	Common	Native
Calidris alpina	Dunlin	Present	Common	Native
Calidris bairdii	Baird's Sandpiper	Present	Rare	Native
Calidris canutus	Red Knot	Present	Common	Native
Calidris ferruginea	Curlew Sandpiper	Present	Rare	Native
Calidris fuscicollis	White-rumped Sandpiper	Present	Uncommon	Native
Calidris himantopus	Stilt Sandpiper	Present	Uncommon	Native
Calidris maritima	Purple Sandpiper	Present	Rare	Native
Calidris mauri	Western Sandpiper	Present	Common	Native
Calidris melanotos	Pectoral Sandpiper	Present	Uncommon	Native
Calidris minutilla	Least Sandpiper	Present	Common	Native
Calidris pusilla	Semipalmated Sandpiper	Present	Common	Native
Catoptrophorus semipalmatus	Willet	Present	Common	Native
Gallinago gallinago	Common Snipe	Present	Uncommon	Native
Limnodromus griseus	Short-billed Dowitcher	Present	Common	Native
Limnodromus scolopaceus	Long-billed Dowitcher	Present	Rare	Native
Limosa fedoa	Marbled Godwit	Present	Uncommon	Native
Limosa haemastica	Hudsonian Godwit	Present	Rare	Native
Numenius americanus	Long-billed Curlew	Present	Rare	Native
Numenius phaeopus	Whimbrel	Present	Common	Native
Phalaropus fulicaria	Red Phalarope	Present	Rare	Native
Phalaropus lobatus	Red-necked Phalarope	Present	Rare	Native
Phalaropus tricolor	Wilson's Phalarope	Present	Uncommon	Native
Philomachus pugnax	Ruff	Present	Rare	Native
Scolopax minor	American Woodcock	Present	Uncommon	Native

Table C-3. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Tringa flavipes	Lesser Yellowlegs	Present	Uncommon	Native
Tringa melanoleuca	Greater Yellowlegs	Present	Common	Native
Tringa solitaria	Solitary Sandpiper	Present	Uncommon	Native
Tryngites subruficollis	Buff-breasted Sandpiper	Present	Rare	Native
Charadriiformes/Stercorariidae				
Stercorarius longicaudus	Long-tailed Jaeger	Probably Present		Native
Stercorarius parasiticus	Parasitic Jaeger	Probably Present		Native
Stercorarius pomarinus	Pomarine Jaeger	Probably Present		Native
Columbiformes/Columbidae				
Columba livia	Rock Dove	Present	Rare	Non-native
Zenaida macroura	Mourning Dove	Present	Common	Native
Coraciiformes/Alcedinidae				
Ceryle alcyon	Belted Kingfisher	Present	Uncommon	Native
Cuculiformes/Cuculidae				
Coccyzus americanus	Yellow-billed Cuckoo	Present	Uncommon	Native
Falconiformes/Falconidae				
Falco columbarius	Merlin	Present	Common	Native
Falco peregrinus	Peregrine Falcon	Present	Common	Native
Falco sparverius	American Kestrel	Present	Common	Native
Galliformes/Odontophoridae				
Colinus virginianus	Northern Bobwhite	Present	Uncommon	Native
Galliformes/Phasianidae				
Phasianus colchicus	Ring-necked Pheasant	Present	Uncommon	Non-native
Gaviiformes/Gaviidae				
Gavia immer	Common Loon	Present	Common	Native
Gavia stellata	Red-throated Loon	Present	Common	Native
Gruiformes/Rallidae				
Fulica americana	American Coot	Present	Rare	Native
Gallinula chloropus	Common Moorhen	Present	Rare	Native
Laterallus jamaicensis	Black Rail	Present	Uncommon	Native
Porzana carolina	Sora	Present	Uncommon	Native
Rallus elegans	King Rail	Present	Rare	Native
Rallus limicola	Virginia Rail	Present	Common	Native
Rallus longirostris	Clapper Rail	Present	Common	Native
Passeriformes/Bombycillidae				
Bombycilla cedrorum	Cedar Waxing	Present	Uncommon	Native
Passeriformes/Cardinalidae				
Cardinalis cardinalis	Northern Cardinal	Present	Common	Native

Table C-3. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Guiraca caerulea	Blue Grosbeak	Present	Common	Native
Passerina ciris	Painted Bunting	Present	Rare	Native
Passerina cyanea	Indigo Bunting	Present	Common	Native
Pheucticus ludovicianus	Rose-breasted Grosbeak	Present	Common	Native
Passeriformes/Certhiidae				
Certhia americana	Brown Creeper	Present	Uncommon	Native
Polioptila caerulea	Blue-gray Gnatcatcher	Present	Uncommon	Native
Passeriformes/Corvidae				
Corvus ossifragus	Fish Crow	Present	Common	Native
Cyanocitta cristata	Blue Jay	Present	Rare	Native
Passeriformes/Emberizidae				
Ammodramus caudacutus	Saltmarsh Sharp-tailed Sparrow	Present	Common	Native
Ammodramus maritimus	Seaside Sparrow	Present	Common	Native
Ammodramus savannarum	Grasshopper Sparrow	Present	Rare	Native
Calcarius lapponicus	Lapland Longspur	Present	Rare	Native
Chondestes grammacus	Lark Sparrow	Present	Rare	Native
Junco hyemalis	Dark-eyed Junco	Present	Common	Native
Melospiza georgiana	Swamp Sparrow	Present	Common	Native
Melospiza lincolnii	Lincoln's Sparrow	Present	Rare	Native
Melospiza melodia	Song Sparrow	Present	Common	Native
Passerculus sandwichensis	Savannah Sparrow	Present	Common	Native
Passerella iliaca	Fox Sparrow	Present	Uncommon	Native
Pipilo erythrophthalmus	Eastern Towhee	Present	Common	Native
Plectrophenax nivalis	Snow Bunting	Present	Rare	Native
Spizella pallida	Clay-colored Sparrow	Present	Rare	Native
Spizella passerina	Chipping Sparrow	Present	Uncommon	Native
Spizella pusilla	Field Sparrow	Present	Uncommon	Native
Zonotrichia albicollis	White-throated Sparrow	Present	Uncommon	Native
Zonotrichia leucophrys	White-crowned Sparrow	Present	Rare	Native
Passeriformes/Fringillidae				
Carduelis pinus	Pine Siskin	Present	Rare	Native
Carduelis tristis	American Goldfinch	Present	Uncommon	Native
Carpodacus mexicanus	House Finch	Present	Uncommon	Non-native
Carpodacus purpureus	Purple Finch	Present	Uncommon	Native
Coccothraustes vespertinus	Evening Grosbeak	Present	Rare	Native
Passeriformes/Hirundinidae				
Hirundo rustica	Barn Swallow	Present	Common	Native
Petrochelidon pyrrhonota	Cliff Swallow	Present	Rare	Native

Table C-3. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Progne subis	Purple Martin	Present	Uncommon	Native
Riparia riparia	Bank Swallow	Present	Uncommon	Native
Stelgidopteryx serripennis	Northern Rough-winged Swallow	Present	Rare	Native
Tachycineta bicolor	Tree Swallow	Present	Common	Native
Passeriformes/Icteridae				
Agelaius phoeniceus	Red-winged Blackbird	Present	Common	Native
Dolichonyx oryzivorus	Bobolink	Present	Uncommon	Native
Icterus galbula	Baltimore Oriole	Present	Common	Native
Icterus spurius	Orchard Oriole	Present	Uncommon	Native
Molothrus ater	Brown-headed Cowbird	Present	Uncommon	Native
Quiscalus major	Boat-tailed Grackle	Present	Common	Native
Quiscalus quiscula	Common Grackle	Present	Uncommon	Native
Sturnella magna	Eastern Meadowlark	Present	Common	Native
Passeriformes/Mimidae				
Dumetella carolinensis	Gray Catbird	Present	Uncommon	Native
Mimus polyglottos	Northern Mockingbird	Present	Uncommon	Native
Toxostoma rufum	Brown Thrasher	Present	Uncommon	Native
Passeriformes/Motacillidae				
Anthus rubescens	American Pipit	Present	Uncommon	Native
Passeriformes/Paridae				
Poecile carolinensis	Carolina Chickadee	Present	Rare	Native
Passeriformes/Parulidae				
Dendroica caerulescens	Black-throated Blue Warbler	Present	Common	Native
Dendroica castanea	Bay-breasted Warbler	Present	Rare	Native
Dendroica coronata	Yellow-rumped Warbler	Present	Common	Native
Dendroica discolor	Prairie Warbler	Present	Common	Native
Dendroica dominica	Yellow-throated Warbler	Present	Rare	Native
Dendroica fusca	Blackburnian Warbler	Present	Rare	Native
Dendroica magnolia	Magnolia Warbler	Present	Common	Native
Dendroica palmarum	Palm Warbler	Present	Uncommon	Native
Dendroica pensylvanica	Chestnut-sided Warbler	Present	Rare	Native
Dendroica petechia	Yellow Warbler	Present	Uncommon	Native
Dendroica pinus	Pine Warbler	Present	Uncommon	Native
Dendroica striata	Blackpoll Warbler	Present	Uncommon	Native
Dendroica tigrina	Cape May Warbler	Present	Common	Native
Dendroica virens	Black-throated Green Warbler	Present	Uncommon	Native

Table C-3. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Geothlypis trichas	Common Yellowthroat	Present	Common	Native
Icteria virens	Yellow-breasted Chat	Present	Uncommon	Native
Mniotilta varia	Black-and-white Warbler	Present	Common	Native
Oporornis agilis	Connecticut Warbler	Present	Rare	Native
Parula americana	Northern Parula	Present	Uncommon	Native
Protonotaria citrea	Prothonotary Warbler	Present	Uncommon	Native
Seiurus aurocapillus	Ovenbird	Present	Common	Native
Seiurus noveboracensis	Northern Waterthrush	Present	Uncommon	Native
Setophaga ruticilla	American Redstart	Present	Common	Native
Vermivora celata	Orange-crowned Warbler	Present	Uncommon	Native
Vermivora peregrina	Tennessee Warbler	Present	Uncommon	Native
Vermivora pinus	Blue-winged Warbler	Present	Rare	Native
Vermivora ruficapilla	Nashville Warbler	Present	Rare	Native
Wilsonia canadensis	Canada Warbler	Present	Rare	Native
Wilsonia citrina	Hooded Warbler	Present	Rare	Native
Wilsonia pusilla	Wilson's Warbler	Present	Rare	Native
Passeriformes/Regulidae				
Regulus calendula	Ruby-crowned Kinglet	Present	Common	Native
Regulus satrapa	Golden-crowned Kinglet	Present	Common	Native
Passeriformes/Sittidae				
Sitta canadensis	Red-breasted Nuthatch	Present	Common	Native
Passeriformes/Sturnidae				
Sturnus vulgaris	European Starling	Present	Uncommon	Non-native
Passeriformes/Thraupidae				
Piranga olivacea	Scarlet Tanager	Present	Uncommon	Native
Piranga rubra	Summer Tanager	Present	Rare	Native
Passeriformes/Troglodytidae				
Cistothorus palustris	Marsh Wren	Present	Common	Native
Cistothorus platensis	Sedge Wren	Present	Uncommon	Native
Thryothorus ludovicianus	Carolina Wren	Present	Common	Native
Troglodytes aedon	House Wren	Present	Uncommon	Native
Troglodytes troglodytes	Winter Wren	Present	Uncommon	Native
Passeriformes/Turdidae				
Catharus fuscescens	Veery	Present	Rare	Native
Catharus guttatus	Hermit Thrush	Present	Uncommon	Native
Catharus minimus	Gray-cheeked Thrush	Present	Uncommon	Native
Catharus ustulatus	Swainson's Thrush	Present	Uncommon	Native
Hylocichla mustelina	Wood Thrush	Present	Uncommon	Native

Table C-3. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Sialia sialis	Eastern Bluebird	Present	Rare	Native
Turdus migratorius	American Robin	Present	Common	Native
Passeriformes/Tyrannidae				
Contopus virens	Eastern Wood-pewee	Present	Common	Native
Myiarchus crinitus	Great Crested Flycatcher	Present	Common	Native
Sayornis phoebe	Eastern Phoebe	Present	Common	Native
Tyrannus dominicensis	Gray Kingbird	Present	Rare	Native
Tyrannus tyrannus	Eastern Kingbird	Present	Common	Native
Tyrannus verticalis	Western Kingbird	Present	Uncommon	Native
Passeriformes/Vireonidae				
Vireo griseus	White-eyed Vireo	Present	Uncommon	Native
Vireo olivaceus	Red-eyed Vireo	Present	Common	Native
Vireo philadelphicus	Philadelphia Vireo	Present	Rare	Native
Vireo solitarius	Blue-headed Vireo	Present	Uncommon	Native
Pelecaniformes/Ardeidae				
Ardea alba	Great Egret	Present	Common	Native
Ardea herodias	Great Blue Heron	Present	Common	Native
Botaurus lentiginosus	American Bittern	Present	Uncommon	Native
Bubulcus ibis	Cattle Egret	Present	Common	Native
Butorides virescens	Green Heron	Present	Uncommon	Native
Egretta caerulea	Little Blue Heron	Present	Common	Native
Egretta rufescens	Reddish Egret	Present	Rare	Native
Egretta thula	Snowy Egret	Present	Common	Native
Egretta tricolor	Tricolored Heron	Present	Common	Native
Ixobrychus exilis	Least Bittern	Present	Rare	Native
Nyctanassa violacea	Yellow-crowned Night-heron	Present	Uncommon	Native
Nycticorax nycticorax	Black-crowned Night-heron	Present	Common	Native
Pelecaniformes/Pelecanidae				
Pelecanus erythrorhynchos	American White Pelican	Present	Rare	Native
Pelecanus occidentalis	Brown Pelican	Present	Common	Native
Pelecaniformes/Threskiornithidae				
Eudocimus albus	White Ibis	Present	Uncommon	Native
Plegadis falcinellus	Glossy Ibis	Present	Uncommon	Native
Piciformes/Picidae				
Colaptes auratus	Northern Flicker	Present	Common	Native
Melanerpes carolinus	Red-bellied Woodpecker	Present	Rare	Native
Melanerpes erythrocephalus	Red-headed	Present	Rare	Native

Table C-3. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
	Woodpecker			
Picoides pubescens	Downy Woodpecker	Present	Rare	Native
Sphyrapicus varius	Yellow-bellied Sapsucker	Present	Uncommon	Native
Podicipediformes/Podicipedidae				
Podiceps auritus	Horned Grebe	Present	Common	Native
Podiceps grisegena	Red-necked Grebe	Present	Rare	Native
Podilymbus podiceps	Pied-billed Grebe	Present	Uncommon	Native
Procellariiformes/Hydrobatidae				
Oceanites oceanicus	Wilson's Storm-petrel	Probably Present		Native
Procellariiformes/Procellariidae				
Calonectris diomedea	Cory's Shearwater	Probably Present		Native
Puffinus gravis	Greater Shearwater	Probably Present		Native
Puffinus griseus	Sooty Shearwater	Probably Present		Native
Puffinus lherminieri	Audubon's Shearwater	Probably Present		Native
Strigiformes/Caprimulgidae				
Caprimulgus carolinensis	Chuck's-will-widow	Present	Uncommon	Native
Chordeiles minor	Common Nighthawk	Present	Common	Native
Strigiformes/Strigidae				
Asio flammeus	Short-eared Owl	Present	Uncommon	Native
Bubo virginianus	Great Horned Owl	Present	Uncommon	Native
Strigiformes/Tytonidae				
Tyto alba	Barn Owl	Present	Uncommon	Native
Suliformes/Fregatidae				
Fregata magnificens	Magnificent Frigatebird	Present	Rare	Native
Suliformes/Phalacrocoracidae				
Phalacrocorax auritus	Double-crested Cormorant	Present	Common	Native
Phalacrocorax carbo	Great Cormorant	Present	Uncommon	Native
Suliformes/Sulidae				
Morus bassanus	Northern Gannet	Probably Present		Native

Table C-4. Bird species known or likely to occur at Chattahoochee River National Recreation Area. This species list reflects all NPSpecies/IRMA entries and updates through October 2013, and are currently undergoing review and update.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Accipitriformes/Accipitridae				
Accipiter cooperii	Coopers Hawk	Present	Unknown	Native
Accipiter striatus	Sharp-shinned Hawk	Present	Unknown	Native
Buteo jamaicensis	Red Tailed Hawk, Red-tailed Hawk	Present	Unknown	Native
Buteo lineatus	Red-shouldered Hawk	Present	Unknown	Native
Buteo platypterus	Broad-winged Hawk	Present	Unknown	Native
Circus cyaneus	Northern Harrier	Present	Unknown	Native
Haliaeetus leucocephalus	Bald Eagle	Present	Unknown	Native
Accipitriformes/Cathartidae				
Cathartes aura	Turkey Vulture	Present	Unknown	Native
Coragyps atratus	Black Vulture	Present	Unknown	Native
Accipitriformes/Pandionidae				
Pandion haliaetus	Ospery, Osprey	Present	Unknown	Native
Anseriformes/Anatidae				
Aix sponsa	Wood Duck	Present	Unknown	Native
Anas acuta	Northern Pintail	Present	Unknown	Native
Anas americana	American Wigeon	Present	Unknown	Native
Anas clypeata	Northern Shoveler	Present	Unknown	Native
Anas crecca	Green-wing Teal	Present	Unknown	Native
Anas discors	Blue-winged Teal	Present	Unknown	Native
Anas platyrhynchos	Mallard	Present	Unknown	Native
Anas strepera	Gadwall	Present	Unknown	Native
Anser albifrons	Greater White-fronted Goose	Present	Unknown	Native
Aythya marila	Greater Scaup	Present	Unknown	Native
Branta canadensis	Canada Goose	Present	Unknown	Native
Lophodytes cucullatus	Hooded Merganser	Present	Unknown	Native
Mergus serrator	Red-breasted Merganser	Present	Unknown	Native
Apodiformes/Apodidae				
Chaetura pelagica	Chimney Swift	Present	Unknown	Native
Apodiformes/Trochilidae				
Archilochus colubris	Ruby-throated Hummingbird	Present	Unknown	Native
Charadriiformes/Charadriidae				
Charadrius vociferus	Killdeer	Present	Unknown	Native
Charadriiformes/Laridae				
Larus argentatus	Herring Gull	Present	Unknown	Native
Larus delawarensis	Ring-billed Gull	Present	Unknown	Native
Larus philadelphia	Bonaparte's Gull	Present	Unknown	Native
Charadriiformes/Scolopacidae				

Table C-4. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Actitis macularia	Spotted Sandpiper	Present	Unknown	Native
Calidris melanotos	Pectoral Sandpiper	Present	Unknown	Native
Calidris minutilla	Least Sandpiper	Present	Unknown	Native
Gallinago delicata	Wilson's Snipe	Present	Unknown	Native
Gallinago gallinago	Common Snipe, Snipe	Present	Unknown	Native
Scolopax minor	American Woodcock	Present	Unknown	Native
Tringa flavipes	Lesser Yellowlegs	Present	Unknown	Native
Tringa melanoleuca	Greater Yellowlegs	Present	Unknown	Native
Tringa solitaria	Solitary Sandpiper	Present	Unknown	Native
Columbiformes/Columbidae				
Columba livia	Rock Dove, Rock Pigeon	Present	Unknown	Non-native
Streptopelia decaocto	Eurasian Collared Dove	Present	Unknown	Native
Zenaida macroura	Mourning Dove	Present	Unknown	Native
Coraciiformes/Alcedinidae				
Ceryle alcyon	Belted Kingfisher	Present	Unknown	Native
Cuculiformes/Cuculidae				
Coccyzus americanus	Yellow-billed Cuckoo	Present	Unknown	Native
Coccyzus erythropthalmus	Black-billed Cuckoo	Present	Unknown	Native
Falconiformes/Falconidae				
Falco columbarius	Merlin	Present	Unknown	Native
Falco sparverius	American Kestrel	Present	Unknown	Native
Galliformes/Phasianidae				
Meleagris gallopavo	Wild Turkey	Present	Unknown	Native
Gaviiformes/Gaviidae				
Gavia immer	Common Loon	Present	Unknown	Native
Gruiformes/Gruidae				
Grus canadensis	Sandhill Crane	Present	Unknown	Native
Gruiformes/Rallidae				
Fulica americana	American Coot	Present	Unknown	Native
Porzana carolina	Sora	Present	Unknown	Native
Rallus elegans	King Rail	Present	Unknown	Native
Passeriformes/Bombycillidae				
Bombycilla cedrorum	Cedar waxwing	Present	Unknown	Native
Passeriformes/Cardinalidae				
Cardinalis cardinalis	Northern Cardinal	Present	Unknown	Native
Passerina caerulea	Blue Grosbeak	Present	Unknown	Native
Passerina cyanea	Indigo Bunting	Present	Unknown	Native
Pheucticus ludovicianus	Rose-breasted Grosbeak	Present	Unknown	Native
Passeriformes/Certhiidae				
Certhia americana	Brown Creeper	Present	Unknown	Native

Table C-4. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Polioptila caerulea	Blue-gray Gnatcatcher	Present	Unknown	Native
Passeriformes/Corvidae				
Corvus brachyrhynchos	American Crow	Present	Unknown	Native
Corvus ossifragus	Fish Crow	Present	Unknown	Native
Cyanocitta cristata	Blue Jay	Present	Unknown	Native
Passeriformes/Emberizidae				
Ammodramus henslowii	Henlow's Sparrow	Present	Unknown	Native
Ammodramus leconteii	Le Conte's Sparrow	Present	Unknown	Native
Ammodramus savannarum	Grasshopper Sparrow	Present	Unknown	Native
Junco hyemalis	Dark-eyed Junco	Present	Unknown	Native
Melospiza georgiana	Swamp Sparrow	Present	Unknown	Native
Melospiza lincolnii	Lincoln’s Sparrow	Present	Unknown	Native
Melospiza melodia	Song Sparrow	Present	Unknown	Native
Passerculus sandwichensis	Savannah Sparrow	Present	Unknown	Native
Passerella iliaca	Fox Sparrow	Present	Unknown	Native
Pipilo erythrophthalmus	Eastern Towhee	Present	Unknown	Native
Pooecetes gramineus	Vesper Sparrow	Present	Unknown	Native
Spizella passerina	Chipping Sparrow	Present	Unknown	Native
Spizella pusilla	Field Sparrow	Present	Unknown	Native
Zonotrichia albicollis	White-throated Sparrow	Present	Unknown	Native
Zonotrichia leucophrys	White-crowned Sparrow	Present	Unknown	Native
Passeriformes/Fringillidae				
Carduelis pinus	Pine Siskin	Present	Unknown	Native
Carduelis tristis	American Goldfinch	Present	Unknown	Native
Carpodacus mexicanus	House Finch	Present	Unknown	Non-native
Carpodacus purpureus	Purple Finch	Present	Unknown	Native
Passeriformes/Hirundinidae				
Hirundo rustica	Barn Swallow	Present	Unknown	Native
Petrochelidon pyrrhonota	Cliff Swallow	Present	Unknown	Native
Progne subis	Purple Martin	Present	Unknown	Native
Stelgidopteryx serripennis	Northern Rough-winged Swallow	Present	Unknown	Native
Tachycineta bicolor	Tree Swallow	Present	Unknown	Native
Passeriformes/Icteridae				
Agelaius phoeniceus	Red-winged Blackbird	Present	Unknown	Native
Dolichonyx oryzivorus	Bobolink	Present	Unknown	Native
Euphagus carolinus	Rusty Blackbird	Present	Unknown	Native
Icterus galbula	Baltimore Oriole	Present	Unknown	Native
Icterus spurius	Orchard Oriole	Present	Unknown	Native
Molothrus ater	Brown-headed Cowbird	Present	Unknown	Native

Table C-4. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Quiscalus quiscula	Common Grackle	Present	Unknown	Native
Sturnella magna	Eastern Meadowlark	Present	Unknown	Native
Passeriformes/Mimidae				
Dumetella carolinensis	Gray Catbird	Present	Unknown	Native
Mimus polyglottos	Northern Mockingbird	Present	Unknown	Native
Toxostoma rufum	Brown Thrasher	Present	Unknown	Native
Passeriformes/Motacillidae				
Anthus rubescens	American Pipit	Present	Unknown	Native
Passeriformes/Paridae				
Baeolophus bicolor	Titmouse, Tufted Titmouse	Present	Unknown	Native
Poecile carolinensis	Carolina Chickadee	Present	Unknown	Native
Passeriformes/Parulidae				
Dendroica caerulescens	Black-throated Blue Warbler	Present	Unknown	Native
Dendroica castanea	Bay-breasted Warbler	Present	Unknown	Native
Dendroica cerulea	Cerulean Warbler	Present	Unknown	Native
Dendroica coronata	Yellow Rumped warbler	Present	Unknown	Native
Dendroica discolor	Prairie Warbler	Present	Unknown	Native
Dendroica dominica	Yellow-throated Warbler	Present	Unknown	Native
Dendroica fusca	Blackburnian Warbler	Present	Unknown	Native
Dendroica magnolia	Magnolia Warbler	Present	Unknown	Native
Dendroica palmarum	Palm Warbler	Present	Unknown	Native
Dendroica palmarum hypochrysea	Palm Warbler (eastern)	Present	Unknown	Native
Dendroica palmarum palmarum	Palm Warbler (western)	Present	Unknown	Native
Dendroica pensylvanica	Chestnut Sided Warbler	Present	Unknown	Native
Dendroica petechia	Yellow Warbler	Present	Unknown	Native
Dendroica pinus	Pine Warbler	Present	Unknown	Native
Dendroica striata	Blackpoll Warbler	Present	Unknown	Native
Dendroica tigrina	Cape May Warbler	Present	Unknown	Native
Dendroica virens	Black Throated Green Warbler	Present	Unknown	Native
Geothlypis trichas	Common Yellowthroat	Present	Unknown	Native
Helmitheros vermivorum	Worm-eating warbler	Present	Unknown	Native
Icteria virens	Yellow-breasted chat	Present	Unknown	Native
Mniotilta varia	Black and White Warbler	Present	Unknown	Native
Oporornis agilis	Connecticut Warbler	Present	Unknown	Native
Oporornis formosus	Kentucky Warbler	Present	Unknown	Native
Oporornis philadelphia	Mourning Warbler	Present	Unknown	Native
Parula americana	Northern Parula	Present	Unknown	Native
Protonotaria citrea	Prothonotary Warbler	Present	Unknown	Native
Seiurus aurocapilla	Ovenbird	Present	Unknown	Native

Table C-4. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Seiurus motacilla	Louisiana Waterthrush	Present	Unknown	Native
Seiurus noveboracensis	Northern Waterthrush	Present	Unknown	Native
Setophaga ruticilla	American Redstart	Present	Unknown	Native
Vermivora celata	Orange-crowned Warbler	Present	Unknown	Native
Vermivora chrysoptera	Golden-winged Warbler	Present	Unknown	Native
Vermivora lawrencii	Lawrence's Warbler	Present	Unknown	Native
Vermivora leucobronchialis	Brewster's Warbler	Present	Unknown	Native
Vermivora peregrina	Tennessee Warbler	Present	Unknown	Native
Vermivora pinus	Blue-winged Warbler	Present	Unknown	Native
Vermivora ruficapilla	Nashville Warbler	Present	Unknown	Native
Wilsonia canadensis	Canada Warbler	Present	Unknown	Native
Wilsonia citrina	Hooded Warbler	Present	Unknown	Native
Wilsonia pusilla	Wilson’s Warbler	Present	Unknown	Native
Passeriformes/Passeridae				
Passer domesticus	House Sparrow	Present	Unknown	Non-native
Passeriformes/Regulidae				
Regulus calendula	Ruby Crowned Kinglet	Present	Unknown	Native
Regulus satrapa	Golden-crowned Kinglet	Present	Unknown	Native
Passeriformes/Sittidae				
Sitta canadensis	Red-breasted Nuthatch	Present	Unknown	Native
Sitta carolinensis	White-breasted Nuthatch	Present	Unknown	Native
Sitta pusilla	Brown Headed Nuthatch	Present	Unknown	Native
Passeriformes/Sturnidae				
Sturnus vulgaris	European Starling	Present	Unknown	Non-native
Passeriformes/Thraupidae				
Piranga olivacea	Scarlet Tanager	Present	Unknown	Native
Piranga rubra	Summer Tanager	Present	Unknown	Native
Passeriformes/Troglodytidae				
Cistothorus palustris	Marsh Wren	Present	Unknown	Native
Cistothorus platensis	Sedge Wren	Present	Unknown	Native
Thryothorus ludovicianus	Carolina Wren	Present	Unknown	Native
Troglodytes aedon	House Wren	Present	Unknown	Native
Troglodytes troglodytes	Winter Wren	Present	Unknown	Native
Passeriformes/Turdidae				
Catharus fuscescens	Veery	Present	Unknown	Native
Catharus guttatus	Hermit Thrush	Present	Unknown	Native
Catharus minimus	Gray-cheeked Thrush	Present	Unknown	Native
Catharus ustulatus	Swainson’s Thrush	Present	Unknown	Native
Hylocichla mustelina	Wood Thrush	Present	Unknown	Native
Sialia sialis	Eastern Bluebird	Present	Unknown	Native

Table C-4. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Turdus migratorius	American Robin	Present	Unknown	Native
Passeriformes/Tyrannidae				
Contopus cooperi	Olive-sided Flycatcher	Present	Unknown	Native
Contopus virens	Eastern Pewee	Present	Unknown	Native
Empidonax flaviventris	Yellow-bellied Flycatcher	Present	Unknown	Native
Empidonax virescens	Acadian Flycatcher	Present	Unknown	Native
Myiarchus crinitus	Great Crested Flycatcher	Present	Unknown	Native
Sayornis phoebe	Eastern Phoebe	Present	Unknown	Native
Tyrannus tyrannus	Eastern Kingbird	Present	Unknown	Native
Passeriformes/Vireonidae				
Vireo flavifrons	Yellow-throated Vireo	Present	Unknown	Native
Vireo griseus	White-eyed Vireo	Present	Unknown	Native
Vireo olivaceus	Red-eyed Vireo	Present	Unknown	Native
Vireo philadelphicus	Philadelphia Vireo	Present	Unknown	Native
Vireo solitarius	Blue-headed Vireo	Present	Unknown	Native
Pelecaniformes/Ardeidae				
Ardea alba	Great Egret	Present	Unknown	Native
Ardea herodias	Great Blue Heron	Present	Unknown	Native
Botaurus lentiginosus	American Bittern	Present	Unknown	Native
Bubulcus ibis	Cattle Egret	Present	Unknown	Native
Butorides virescens	Green Heron	Present	Unknown	Native
Nyctanassa violacea	Yellow Crowned Night Heron	Present	Unknown	Native
Pelecaniformes/Threskiornithidae				
Eudocimus albus	White Ibis	Present	Unknown	Native
Piciformes/Picidae				
Colaptes auratus	Northern Flicker	Present	Unknown	Native
Dryocopus pileatus	Pileated Woodpecker	Present	Unknown	Native
Melanerpes carolinus	Red-bellied Woodpecker	Present	Unknown	Native
Melanerpes erythrocephalus	Red-headed Woodpecker	Present	Unknown	Native
Picoides pubescens	Downy Woodpecker	Present	Unknown	Native
Picoides villosus	Hairy Woodpecker	Present	Unknown	Native
Sphyrapicus varius	Yellow-bellied Sapsucker	Present	Unknown	Native
Podicipediformes/Podicipedidae				
Podilymbus podiceps	Pied-billed Grebe	Present	Unknown	Native
Strigiformes/Strigidae				
Bubo virginianus	Great Horned Owl	Present	Unknown	Native
Otus asio	Eastern Screech Owl	Present	Unknown	Native
Strix varia	Barred Owl	Present	Unknown	Native
Suliformes/Phalacrocoracidae				
Phalacrocorax auritus	Double-crested Cormorant	Present	Unknown	Native

Table C-5. Bird species known or likely to occur at Congaree National Park. This species list reflects all NPSpecies/IRMA entries and updates through October 2013, and is currently undergoing review and update.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Accipitriformes/Accipitridae				
Accipiter cooperii	Cooper's Hawk	Present	Uncommon	Native
Accipiter striatus	Sharp-shinned Hawk	Present	Uncommon	Native
Aquila chrysaetos	Golden Eagle	Present	Rare	Native
Buteo jamaicensis	Red-tailed Hawk	Present	Uncommon	Native
Buteo lineatus	Red-shouldered Hawk	Present	Abundant	Native
Buteo platypterus	Broad-winged Hawk	Present	Occasional	Native
Buteo swainsoni	Swainson's Hawk	Present	Rare	Native
Circus cyaneus	Northern Harrier	Present	Uncommon	Native
Elanoides forficatus	Swallow-tailed Kite	Present	Rare	Native
Haliaeetus leucocephalus	Bald Eagle	Present	Occasional	Native
Ictinia mississippiensis	Mississippi Kite	Present	Uncommon	Native
Accipitriformes/Cathartidae				
Cathartes aura	Turkey Vulture	Present	Common	Native
Coragyps atratus	Black Vulture	Present	Common	Native
Accipitriformes/Pandionidae				
Pandion haliaetus	Osprey	Present	Uncommon	Native
Anseriformes/Anatidae				
Aix sponsa	Wood Duck	Present	Common	Native
Anas americana	American Wigeon	Present	Rare	Native
Anas clypeata	Northern Shoveler	Present	Rare	Native
Anas crecca	Green-winged Teal	Present	Rare	Native
Anas discors	Blue-winged Teal	Present	Rare	Native
Anas platyrhynchos	Mallard	Present	Rare	Native
Anas rubripes	American Black Duck	Present	Rare	Native
Aythya collaris	Ring-necked Duck	Present	Rare	Native
Branta canadensis	Canada Goose	Present	Uncommon	Native
Lophodytes cucullatus	Hooded Merganser	Present	Uncommon	Native
Apodiformes/Apodidae				
Chaetura pelagica	Chimney Swift	Present	Abundant	Native
Apodiformes/Trochilidae				
Archilochus colubris	Ruby-throated Hummingbird	Present	Common	Native
Charadriiformes/Charadriidae				
Charadrius vociferus	Killdeer	Present	Rare	Native
Charadriiformes/Laridae				
Larus delawarensis	Ring-billed Gull	Present	Rare	Native
Larus philadelphia	Boneparte's Gull	Present	Rare	Native
Sterna caspia	Caspian Tern	Present	Rare	Native
Charadriiformes/Scolopacidae				

Table C-5. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Actitis macularia	Spotted Sandpiper	Present	Rare	Native
Gallinago gallinago	Common Snipe	Present	Rare	Native
Scolopax minor	American Woodcock	Present	Occasional	Native
Tringa flavipes	Lesser Yellowlegs	Present	Rare	Native
Tringa solitaria	Solitary Sandpiper	Present	Rare	Native
Ciconiiformes/Ciconiidae				
Mycteria americana	Wood Stork	Present	Occasional	Native
Columbiformes/Columbidae				
Columba livia	Rock Dove	Present	Rare	Non-native
Streptopelia decaocto	Eurasian Collared-dove	Present	Rare	Non-native
Zenaida macroura	Mourning Dove	Present	Common	Native
Coraciiformes/Alcedinidae				
Megaceryle alcyon	Belted Kingfisher	Present	Uncommon	Native
Cuculiformes/Cuculidae				
Coccyzus americanus	Yellow-billed Cuckoo	Present	Common	Native
Coccyzus erythropthalmus	Black-billed Cuckoo	Present	Rare	Native
Falconiformes/Falconidae				
Falco columbarius	Merlin	Present	Unknown	Native
Falco peregrinus	Peregrine Falcon	Present	Rare	Native
Falco sparverius	American Kestrel	Present	Occasional	Native
Galliformes/Odontophoridae				
Colinus virginianus	Northern Bobwhite	Present	Uncommon	Native
Galliformes/Phasianidae				
Meleagris gallopavo	Wild Turkey	Present	Common	Native
Passeriformes/Bombycillidae				
Bombycilla cedrorum	Cedar Waxwing	Present	Uncommon	Native
Passeriformes/Cardinalidae				
Cardinalis cardinalis	Northern Cardinal	Present	Abundant	Native
Guiraca caerulea	Blue Grosbeak	Present	Occasional	Native
Passerina cyanea	Indigo Bunting	Present	Common	Native
Pheucticus ludovicianus	Rose-breasted Grosbeak	Present	Occasional	Native
Passeriformes/Certhiidae				
Certhia americana	Brown Creeper	Present	Common	Native
Polioptila caerulea	Blue-gray Gnatcatcher	Present	Common	Native
Passeriformes/Corvidae				
Corvus brachyrhynchos	American Crow, Common Crow	Present	Abundant	Native
Corvus ossifragus	Fish Crow	Present	Common	Native
Cyanocitta cristata	Blue Jay	Present	Common	Native
Passeriformes/Emberizidae				
Aimophila aestivalis	Bachman's Sparrow	Present	Rare	Native

Table C-5. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Ammodramus henslowii	Henslow's Sparrow	Present	Rare	Native
Junco hyemalis	Dark-eyed Junco	Present	Uncommon	Native
Melospiza georgiana	Swamp Sparrow	Present	Uncommon	Native
Melospiza lincolnii	Lincoln's Sparrow	Present	Rare	Native
Melospiza melodia	Song Sparrow	Present	Uncommon	Native
Passerculus sandwichensis	Savannah Sparrow	Present	Rare	Native
Passerella iliaca	Fox Sparrow	Present	Uncommon	Native
Pipilo erythrophthalmus	Eastern Towhee	Present	Common	Native
Pooecetes gramineus	Vesper Sparrow	Present	Rare	Native
Spizella passerina	Chipping Sparrow	Present	Occasional	Native
Spizella pusilla	Field Sparrow	Present	Occasional	Native
Zonotrichia albicollis	White-throated Sparrow	Present	Common	Native
Passeriformes/Fringillidae				
Carduelis pinus	Pine Siskin	Present	Rare	Native
Carduelis tristis	American Goldfinch	Present	Common	Native
Carpodacus mexicanus	House Finch	Present	Rare	Non-native
Carpodacus purpureus	Purple Finch	Present	Occasional	Native
Coccothraustes vespertinus	Evening Grosbeak	Present	Occasional	Native
Passeriformes/Hirundinidae				
Hirundo pyrrhonota	Cliff Swallow	Present	Uncommon	Native
Hirundo rustica	Barn Swallow	Present	Uncommon	Native
Progne subis	Purple Martin	Present	Uncommon	Native
Riparia riparia	Bank Swallow	Present	Unknown	Native
Stelgidopteryx serripennis	Rough-winged Swallow	Present	Occasional	Native
Tachycineta bicolor	Tree Swallow	Present	Occasional	Native
Passeriformes/Icteridae				
Agelaius phoeniceus	Red-winged Blackbird	Present	Uncommon	Native
Dolichonyx oryzivorus	Bobolink	Present	Rare	Native
Euphagus carolinus	Rusty Blackbird	Present	Rare	Native
Icterus galbula	Baltimore Oriole	Present	Rare	Native
Icterus spurius	Orchard Oriole	Present	Rare	Native
Molothrus ater	Brown-headed Cowbird	Present	Uncommon	Native
Quiscalus quiscula	Common Grackle	Present	Common	Native
Sturnella magna	Eastern Meadowlark	Present	Rare	Native
Passeriformes/Laniidae				
Lanius ludovicianus	Loggerhead Shrike	Present	Rare	Native
Passeriformes/Mimidae				
Dumetella carolinensis	Catbird, Gray Catbird	Present	Uncommon	Native
Mimus polyglottos	Mockingbird	Present	Uncommon	Native
Toxostoma rufum	Brown Thrasher	Present	Uncommon	Native
Passeriformes/Motacillidae				

Table C-5. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Anthus rubescens	American Pipit	Present	Rare	Native
Passeriformes/Paridae				
Baeolophus bicolor	Tufted Titmouse	Present	Abundant	Native
Poecile carolinensis	Carolina Chickadee	Present	Abundant	Native
Passeriformes/Parulidae				
Dendroica caerulescens	Black-throated Blue Warbler	Present	Common	Native
Dendroica castanea	Bay-breasted Warbler	Present	Rare	Native
Dendroica cerulea	Cerulean Warbler	Present	Rare	Native
Dendroica coronata	Yellow-rumped Warbler	Present	Abundant	Native
Dendroica discolor	Prairie Warbler	Present	Occasional	Native
Dendroica dominica	Yellow-throated Warbler	Present	Abundant	Native
Dendroica fusca	Blackburnian Warbler	Present	Rare	Native
Dendroica magnolia	Magnolia Warbler	Present	Uncommon	Native
Dendroica palmarum	Palm Warbler	Present	Rare	Native
Dendroica pensylvanica	Chestnut-sided Warbler	Present	Uncommon	Native
Dendroica petechia	Yellow Warbler	Present	Rare	Native
Dendroica pinus	Pine Warbler	Present	Abundant	Native
Dendroica striata	Blackpoll Warbler	Present	Rare	Native
Dendroica tigrina	Cape May Warbler	Present	Rare	Native
Dendroica virens	Black-throated Green Warbler	Present	Rare	Native
Geothlypis trichas	Common Yellowthroat	Present	Uncommon	Native
Helmitheros vermivorus	Worm-eating Warbler	Present	Uncommon	Native
Icteria virens	Yellow-breasted Chat	Present	Uncommon	Native
Limnothlypis swainsonii	Swainson's Warbler	Present	Common	Native
Mniotilta varia	Black-and-white Warbler	Present	Uncommon	Native
Oporornis formosus	Kentucky Warbler	Present	Common	Native
Oporornis philadelphia	Mourning Warbler	Present	Rare	Native
Parula americana	Northern Parula	Present	Abundant	Native
Protonotaria citrea	Prothonotary Warbler	Present	Common	Native
Seiurus aurocapillus	Ovenbird	Present	Uncommon	Native
Seiurus motacilla	Louisiana Waterthrush	Present	Uncommon	Native
Seiurus noveboracensis	Northern Waterthrush	Present	Uncommon	Native
Setophaga ruticilla	American Redstart	Present	Common	Native
Vermivora celata	Orange-crowned Warbler	Present	Occasional	Native
Vermivora chrysoptera	Golden-winged Warbler	Present	Rare	Native
Vermivora peregrina	Tennessee Warbler	Present	Rare	Native
Vermivora pinus	Blue-winged Warbler	Present	Rare	Native
Vermivora ruficapilla	Nashville Warbler	Present	Rare	Native
Wilsonia canadensis	Canada Warbler	Present	Rare	Native
Wilsonia citrina	Hooded Warbler	Present	Common	Native

Table C-5. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Passeriformes/Passeridae				
Passer domesticus	House Sparrow	Present	Rare	Non-native
Passeriformes/Regulidae				
Regulus calendula	Ruby-crowned Kinglet	Present	Abundant	Native
Regulus satrapa	Golden-crowned Kinglet	Present	Common	Native
Passeriformes/Sittidae				
Sitta canadensis	Red-breasted Nuthatch	Present	Rare	Native
Sitta carolinensis	White-breasted Nuthatch	Present	Common	Native
Sitta pusilla	Brown-headed Nuthatch	Present	Common	Native
Passeriformes/Sturnidae				
Sturnus vulgaris	European Starling	Present	Rare	Non-native
Passeriformes/Thraupidae				
Piranga olivacea	Scarlet Tanager	Present	Uncommon	Native
Piranga rubra	Summer Tanager	Present	Common	Native
Passeriformes/Troglodytidae				
Thryothorus ludovicianus	Carolina Wren	Present	Abundant	Native
Troglodytes aedon	House Wren	Present	Uncommon	Native
Troglodytes troglodytes	Winter Wren	Present	Common	Native
Passeriformes/Turdidae				
Catharus bicknelli	Bicknell's Thrush	Present	Rare	Native
Catharus fuscescens	Veery	Present	Uncommon	Native
Catharus guttatus	Hermit Thrush	Present	Common	Native
Catharus minimus	Gray-cheeked Thrush	Present	Rare	Native
Catharus ustulatus	Swainson’s Thrush	Present	Uncommon	Native
Hylocichla mustelina	Wood Thrush	Present	Common	Native
Sialia sialis	Eastern Bluebird	Present	Uncommon	Native
Turdus migratorius	American Robin	Present	Common	Native
Passeriformes/Tyrannidae				
Contopus borealis	Olive-sided Flycatcher	Present	Rare	Native
Contopus virens	Eastern Wood-pewee	Present	Common	Native
Empidonax minimus	Least Flycatcher	Present	Rare	Native
Empidonax virescens	Acadian Flycatcher	Present	Common	Native
Myiarchus crinitus	Great Crested Flycatcher	Present	Common	Native
Sayornis phoebe	Eastern Phobe	Present	Common	Native
Tyrannus tyrannus	Eastern Kingbird	Present	Uncommon	Native
Tyrannus verticalis	Western Kingbird	Present	Rare	Native
Passeriformes/Vireonidae				
Vireo flavifrons	Yellow-throated Vireo	Present	Common	Native
Vireo gilvus	Warbling Vireo	Present	Rare	Native
Vireo griseus	White-eyed Vireo	Present	Common	Native

Table C-5. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Vireo olivaceus	Red-eyed Vireo	Present	Common	Native
Vireo philadelphicus	Philadelphia Vireo	Present	Rare	Native
Vireo solitarius	Blue-headed Vireo	Present	Common	Native
Pelecaniformes/Ardeidae				
Ardea alba	Great Egret	Present	Uncommon	Native
Ardea herodias	Great Blue Heron	Present	Common	Native
Botaurus lentiginosus	American Bittern	Present	Rare	Native
Bubulcus ibis	Cattle Egret	Present	Rare	Native
Butorides virescens	Green Heron	Present	Uncommon	Native
Egretta caerulea	Little Blue Heron	Present	Rare	Native
Egretta thula	Snowy Egret	Present	Rare	Native
Nyctanassa violacea	Yellow-crowned Night-heron	Present	Uncommon	Native
Pelecaniformes/Threskiornithidae				
Ajaia ajaja	Roseate Spoonbill	Present	Rare	Native
Eudocimus albus	White Ibis	Present	Occasional	Native
Piciformes/Picidae				
Colaptes auratus	Northern Flicked	Present	Common	Native
Dryocopus pileatus	Pileated Woodpecker	Present	Abundant	Native
Melanerpes carolinus	Red-bellied Woodpecker	Present	Abundant	Native
Melanerpes erythrocephalus	Red-headed Woodpecker	Present	Common	Native
Picoides pubescens	Downy Woodpecker	Present	Common	Native
Picoides villosus	Hairy Woodpecker	Present	Common	Native
Sphyrapicus varius	Yellow-bellied Sapsucker	Present	Common	Native
Podicipediformes/Podicipedidae				
Podilymbus podiceps	Pied-billed Grebe	Present	Rare	Native
Strigiformes/Caprimulgidae				
Caprimulgus carolinensis	Chuck-will's-widow	Present	Uncommon	Native
Caprimulgus vociferus	Whip-poor-will	Present	Uncommon	Native
Chordeiles minor	Common Nighthawk	Present	Rare	Native
Strigiformes/Strigidae				
Bubo virginianus	Great Horned Owl	Present	Uncommon	Native
Megascops asio	Eastern Screech Owl	Present	Uncommon	Native
Strix varia	Barred Owl	Present	Abundant	Native
Suliformes/Anhingidae				
Anhinga anhinga	Anhinga	Present	Uncommon	Native
Suliformes/Phalacrocoracidae				
Phalacrocorax auritus	Double-crested Cormorant	Present	Occasional	Native

Table C-6. Bird species known or likely to occur at Cumberland Island National Seashore. This species list reflects all NPSpecies/IRMA entries and updates through October 2013, and are currently undergoing review and update.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Accipitriformes/Accipitridae				
Accipiter cooperii	Cooper's Hawk	Present	Uncommon	Native
Accipiter striatus	Sharp-shinned Hawk	Present	Uncommon	Native
Aquila chrysaetos	Golden Eagle	Present	Occasional	Native
Buteo jamaicensis	Red-tailed Hawk	Present	Common	Native
Buteo lagopus	Rough-legged Hawk	Present	Occasional	Native
Buteo lineatus	Red-shouldered Hawk	Present	Common	Native
Buteo platypterus	Broad-winged Hawk	Present	Rare	Native
Circus cyaneus	Northern Harrier	Present	Common	Native
Elanoides forficatus	American Swallow-tailed Kite	Present	Rare	Native
Haliaeetus leucocephalus	Bald Eagle	Present	Uncommon	Native
Ictinia mississippiensis	Mississippi Kite	Present	Occasional	Native
Accipitriformes/Cathartidae				
Cathartes aura	Turkey Vulture	Present	Common	Native
Coragyps atratus	Black Vulture	Present	Common	Native
Accipitriformes/Pandionidae				
Pandion haliaetus	Osprey	Present	Common	Native
Anseriformes/Anatidae				
Aix sponsa	Wood Duck	Present	Common	Native
Anas acuta	Northern Pintail	Present	Common	Native
Anas americana	American Wigeon	Present	Common	Native
Anas clypeata	Northern Shoveler	Present	Common	Native
Anas crecca	Green-winged Teal	Present	Common	Native
Anas discors	Blue-winged Teal	Present	Uncommon	Native
Anas fulvigula	Mottled Duck	Present	Occasional	Native
Anas penelope	Eurasian Wigeon	Present	Occasional	Native
Anas platyrhynchos	Mallard	Present	Common	Native
Anas rubripes	American Black Duck	Present	Common	Native
Anas strepera	Gadwall	Present	Common	Native
Aythya affinis	Lesser Scaup	Present	Common	Native
Aythya americana	Redhead	Present	Uncommon	Native
Aythya collaris	Ring-necked Duck	Present	Common	Native
Aythya marila	Greater Scaup	Present	Rare	Native
Aythya valisineria	Canvasback	Present	Common	Native
Branta bernicla	Brant	Present	Occasional	Native
Branta canadensis	Canada Goose	Present	Uncommon	Native
Bucephala albeola	Bufflehead	Present	Common	Native
Bucephala clangula	Common Goldeneye	Present	Uncommon	Native
Chen caerulescens	Snow Goose	Present	Rare	Native
Clangula hyemalis	Oldsquaw	Present	Uncommon	Native
Cygnus columbianus	Tundra Swan	Present	Occasional	Native
Dendrocygna bicolor	Fulvous Whistling-Duck	Present	Occasional	Native

Table C-6. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Lophodytes cucullatus	Hooded Merganser	Present	Common	Native
Melanitta fusca	White-winged Scoter	Present	Uncommon	Native
Melanitta nigra	Black Scoter	Present	Common	Native
Melanitta perspicillata	Surf Scoter	Present	Uncommon	Native
Mergus merganser	Common Merganser	Present	Rare	Native
Mergus serrator	Red-breasted Merganser	Present	Common	Native
Oxyura jamaicensis	Ruddy Duck	Present	Common	Native
Somateria spectabilis	King Eider	Present	Occasional	Native
Apodiformes/Apodidae				
Chaetura pelagica	Chimney Swift	Present	Common	Native
Apodiformes/Trochilidae				
Archilochus colubris	Ruby-throated Hummingbird	Present	Common	Native
Charadriiformes/Alcidae				
Alca torda	Razorbill	Probably Present		Native
Alle alle	Dovekie	Probably Present		Native
Charadriiformes/Charadriidae				
Charadrius melodus	Piping Plover	Present	Uncommon	Native
Charadrius montanus	Mountain Plover	Present	Occasional	Native
Charadrius semipalmatus	Semipalmated Plover	Present	Common	Native
Charadrius vociferus	Killdeer	Present	Common	Native
Charadrius wilsonia	Wilson's Plover	Present	Common	Native
Pluvialis dominica	American Golden-plover	Present	Rare	Native
Pluvialis squatarola	Black-bellied Plover	Present	Common	Native
Charadriiformes/Haematopodidae				
Haematopus palliatus	American Oystercatcher	Present	Common	Native
Charadriiformes/Laridae				
Anous stolidus	Brown Noddy	Probably Present		Native
Chlidonias niger	Black Tern	Present	Common	Native
Larus argentatus	Herring Gull	Present	Common	Native
Larus atricilla	Laughing Gull	Present	Common	Native
Larus delawarensis	Ring-billed Gull	Present	Common	Native
Larus fuscus	Lesser Black-backed Gull	Present	Rare	Native
Larus glaucoides	Iceland Gull	Present	Occasional	Native
Larus hyperboreus	Glaucous Gull	Present	Occasional	Native
Larus marinus	Great Black-backed Gull	Present	Common	Native
Larus philadelphia	Bonaparte’s Gull	Present	Common	Native
Rissa tridactyla	Black-legged Kittiwake	Probably Present		Native
Rynchops niger	Black Skimmer	Present	Common	Native
Sterna anaethetus	Bridled Tern	Probably Present		Native
Sterna antillarum	Least Tern	Present	Common	Native
Sterna caspia	Caspian Tern	Present	Uncommon	Native
Sterna forsteri	Forster's Tern	Present	Common	Native
Sterna fuscata	Sooty Tern	Probably Present		Non-native

Table C-6. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Sterna hirundo	Common Tern	Present	Rare	Native
Sterna maxima	Royal Tern	Present	Common	Native
Sterna nilotica	Gull-billed Tern	Present	Uncommon	Native
Sterna sandvicensis	Sandwich Tern	Present	Uncommon	Native
Xema sabini	Sabine's Gull	Present	Occasional	Native
Charadriiformes/Recurvirostridae				
Himantopus mexicanus	Black-necked Stilt	Present	Rare	Native
Recurvirostra americana	American Avocet	Present	Rare	Native
Charadriiformes/Scolopacidae				
Actitis macularia	Spotted Sandpiper	Present	Common	Native
Arenaria interpres	Ruddy Turnstone	Present	Common	Native
Bartramia longicauda	Upland Sandpiper	Present	Rare	Native
Calidris alba	Sanderling	Present	Common	Native
Calidris alpina	Dunlin	Present	Common	Native
Calidris bairdii	Baird's Sandpiper	Present	Occasional	Native
Calidris canutus	Red Knot	Present	Common	Native
Calidris fuscicollis	White-rumped Sandpiper	Present	Uncommon	Native
Calidris himantopus	Stilt Sandpiper	Present	Uncommon	Native
Calidris maritima	Purple Sandpiper	Present	Rare	Native
Calidris mauri	Western Sandpiper	Present	Common	Native
Calidris melanotos	Pectoral Sandpiper	Present	Common	Native
Calidris minutilla	Least Sandpiper	Present	Common	Native
Calidris pusilla	Semipalmated Sandpiper	Present	Common	Native
Catoptrophorus semipalmatus	Willet	Present	Common	Native
Gallinago gallinago	Common Snipe	Present	Common	Native
Limnodromus griseus	Short-billed Dowitcher	Present	Common	Native
Limnodromus scolopaceus	Long-billed Dowitcher	Present	Occasional	Native
Limosa fedoa	Marbled Godwit	Present	Uncommon	Native
Numenius americanus	Long-billed Curlew	Present	Rare	Native
Numenius phaeopus	Whimbrel	Present	Rare	Native
Phalaropus fulicaria	Red Phalarope	Present	Common	Native
Phalaropus lobatus	Red-necked Phalarope	Present	Rare	Native
Phalaropus tricolor	Wilson's Phalarope	Present	Rare	Native
Scolopax minor	American Woodcock	Present	Uncommon	Native
Tringa flavipes	Lesser Yellowlegs	Present	Uncommon	Native
Tringa melanoleuca	Greater Yellowlegs	Present	Common	Native
Tringa solitaria	Solitary Sandpiper	Present	Common	Native
Tryngites subruficollis	Buff-breasted Sandpiper	Present	Rare	Native
Charadriiformes/Stercorariidae				
Stercorarius parasiticus	Parasitic Jaeger	Probably Present		Native
Stercorarius pomarinus	Pomarine Jaeger	Probably Present		Native
Ciconiiformes/Ciconiidae				
Mycteria americana	Wood Stork	Present	Common	Native
Columbiformes/Columbidae				

Table C-6. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Columba livia	Rock Dove	Present	Common	Non-native
Columbina passerina	Common Ground-dove	Present	Common	Native
Streptopelia decaocto	Eurasian Collared-dove	Probably Present		Non-native
Zenaida asiatica	White-winged Dove	Present	Occasional	Native
Zenaida macroura	Mourning Dove	Present	Common	Native
Coraciiformes/Alcedinidae				
Ceryle alcyon	Belted Kingfisher	Present	Common	Native
Cuculiformes/Cuculidae				
Coccyzus americanus	Yellow-billed Cuckoo	Present	Common	Native
Coccyzus erythropthalmus	Black-billed Cuckoo	Present	Uncommon	Native
Falconiformes/Falconidae				
Falco columbarius	Merlin	Present	Uncommon	Native
Falco peregrinus	Peregrine Falcon	Present	Uncommon	Native
Falco sparverius	American Kestrel	Present	Common	Native
Galliformes/Phasianidae				
Meleagris gallopavo	Wild Turkey	Present	Common	Native
Gaviiformes/Gaviidae				
Gavia immer	Common Loon	Present	Common	Native
Gavia stellata	Red-throated Loon	Present	Uncommon	Native
Gruiformes/Gruidae				
Grus canadensis	Sandhill Crane	Present	Occasional	Native
Gruiformes/Rallidae				
Coturnicops noveboracensis	Yellow Rail	Present	Rare	Native
Fulica americana	American Coot	Present	Rare	Native
Gallinula chloropus	Common Moorhen	Present	Common	Native
Laterallus jamaicensis	Black Rail	Present	Rare	Native
Porphyrula martinica	Purple Gallinule	Present	Common	Native
Porzana carolina	Sora	Present	Uncommon	Native
Rallus elegans	King Rail	Present	Common	Native
Rallus limicola	Virginia Rail	Present	Common	Native
Rallus longirostris	Clapper Rail	Present	Common	Native
Passeriformes/Bombycillidae				
Bombycilla cedrorum	Cedar Waxwing	Present	Common	Native
Passeriformes/Cardinalidae				
Cardinalis cardinalis	Northern Cardinal	Present	Common	Native
Guiraca caerulea	Blue Grosbeak	Present	Uncommon	Native
Passerina ciris	Painted Bunting	Present	Common	Native
Passerina cyanea	Indigo Bunting	Present	Uncommon	Native
Passeriformes/Certhiidae				
Certhia familiaris	Brown Creeper	Present	Uncommon	Native
Polioptila caerulea	Blue-gray Gnatcatcher	Present	Common	Native
Passeriformes/Corvidae				
Corvus brachyrhynchos	American Crow	Present	Common	Native
Corvus ossifragus	Fish Crow	Present	Common	Native

Table C-6. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Cyanocitta cristata	Blue Jay	Present	Common	Native
Passeriformes/Emberizidae				
Aimophila aestivalis	Bachman's Sparrow	Present	Uncommon	Native
Ammodramus caudacutus	Saltmarsh Sharp-tailed Sparrow	Present	Common	Native
Ammodramus henslowii	Henslow's Sparrow	Present	Occasional	Native
Ammodramus leconteii	Le Conte's Sparrow	Present	Occasional	Native
Ammodramus maritimus	Seaside Sparrow	Present	Common	Native
Ammodramus nelsoni	Nelson's Sharp-tailed Sparrow	Present	Common	Native
Ammodramus savannarum	Grasshopper Sparrow	Present	Occasional	Native
Calamospiza melanocorys	Lark Bunting	Present	Occasional	Native
Calcarius lapponicus	Lapland Longspur	Present	Occasional	Native
Chondestes grammacus	Lark Sparrow	Present	Occasional	Native
Junco hyemalis	Dark-eyed Junco	Present	Common	Native
Melospiza georgiana	Swamp Sparrow	Present	Common	Native
Melospiza lincolnii	Lincoln's Sparrow	Present	Occasional	Native
Melospiza melodia	Song Sparrow	Present	Common	Native
Passerculus sandwichensis	Savannah Sparrow	Present	Common	Native
Passerella iliaca	Fox Sparrow	Present	Uncommon	Native
Pipilo erythrophthalmus	Eastern Towhee	Present	Common	Native
Plectrophenax nivalis	Snow Bunting	Present	Occasional	Native
Pooecetes gramineus	Vesper Sparrow	Present	Uncommon	Native
Spizella passerina	Chipping Sparrow	Present	Common	Native
Spizella pusilla	Field Sparrow	Present	Common	Native
Zonotrichia albicollis	White-throated Sparrow	Present	Common	Native
Zonotrichia leucophrys	White-crowned Sparrow	Present	Occasional	Native
Passeriformes/Fringillidae				
Carduelis pinus	Pine Siskin	Present	Rare	Native
Carduelis tristis	American Goldfinch	Present	Common	Native
Carpodacus purpureus	Purple Finch	Present	Uncommon	Native
Loxia curvirostra	Red Crossbill	Present	Occasional	Native
Passeriformes/Hirundinidae				
Hirundo rustica	Barn Swallow	Present	Common	Native
Petrochelidon pyrrhonota	Cliff Swallow	Present	Rare	Native
Progne subis	Purple Martin	Present	Common	Native
Riparia riparia	Bank Swallow	Present	Uncommon	Native
Stelgidopteryx serripennis	Northern Rough-winged Swallow	Present	Common	Native
Tachycineta bicolor	Tree Swallow	Present	Common	Native
Passeriformes/Icteridae				
Agelaius phoeniceus	Red-winged Blackbird	Present	Common	Native
Cassidix major	Boat-tailed Grackle	Present	Common	Native
Dolichonyx oryzivorus	Bobolink	Present	Common	Native
Euphagus carolinus	Rusty Blackbird	Present	Uncommon	Native

Table C-6. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Icterus galbula	Baltimore Oriole	Present	Rare	Native
Icterus spurius	Orchard Oriole	Present	Common	Native
Molothrus ater	Brown-headed Cowbird	Present	Common	Native
Quiscalus major	Boat-tailed Grackle	Present	Common	Native
Quiscalus quiscula	Common Grackle	Present	Common	Native
Sturnella magna	Eastern Meadowlark	Present	Common	Native
Sturnella neglecta	Western Meadowlark	Present	Occasional	Native
Xanthocephalus xanthocephalus	Yellow-headed Blackbird	Present	Occasional	Native
Passeriformes/Laniidae				
Lanius ludovicianus	Loggerhead Shrike	Present	Common	Native
Passeriformes/Mimidae				
Dumetella carolinensis	Gray Catbird	Present	Common	Native
Mimus polyglottos	Northern Mockingbird	Present	Common	Native
Toxostoma rufum	Brown Thrasher	Present	Common	Native
Passeriformes/Motacillidae				
Anthus rubescens	American Pipit	Present	Common	Native
Anthus spragueii	Sprague's Pipit	Present	Occasional	Native
Passeriformes/Paridae				
Baeolophus bicolor	Tufted Titmouse	Present	Rare	Native
Poecile carolinensis	Carolina Chickadee	Present	Common	Native
Passeriformes/Parulidae				
Dendroica caerulescens	Black-throated Blue Warbler	Present	Common	Native
Dendroica coronata	Yellow-rumped Warbler	Present	Common	Native
Dendroica discolor	Prairie Warbler	Present	Common	Native
Dendroica dominica	Yellow-throated Warbler	Present	Common	Native
Dendroica fusca	Blackburnian Warbler	Present	Rare	Native
Dendroica kirtlandii	Kirtland's Warbler	Present	Occasional	Native
Dendroica magnolia	Magnolia Warbler	Present	Uncommon	Native
Dendroica palmarum	Palm Warbler	Present	Common	Native
Dendroica pensylvanica	Chestnut-sided Warbler	Present	Uncommon	Native
Dendroica petechia	Yellow Warbler	Present	Common	Native
Dendroica pinus	Pine Warbler	Present	Common	Native
Dendroica striata	Blackpoll Warbler	Present	Common	Native
Dendroica tigrina	Cape May Warbler	Present	Common	Native
Dendroica virens	Black-throated Green Warbler	Present	Uncommon	Native
Geothlypis trichas	Common Yellowthroat	Present	Common	Native
Helmitheros vermivorus	Worm-eating Warbler	Present	Uncommon	Native
Icteria virens	Yellow-breasted Chat	Present	Uncommon	Native
Limnothlypis swainsonii	Swainson's Warbler	Present	Rare	Native
Mniotilta varia	Black-and-white Warbler	Present	Common	Native
Oporornis agilis	Connecticut Warbler	Present	Uncommon	Native
Oporornis formosus	Kentucky Warbler	Present	Common	Native

Table C-6. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Parula americana	Northern Parula	Present	Common	Native
Protonotaria citrea	Prothonotary Warbler	Present	Common	Native
Seiurus aurocapillus	Ovenbird	Present	Common	Native
Seiurus motacilla	Louisiana Waterthrush	Present	Common	Native
Seiurus noveboracensis	Northern Waterthrush	Present	Uncommon	Native
Setophaga ruticilla	American Redstart	Present	Common	Native
Vermivora celata	Orange-crowned Warbler	Present	Common	Native
Vermivora chrysoptera	Golden-winged Warbler	Present	Occasional	Native
Vermivora peregrina	Tennessee Warbler	Present	Uncommon	Native
Vermivora pinus	Blue-winged Warbler	Present	Uncommon	Native
Vermivora ruficapilla	Nashville Warbler	Present	Common	Native
Wilsonia canadensis	Canada Warbler	Present	Occasional	Native
Wilsonia citrina	Hooded Warbler	Present	Common	Native
Wilsonia pusilla	Wilson's Warbler	Present	Occasional	Native
Passeriformes/Passeridae				
Passer domesticus	House Sparrow	Present	Common	Non-native
Passeriformes/Regulidae				
Regulus calendula	Ruby-crowned Kinglet	Present	Common	Native
Regulus satrapa	Golden-crowned Kinglet	Present	Uncommon	Native
Passeriformes/Sittidae				
Sitta canadensis	Red-breasted Nuthatch	Present	Uncommon	Native
Sitta carolinensis	White-breasted Nuthatch	Present	Uncommon	Native
Sitta pusilla	Brown-headed Nuthatch	Present	Common	Native
Passeriformes/Sturnidae				
Sturnus vulgaris	European Starling	Present	Common	Non-native
Passeriformes/Thraupidae				
Piranga olivacea	Scarlet Tanager	Present	Uncommon	Native
Piranga rubra	Summer Tanager	Present	Common	Native
Passeriformes/Troglodytidae				
Cistothorus palustris	Marsh Wren	Present	Common	Native
Cistothorus platensis	Sedge Wren	Present	Uncommon	Native
Thryomanes bewickii	Bewick's Wren	Present	Rare	Native
Thryothorus ludovicianus	Carolina Wren	Present	Common	Native
Troglodytes aedon	House Wren	Present	Uncommon	Native
Troglodytes troglodytes	Winter Wren	Present	Uncommon	Native
Passeriformes/Turdidae				
Catharus fuscescens	Veery	Present	Uncommon	Native
Catharus guttatus	Hermit Thrush	Present	Common	Native
Catharus minimus	Gray-cheeked Thrush	Present	Uncommon	Native
Catharus ustulatus	Swainson's Thrush	Present	Common	Native
Hylocichla mustelina	Wood Thrush	Present	Common	Native
Sialia sialis	Eastern Bluebird	Present	Common	Native
Turdus migratorius	American Robin	Present	Common	Native
Passeriformes/Tyrannidae				

Table C-6. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Contopus virens	Eastern Wood-pewee	Present	Common	Native
Empidonax flaviventris	Yellow-bellied Flycatcher	Present	Occasional	Native
Empidonax minimus	Least Flycatcher	Present	Rare	Native
Empidonax traillii	Willow Flycatcher	Present	Occasional	Native
Empidonax virescens	Scadian Flycatcher	Present	Common	Native
Myiarchus crinitus	Great Crested Flycatcher	Present	Common	Native
Pyrocephalus rubinus	Vermilion Flycatcher	Present	Occasional	Native
Sayornis phoebe	Eastern Phobe	Present	Common	Native
Tyrannus dominicensis	Gray Kingbird	Present	Rare	Native
Tyrannus tyrannus	Eastern Kingbird	Present	Common	Native
Tyrannus verticalis	Western Kingbird	Present	Occasional	Native
Passeriformes/Vireonidae				
Vireo flavifrons	Yellow-throated Vireo	Present	Common	Native
Vireo griseus	White-eyed Vireo	Present	Common	Native
Vireo olivaceus	Red-eyed Vireo	Present	Common	Native
Vireo philadelphicus	Philadelphia Vireo	Present	Occasional	Native
Vireo solitarius	Blue-headed Vireo	Present	Common	Native
Pelecaniformes/Ardeidae				
Ardea alba	Great Egret	Present	Common	Native
Ardea herodias	Great Blue Heron	Present	Common	Native
Botaurus lentiginosus	American Bittern	Present	Uncommon	Native
Bubulcus ibis	Cattle Egret	Present	Common	Native
Butorides virescens	Green Heron	Present	Common	Native
Egretta caerulea	Little Blue Heron	Present	Common	Native
Egretta rufescens	Reddish Egret	Present	Occasional	Native
Egretta thula	Snowy Egret	Present	Common	Native
Egretta tricolor	Tricolored Heron	Present	Common	Native
Ixobrychus exilis	Least Bittern	Present	Common	Native
Nyctanassa violacea	Yellow-crowned Night-heron	Present	Common	Native
Nycticorax nycticorax	Black-crowned Night-heron	Present	Common	Native
Pelecaniformes/Pelecanidae				
Pelecanus erythrorhynchos	American White Pelican	Present	Rare	Native
Pelecanus occidentalis	Brown Pelican	Present	Common	Native
Pelecaniformes/Threskiornithidae				
Ajaia ajaja	Roseate Spoonbill	Present	Occasional	Native
Eudocimus albus	White Ibis	Present	Common	Native
Plegadis falcinellus	Glossy Ibis	Present	Uncommon	Native
Piciformes/Picidae				
Colaptes auratus	Northern Flicker	Present	Common	Native
Dryocopus pileatus	Pileated Woodpecker	Present	Common	Native
Melanerpes carolinus	Red-bellied Woodpecker	Present	Common	Native
Melanerpes erythrocephalus	Red-headed Woodpecker	Present	Uncommon	Native

Table C-6. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Picoides borealis	Red-cockaded Woodpecker	Present	Occasional	Native
Picoides pubescens	Downy Woodpecker	Present	Common	Native
Picoides villosus	Hairy Woodpecker	Present	Uncommon	Native
Sphyrapicus varius	Yellow-bellied Sapsucker	Present	Common	Native
Podicipediformes/Podicipedidae				
Podiceps auritus	Horned Grebe	Present	Common	Native
Podiceps grisegena	Red-necked Grebe	Present	Rare	Native
Podilymbus podiceps	Pied-billed Grebe	Present	Uncommon	Native
Procellariiformes/Hydrobatidae				
Oceanites oceanicus	Wilson's Storm-petrel	Probably Present		Native
Oceanodroma leucorhoa	Leach's Storm Petrel, Leach's Storm-petrel	Probably Present		Native
Procellariiformes/Procellariidae				
Calonectris diomedea	Cory's Shearwater	Probably Present		Native
Puffinus gravis	Greater Shearwater	Probably Present		Native
Puffinus griseus	Sooty Shearwater	Probably Present		Native
Puffinus lherminieri	Audubon’s Shearwater	Probably Present		Native
Strigiformes/Caprimulgidae				
Caprimulgus carolinensis	Chuck-will’s-widow	Present	Common	Native
Caprimulgus vociferus	Whip-poor-will	Present	Uncommon	Native
Chordeiles minor	Common Nighthawk	Present	Common	Native
Strigiformes/Strigidae				
Aegolius acadicus	Northern Saw-whet Owl	Present	Occasional	Native
Asio flammeus	Short-eared Owl	Present	Uncommon	Native
Athene cunicularia	Burrowing Owl	Present	Occasional	Native
Bubo virginianus	Great Horned Owl	Present	Common	Native
Megascops asio	Screech Owl	Present	Common	Native
Strix varia	Barred Owl	Present	Common	Native
Strigiformes/Tytonidae				
Tyto alba	Barn Owl	Present	Uncommon	Native
Suliformes/Anhingidae				
Anhinga anhinga	Anhinga	Present	Common	Native
Suliformes/Fregatidae				
Fregata magnificens	Magnificent Frigatebird	Present	Occasional	Native
Suliformes/Phalacrocoracidae				
Phalacrocorax auritus	Double-crested Cormorant	Present	Common	Native
Phalacrocorax carbo	Great Cormorant	Present	Occasional	Native
Suliformes/Sulidae				
Morus bassanus	Northern Gannet	Present	Common	Native

Table C-7. Bird species known or likely to occur at Fort Frederica National Monument. This species list reflects all NPSpecies/IRMA entries and updates through October 2013, and are currently undergoing review and update.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Accipitriformes/Accipitridae				
Buteo lineatus	Red-shouldered Hawk	Present	Unknown	Native
Haliaeetus leucocephalus	Bald Eagle	Present	Unknown	Native
Accipitriformes/Cathartidae				
Cathartes aura	Turkey Vulture	Present	Unknown	Native
Coragyps atratus	Black Vulture	Present	Unknown	Native
Accipitriformes/Pandionidae				
Pandion haliaetus	Osprey, Western Osprey	Present	Unknown	Native
Anseriformes/Anatidae				
Lophodytes cucullatus	Hooded Merganser	Present	Unknown	Native
Apodiformes/Trochilidae				
Archilochus colubris	Ruby-throated Hummingbird	Present	Unknown	Native
Charadriiformes/Laridae				
Larus delawarensis	Ring-billed Gull	Present	Unknown	Native
Sterna forsteri	Forster's Tern	Present	Unknown	Native
Ciconiiformes/Ciconiidae				
Mycteria americana	Wood Stork	Present	Unknown	Native
Columbiformes/Columbidae				
Zenaida macroura	Mourning Dove	Present	Unknown	Native
Coraciiformes/Alcedinidae				
Megaceryle alcyon	Belted Kingfisher	Present	Unknown	Native
Cuculiformes/Cuculidae				
Coccyzus americanus	Yellow-billed Cuckoo	Present	Unknown	Native
Coccyzus erythropthalmus	Black-billed Cuckoo	Present	Unknown	Native
Gaviiformes/Gaviidae				
Gavia immer	Common Loon, Great Northern Diver, Great Northern Loon	Present	Unknown	Native
Gruiformes/Rallidae				
Rallus longirostris	Clapper Rail	Present	Unknown	Native
Passeriformes/Bombycillidae				
Bombycilla cedrorum	Cedar Waxwing	Present	Unknown	Native
Passeriformes/Cardinalidae				
Cardinalis cardinalis	Northern Cardinal	Present	Unknown	Native
Passeriformes/Certhiidae				
Polioptila caerulea	Blue-gray Gnatcatcher, Blue-grey Gnatcatcher	Present	Unknown	Native
Passeriformes/Corvidae				
Corvus ossifragus	Fish Crow	Present	Unknown	Native
Cyanocitta cristata	Blue Jay	Present	Unknown	Native

Table C-7. Continued

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Passeriformes/Emberizidae				
Junco hyemalis	Dark-eyed Junco	Present	Unknown	Native
Passerella iliaca	Fox Sparrow	Present	Unknown	Native
Pipilo erythrophthalmus	Eastern Towhee, Rufous-sided Towhee	Present	Unknown	Native
Spizella passerina	Chipping Sparrow	Present	Unknown	Native
Zonotrichia albicollis	White-throated Sparrow	Present	Unknown	Native
Zonotrichia leucophrys	White-crowned Sparrow	Present	Unknown	Native
Passeriformes/Fringillidae				
Carduelis tristis	American Goldfinch	Present	Unknown	Native
Passeriformes/Icteridae				
Agelaius phoeniceus	Red-winged Blackbird	Present	Unknown	Native
Icterus spurius	Orchard Oriole	Present	Unknown	Native
Molothrus ater	Brown-headed Cowbird	Present	Unknown	Native
Quiscalus major	Boat-tailed Grackle	Present	Unknown	Native
Quiscalus quiscula	Common Grackle	Present	Unknown	Native
Sturnella magna	Eastern Meadowlark	Present	Unknown	Native
Passeriformes/Laniidae				
Lanius ludovicianus	Loggerhead Shrike	Present	Unknown	Native
Passeriformes/Mimidae				
Dumetella carolinensis	Gray Catbird, Grey Catbird	Present	Unknown	Native
Mimus polyglottos	Northern Mockingbird	Present	Unknown	Native
Toxostoma rufum	Brown Thrasher	Present	Unknown	Native
Passeriformes/Paridae				
Baeolophus bicolor	Tufted Titmouse	Present	Unknown	Native
Parus carolinensis	Carolina Chickadee	Present	Unknown	Native
Passeriformes/Parulidae				
Dendroica coronata	Yellow-rumped Warbler	Present	Unknown	Native
Dendroica discolor	Prairie Warbler	Present	Unknown	Native
Dendroica dominica	Yellow-throated Warbler	Present	Unknown	Native
Dendroica palmarum	Palm Warbler	Present	Unknown	Native
Dendroica petechia	American Yellow Warbler, Yellow Warbler	Present	Unknown	Native
Dendroica pinus	Pine Warbler	Present	Unknown	Native
Mniotilta varia	Black-and-white Warbler	Present	Unknown	Native
Parula americana	Northern Parula	Present	Unknown	Native
Setophaga ruticilla	American Redstart	Present	Unknown	Native
Wilsonia citrina	Hooded Warbler	Present	Unknown	Native
Passeriformes/Regulidae				
Regulus calendula	Ruby-crowned Kinglet	Present	Unknown	Native
Regulus satrapa	Golden-crowned Kinglet	Present	Unknown	Native

Table C-7. Continued

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Passeriformes/Sittidae				
Sitta carolinensis	White-breasted Nuthatch	Present	Unknown	Native
Passeriformes/Thraupidae				
Piranga rubra	Summer Tanager	Present	Unknown	Native
Passeriformes/Troglodytidae				
Thryothorus ludovicianus	Carolina Wren	Present	Unknown	Native
Passeriformes/Turdidae				
Hylocichla mustelina	Wood Thrush	Present	Unknown	Native
Sialia sialis	Eastern Bluebird	Present	Unknown	Native
Turdus migratorius	American Robin	Present	Unknown	Native
Passeriformes/Tyrannidae				
Contopus virens	Eastern Wood Pewee, Eastern Wood-pewee	Present	Unknown	Native
Empidonax minimus	Least Flycatcher	Present	Unknown	Native
Myiarchus crinitus	Great Crested Flycatcher	Present	Unknown	Native
Sayornis phoebe	Eastern Phoebe	Present	Unknown	Native
Tyrannus tyrannus	Eastern Kingbird	Present	Unknown	Native
Passeriformes/Vireonidae				
Vireo griseus	White-eyed Vireo	Present	Unknown	Native
Pelecaniformes/Ardeidae				
Ardea alba	Great Egret	Present	Unknown	Native
Ardea herodias	Great Blue Heron	Present	Unknown	Native
Botaurus lentiginosus	American Bittern	Present	Unknown	Native
Bubulcus ibis	Cattle Egret, Western Cattle Egret	Present	Unknown	Native
Butorides virescens	Green Heron	Present	Unknown	Native
Egretta thula	Snowy Egret	Present	Unknown	Native
Pelecaniformes/Pelecanidae				
Pelecanus occidentalis	Brown Pelican	Present	Unknown	Native
Piciformes/Picidae				
Colaptes auratus	Northern Flicker	Present	Unknown	Native
Dryocopus pileatus	Pileated Woodpecker	Present	Unknown	Native
Melanerpes carolinus	Red-bellied Woodpecker	Present	Unknown	Native
Melanerpes erythrocephalus	Red-headed Woodpecker	Present	Unknown	Native
Picoides pubescens	Downy Woodpecker	Present	Unknown	Native
Picoides villosus	Hairy Woodpecker	Present	Unknown	Native
Sphyrapicus varius	Yellow-bellied Sapsucker	Present	Unknown	Native
Podicipediformes/Podicipedidae				
Podilymbus podiceps	Pied-billed Grebe	Present	Unknown	Native
Strigiformes/Strigidae				
Bubo virginianus	Great Horned Owl	Present	Unknown	Native

Table C-7. Continued

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Strix varia	Barred Owl	Present	Unknown	Native
Suliformes/Phalacrocoracidae				
Phalacrocorax auritus	Double-crested Cormorant	Present	Unknown	Native

Table C-8. Bird species known or likely to occur at Fort Matanzas National Monument. This species list reflects all NPSpecies/IRMA entries and updates through October 2013, and are currently undergoing review and update.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Accipitriformes/Accipitridae				
Accipiter cooperii	Cooper's Hawk	Present	Rare	Native
Buteo jamaicensis	Red-tailed Hawk	Present	Unknown	Native
Buteo lineatus	Red-shouldered Hawk	Present	Uncommon	Native
Circus cyaneus	Marsh Hawk, Northern Harrier	Present	Common	Native
Elanoides forficatus	American Swallow-tailed Kite, Swallow-tailed Kite	Present	Occasional	Native
Haliaeetus leucocephalus	Bald Eagle	Present	Uncommon	Native
Accipitriformes/Cathartidae				
Cathartes aura	Turkey Vulture	Present	Abundant	Native
Coragyps atratus	Black Vulture	Present	Abundant	Native
Accipitriformes/Pandionidae				
Pandion haliaetus	Osprey	Present	Abundant	Native
Anseriformes/Anatidae				
Anas platyrhynchos	Mallard	Present	Rare	Native
Lophodytes cucullatus	Hooded Merganser	Present	Uncommon	Native
Mergus merganser	Common Merganser	Present	Uncommon	Native
Mergus serrator	Red-breasted Merganser	Present	Unknown	Native
Apodiformes/Apodidae				
Chaetura pelagica	Chimney Swift	Present	Common	Native
Apodiformes/Trochilidae				
Archilochus colubris	Ruby-throated Hummingbird	Present	Common	Native
Charadriiformes/Charadriidae				
Charadrius melodus	Piping Plover	Present	Rare	Native
Charadrius semipalmatus	Semipalmated Plover	Present	Common	Native
Charadrius vociferus	Killdeer	Present	Uncommon	Native
Charadrius wilsonia	Wilson's Plover	Present	Common	Native
Pluvialis squatarola	Black-bellied Plover	Present	Rare	Native
Charadriiformes/Haematopodidae				
Haematopus palliatus	American Oystercatcher	Present	Occasional	Native
Charadriiformes/Laridae				
Chlidonias niger	Black Tern	Present	Occasional	Native
Larus argentatus	Herring Gull	Present	Common	Native
Larus atricilla	Laughing Gull	Present	Abundant	Native
Larus delawarensis	Ring-billed Gull	Present	Abundant	Native
Larus marinus	Great Black-backed Gull	Present	Occasional	Native
Larus philadelphia	Bonaparte's Gull	Present	Rare	Native
Rynchops niger	Black Skimmer	Present	Common	Native
Sterna antillarum	Least Tern	Present	Common	Native
Sterna caspia	Caspian Tern	Present	Uncommon	Native
Sterna forsteri	Forster’s Tern	Present	Uncommon	Native

Table C-8. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Sterna hirundo	Common Tern	Present	Uncommon	Native
Sterna maxima	Royal Tern	Present	Common	Native
Sterna nilotica	Gull-billed Tern	Present	Occasional	Native
Sterna sandvicensis	Sandwich Tern	Present	Occasional	Native
Charadriiformes/Recurvirostridae				
Himantopus mexicanus	Black-necked Stilt	Present	Occasional	Native
Charadriiformes/Scolopacidae				
Actitis macularia	Spotted Sandpiper	Present	Common	Native
Arenaria interpres	Ruddy Turnstone	Present	Common	Native
Calidris alba	Sanderling	Present	Abundant	Native
Calidris alpina	Dunlin	Present	Common	Native
Calidris canutus	Red Knot	Present	Unknown	Native
Calidris himantopus	Stilt Sandpiper	Present	Occasional	Native
Calidris mauri	Western Sandpiper	Present	Common	Native
Calidris minutilla	Least Sandpiper	Probably Present		Native
Calidris pusilla	Semipalmated Sandpiper	Present	Uncommon	Native
Catoptrophorus semipalmatus	Willet	Present	Common	Native
Limnodromus griseus	Short-billed Dowitcher	Present	Rare	Native
Limnodromus scolopaceus	Long-billed Dowitcher	Present	Occasional	Native
Scolopax minor	American Woodcock	Probably Present		Native
Tringa flavipes	Lesser Yellowlegs	Present	Rare	Native
Tringa melanoleuca	Greater Yellowlegs	Present	Occasional	Native
Tringa solitaria	Solitary Sandpiper	Present	Occasional	Native
Ciconiiformes/Ciconiidae				
Mycteria americana	Wood Stork	Present	Common	Native
Columbiformes/Columbidae				
Columba livia	Rock Dove	Present	Uncommon	Non-native
Columbina passerina	Common Ground-dove	Present	Common	Native
Streptopelia risoria	Ringed Turtle-Dove	Present	Occasional	Non-native
Zenaida macroura	Mourning Dove	Present	Common	Native
Coraciiformes/Alcedinidae				
Megaceryle alcyon	Belted Kingfisher	Present	Common	Native
Cuculiformes/Cuculidae				
Coccyzus americanus	Yellow-billed Cuckoo	Present	Common	Native
Falconiformes/Falconidae				
Falco columbarius	Merlin	Present	Occasional	Native
Falco peregrinus	Peregrine Falcon	Present	Occasional	Native
Falco sparverius	American Kestrel	Present	Common	Native
Galliformes/Odontophoridae				
Colinus virginianus	Northern Bobwhite	Present	Common	Native
Gaviiformes/Gaviidae				
Gavia immer	Common Loon	Present	Occasional	Native
Gruiformes/Aramidae				

Table C-8. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Aramus guarauna	Limpkin	Present	Rare	Native
Gruiformes/Rallidae				
Gallinula chloropus	Common Moorhen	Present	Common	Native
Rallus limicola	Virginia Rail	Present	Rare	Native
Rallus longirostris	Clapper Rail	Present	Common	Native
Passeriformes/Bombycillidae				
Bombycilla cedrorum	Cedar Waxwing	Present	Rare	Native
Passeriformes/Cardinalidae				
Cardinalis cardinalis	Northern Cardinal	Present	Abundant	Native
Passerina ciris	Painted Bunting	Probably Present		Native
Pheucticus ludovicianus	Rose-breasted Grosbeak	Present	Occasional	Native
Passeriformes/Certhiidae				
Polioptila caerulea	Blue-gray Gnatcatcher	Present	Common	Native
Passeriformes/Corvidae				
Corvus brachyrhynchos	American Crow	Present	Common	Native
Corvus ossifragus	Fish Crow	Present	Common	Native
Cyanocitta cristata	Blue Jay	Present	Abundant	Native
Passeriformes/Emberizidae				
Aimophila aestivalis	Bachman's Sparrow	Present	Rare	Native
Ammodramus savannarum	Grasshopper Sparrow	Present	Occasional	Native
Junco hyemalis	Dark-eyed Junco	Present	Common	Native
Melospiza georgiana	Swamp Sparrow	Present	Uncommon	Native
Melospiza melodia	Song Sparrow	Present	Common	Native
Pipilo erythrophthalmus	Eastern Towhee, Rufous-sided Towhee	Present	Common	Native
Spizella passerina	Chipping Sparrow	Probably Present		Native
Spizella pusilla	Field Sparrow	Probably Present		Native
Zonotrichia albicollis	White-throated Sparrow	Probably Present		Native
Passeriformes/Fringillidae				
Carduelis tristis	American Goldfinch	Present	Occasional	Native
Passeriformes/Hirundinidae				
Hirundo rustica	Barn Swallow	Present	Uncommon	Native
Stelgidopteryx serripennis	Northern Rough-winged Swallow	Probably Present		Native
Tachycineta bicolor	Tree Swallow	Present	Common	Native
Passeriformes/Icteridae				
Agelaius phoeniceus	Red-winged Blackbird	Present	Common	Native
Icterus galbula	Baltimore Oriole, Northern Oriole	Present	Occasional	Native
Icterus spurius	Orchard Oriole	Present	Rare	Native
Quiscalus major	Boat-tailed Grackle	Present	Abundant	Native
Quiscalus quiscula	Common Grackle	Present	Common	Native
Sturnella magna	Eastern Meadowlark	Present	Uncommon	Native
Passeriformes/Laniidae				
Lanius ludovicianus	Loggerhead Shrike	Present	Rare	Native

Table C-8. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Passeriformes/Mimidae				
Dumetella carolinensis	Gray Catbird	Present	Uncommon	Native
Mimus polyglottos	Northern Mockingbird	Present	Abundant	Native
Toxostoma rufum	Brown Thrasher	Present	Common	Native
Passeriformes/Paridae				
Parus bicolor	Tufted Titmouse	Present	Uncommon	Native
Poecile carolinensis	Carolina Chickadee	Present	Common	Native
Passeriformes/Parulidae				
Dendroica caerulescens	Black-throated Blue Warbler	Present	Common	Native
Dendroica coronata	Yellow-rumped Warbler	Present	Abundant	Native
Dendroica discolor	Prairie Warbler	Present	Uncommon	Native
Dendroica fusca	Blackburnian Warbler	Probably Present		Native
Dendroica magnolia	Magnolia Warbler	Present	Uncommon	Native
Dendroica palmarum	Palm Warbler	Probably Present		Native
Dendroica pensylvanica	Chestnut-sided Warbler	Probably Present		Native
Dendroica virens	Black-throated Green Warbler	Probably Present		Native
Geothlypis trichas	Common Yellowthroat	Present	Common	Native
Mniotilta varia	Black-and-white Warbler	Probably Present		Native
Parula americana	Northern Parula	Present	Uncommon	Native
Seiurus aurocapillus	Ovenbird	Probably Present		Native
Setophaga ruticilla	American Redstart	Probably Present		Native
Vermivora celata	Orange-crowned Warbler	Probably Present		Native
Wilsonia citrina	Hooded Warbler	Probably Present		Native
Passeriformes/Passeridae				
Passer domesticus	House Sparrow	Present	Common	Non-native
Passeriformes/Regulidae				
Regulus calendula	Ruby-crowned Kinglet	Present	Uncommon	Native
Passeriformes/Sittidae				
Sitta pusilla	Brown-headed Nuthatch	Present	Occasional	Native
Passeriformes/Sturnidae				
Sturnus vulgaris	European Starling	Present	Common	Non-native
Passeriformes/Thraupidae				
Piranga olivacea	Scarlet Tanager	Present	Occasional	Native
Piranga rubra	Summer Tanager	Present	Rare	Native
Passeriformes/Troglodytidae				
Cistothorus palustris	Marsh Wren	Present	Occasional	Native
Cistothorus platensis	Sedge Wren	Probably Present		Native
Thryothorus ludovicianus	Carolina Wren	Present	Abundant	Native
Troglodytes aedon	House Wren	Present	Common	Native
Passeriformes/Turdidae				
Hylocichla mustelina	Wood Thrush	Present	Rare	Native
Sialia sialis	Eastern Bluebird	Present	Rare	Native
Turdus migratorius	American Robin	Present	Common	Native

Table C-8. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Passeriformes/Tyrannidae				
Contopus virens	Eastern Wood-pewee	Present	Uncommon	Native
Myiarchus crinitus	Great Crested Flycatcher	Present	Common	Native
Sayornis phoebe	Eastern Phoebe	Present	Common	Native
Tyrannus dominicensis	Gray Kingbird	Present	Common	Native
Tyrannus tyrannus	Eastern Kingbird	Present	Common	Native
Passeriformes/Vireonidae				
Vireo flavifrons	Yellow-throated Vireo	Present	Rare	Native
Vireo griseus	White-eyed Vireo	Present	Uncommon	Native
Vireo olivaceus	Red-eyed Vireo	Present	Uncommon	Native
Vireo solitarius	Blue-headed Vireo, Solitary Vireo	Present	Rare	Native
Pelecaniformes/Ardeidae				
Ardea alba	Great Egret	Present	Common	Native
Ardea herodias	Great Blue Heron	Present	Abundant	Native
Bubulcus ibis	Cattle Egret, Western Cattle Egret	Present	Abundant	Native
Butorides virescens	Green Heron	Present	Uncommon	Native
Egretta caerulea	Little Blue Heron	Present	Common	Native
Egretta rufescens	Reddish Egret	Present	Occasional	Native
Egretta thula	Snowy Egret	Present	Abundant	Native
Egretta tricolor	Tricolored Heron	Present	Occasional	Native
Nyctanassa violacea	Yellow-crowned Night-heron	Present	Uncommon	Native
Nycticorax nycticorax	Black-crowned Night-heron	Present	Common	Native
Pelecaniformes/Pelecanidae				
Pelecanus erythrorhynchos	American White Pelican	Present	Occasional	Native
Pelecanus occidentalis	Brown Pelican	Present	Abundant	Native
Pelecaniformes/Threskiornithidae				
Ajaia ajaja	Roseate Spoonbill	Present	Common	Native
Eudocimus albus	White Ibis	Present	Common	Native
Piciformes/Picidae				
Colaptes auratus	Northern Flicker	Present	Common	Native
Dryocopus pileatus	Pileated Woodpecker	Present	Occasional	Native
Melanerpes carolinus	Red-bellied Woodpecker	Present	Common	Native
Melanerpes erythrocephalus	Red-headed Woodpecker	Present	Rare	Native
Picoides pubescens	Downy Woodpecker	Present	Abundant	Native
Sphyrapicus varius	Yellow-bellied Sapsucker	Present	Rare	Native
Podicipediformes/Podicipedidae				
Podiceps auritus	Horned Grebe	Present	Occasional	Native
Podilymbus podiceps	Pied-billed Grebe	Present	Rare	Native
Psittaciformes/Psittacidae				
Nandayus nenday	Nanday Parakeet	Present	Occasional	Non-native
Strigiformes/Caprimulgidae				

Table C-8. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Caprimulgus carolinensis	Chuck-will's-widow	Present	Uncommon	Native
Caprimulgus vociferus	Whip-poor-will	Present	Rare	Native
Chordeiles minor	Common Nighthawk	Present	Uncommon	Native
Strigiformes/Strigidae				
Bubo virginianus	Great Horned Owl	Present	Common	Native
Megascops asio	Eastern Screech Owl, Eastern Screech-owl	Present	Uncommon	Native
Strix varia	Barred Owl	Present	Rare	Native
Strigiformes/Tytonidae				
Tyto alba	Barn Owl, Common Barn-owl	Present	Occasional	Native
Suliformes/Anhingidae				
Anhinga anhinga	Anhinga	Present	Common	Native
Suliformes/Fregatidae				
Fregata magnificens	Magnificent Frigatebird	Present	Occasional	Native
Suliformes/Phalacrocoracidae				
Phalacrocorax auritus	Double-crested Comorant	Present	Abundant	Native
Suliformes/Sulidae				
Morus bassanus	Northern Gannet	Present	Common	Native

Table C-9. Bird species known or likely to occur at Fort Pulaski National Monument. This species list reflects all NPSpecies/IRMA entries and updates through October 2013, and are currently undergoing review and update.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Accipitriformes/Accipitridae				
Accipiter cooperii	Cooper's Hawk	Present	Rare	Native
Accipiter striatus	Sharp-shinned Hawk	Present	Uncommon	Native
Buteo jamaicensis	Red-tailed Hawk	Present	Uncommon	Native
Buteo lineatus	Red-shouldered Hawk	Present	Uncommon	Native
Buteo platypterus	Broad-winged Hawk	Present	Unknown	Native
Circus cyaneus	Northern Harrier	Present	Uncommon	Native
Elanoides forficatus	American Swallow-tailed Kite, Swallow-tail Kite	Present	Unknown	Native
Haliaeetus leucocephalus	Bald Eagle	Present	Uncommon	Native
Accipitriformes/Cathartidae				
Cathartes aura	Turkey Vulture	Present	Common	Native
Coragyps atratus	Black Vulture	Present	Rare	Native
Accipitriformes/Pandionidae				
Pandion haliaetus	Osprey	Present	Common	Native
Anseriformes/Anatidae				
Aix sponsa	Wood Duck	Present	Rare	Native
Anas discors	Blue-Winged Teal	Present	Rare	Native
Aythya affinis	Lesser Scaup	Present	Common	Native
Aythya collaris	Ring-necked Duck	Present	Rare	Native
Aythya marila	Greater Scaup	Present	Unknown	Native
Aythya valisineria	Canvasback	Present	Rare	Native
Branta canadensis	Canada Goose	Present	Rare	Native
Bucephala albeola	Bufflehead	Present	Uncommon	Native
Chen caerulescens	Snow Goose	Present	Rare	Native
Lophodytes cucullatus	Hooded Merganser	Present	Common	Native
Mergus serrator	Red-breasted Merganser	Present	Uncommon	Native
Oxyura jamaicensis	Ruddy Duck	Present	Rare	Native
Apodiformes/Apodidae				
Chaetura pelagica	Chimney Swift	Present	Common	Native
Apodiformes/Trochilidae				
Archilochus colubris	Ruby-throated Hummingbird	Present	Uncommon	Native
Charadriiformes/Charadriidae				
Charadrius melodus	Piping Plover	Present	Rare	Native
Charadrius semipalmatus	Semipalmated Plover	Present	Common	Native
Charadrius vociferus	Killdeer	Present	Common	Native
Charadrius wilsonia	Wilson's Plover	Present	Uncommon	Native
Pluvialis dominica	American Golden-plover, Lesser Golden-plover	Present	Rare	Native
Pluvialis squatarola	Black-bellied Plover	Present	Common	Native
Charadriiformes/Haematopodidae				
Haematopus palliatus	American Oystercatcher	Present	Uncommon	Native

Table C-9. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Charadriiformes/Laridae				
Chlidonias niger	Black Tern	Present	Uncommon	Native
Larus argentatus	Herring Gull	Present	Common	Native
Larus atricilla	Laughing Gull	Present	Common	Native
Larus delawarensis	Ring-billed Gull	Present	Common	Native
Larus fuscus	Lesser Black-backed Gull	Present	Unknown	Native
Larus marinus	Great Black-backed Gull	Present	Rare	Native
Larus philadelphia	Bonaparte's Gull	Present	Uncommon	Native
Rynchops niger	Black Skimmer	Present	Uncommon	Native
Sterna antillarum	Least Tern	Present	Uncommon	Native
Sterna caspia	Caspian Tern	Present	Uncommon	Native
Sterna forsteri	Forster's Tern	Present	Common	Native
Sterna hirundo	Common Tern	Present	Common	Native
Sterna maxima	Royal Tern	Present	Common	Native
Sterna sandvicensis	Sandwich Tern	Present	Uncommon	Native
Charadriiformes/Recurvirostridae				
Himantopus mexicanus	Black-necked Stilt	Present	Rare	Native
Charadriiformes/Scolopacidae				
Actitis macularia	Spotted Sandpiper	Present	Uncommon	Native
Arenaria interpres	Ruddy Turnstone	Present	Uncommon	Native
Calidris alba	Sanderling	Present	Unknown	Native
Calidris alpina	Dunlin	Present	Common	Native
Calidris canutus	Red Knot	Present	Common	Native
Calidris maritima	Purple Sandpiper	Present	Unknown	Native
Calidris mauri	Western Sandpiper	Present	Uncommon	Native
Calidris melanotos	Pectoral Sandpiper	Present	Uncommon	Native
Calidris minutilla	Least Sandpiper	Present	Uncommon	Native
Calidris pusilla	Semipalmated Sandpiper	Present	Uncommon	Native
Catoptrophorus semipalmatus	Willet	Present	Common	Native
Gallinago gallinago	Common Snipe	Present	Common	Native
Numenius americanus	Long-billed Curlew	Present	Rare	Native
Numenius phaeopus	Whimbrel	Present	Uncommon	Native
Scolopax minor	American Woodcock	Present	Rare	Native
Tringa flavipes	Lesser Yellowlegs	Present	Uncommon	Native
Tringa melanoleuca	Greater Yellowlegs	Present	Uncommon	Native
Tringa solitaria	Solitary Sandpiper	Present	Uncommon	Native
Tryngites subruficollis	Buff-breasted Sandpiper	Present	Rare	Native
Ciconiiformes/Ciconiidae				
Mycteria americana	Wood Stork	Present	Uncommon	Native
Columbiformes/Columbidae				
Columba livia	Rock Dove	Present	Common	Non-native
Columbina passerina	Common Ground-dove	Present	Rare	Native
Zenaida macroura	Mourning Dove	Present	Common	Native

Table C-9. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Coraciiformes/Alcedinidae				
Megaceryle alcyon	Belted Kingfisher	Present	Common	Native
Cuculiformes/Cuculidae				
Coccyzus americanus	Yellow-billed Cuckoo	Present	Uncommon	Native
Falconiformes/Falconidae				
Falco columbarius	Merlin	Present	Rare	Native
Falco sparverius	American Kestrel	Present	Common	Native
Galliformes/Odontophoridae				
Colinus virginianus	Northern Bobwhite	Present	Common	Native
Gaviiformes/Gaviidae				
Gavia immer	Common Loon	Present	Uncommon	Native
Gruiformes/Rallidae				
Porzana carolina	Sora	Present	Rare	Native
Rallus limicola	Virginia Rail	Present	Rare	Native
Rallus longirostris	Clapper Rail	Present	Common	Native
Passeriformes/Bombycillidae				
Bombycilla cedrorum	Cedar Waxwing	Present	Common	Native
Passeriformes/Cardinalidae				
Cardinalis cardinalis	Northern Cardinal	Present	Common	Native
Guiraca caerulea	Blue Grosbeak	Present	Uncommon	Native
Passerina ciris	Painted Bunting	Present	Common	Native
Passerina cyanea	Indigo Bunting	Present	Uncommon	Native
Pheucticus ludovicianus	Rose-breasted Grosbeak	Present	Rare	Native
Passeriformes/Certhiidae				
Polioptila caerulea	Blue-gray Gnatcatcher	Present	Uncommon	Native
Passeriformes/Corvidae				
Corvus brachyrhynchos	American Crow	Present	Unknown	Native
Corvus ossifragus	Fish Crow	Present	Common	Native
Cyanocitta cristata	Blue Jay	Present	Common	Native
Passeriformes/Emberizidae				
Ammodramus caudacutus	Saltmarsh Sharp-tailed Sparrow, Sharp-tailed Sparrow	Present	Uncommon	Native
Ammodramus leconteii	Le Conte's Sparrow	Present	Rare	Native
Ammodramus maritimus	Seaside Sparrow	Present	Uncommon	Native
Ammodramus nelsoni	Nelson's Sharp-tailed Sparrow	Present	Unknown	Native
Chondestes grammacus	Lark Sparrow	Present	Occasional	Native
Junco hyemalis	Dark-eyed Junco	Present	Rare	Native
Melospiza georgiana	Swamp Sparrow	Present	Common	Native
Melospiza lincolnii	Lincoln's Sparrow	Present	Rare	Native
Melospiza melodia	Song Sparrow	Present	Common	Native
Passerculus sandwichensis	Savannah Sparrow	Present	Common	Native
Pipilo erythrophthalmus	Eastern Towhee, Rufous-sided Towhee	Present	Uncommon	Native

Table C-9. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Spizella passerina	Chipping Sparrow	Present	Uncommon	Native
Spizella pusilla	Field Sparrow	Present	Uncommon	Native
Zonotrichia albicollis	White-throated Sparrow	Present	Common	Native
Zonotrichia leucophrys	White-crowned Sparrow	Present	Rare	Native
Passeriformes/Fringillidae				
Carduelis tristis	American Goldfinch	Present	Common	Native
Carpodacus purpureus	Purple Finch	Present	Uncommon	Native
Passeriformes/Hirundinidae				
Hirundo rustica	Barn Swallow	Present	Common	Native
Petrochelidon pyrrhonota	Cliff Swallow	Present	Unknown	Native
Progne subis	Purple Martin	Present	Common	Native
Riparia riparia	Bank Swallow	Present	Rare	Native
Stelgidopteryx serripennis	Northern Rough-winged Swallow	Present	Uncommon	Native
Tachycineta bicolor	Tree Swallow	Present	Common	Native
Passeriformes/Icteridae				
Agelaius phoeniceus	Red-winged Blackbird	Present	Common	Native
Dolichonyx oryzivorus	Bobolink	Present	Uncommon	Native
Icterus galbula	Baltimore Oriole, Northern Oriole	Present	Rare	Native
Icterus spurius	Orchard Oriole	Present	Common	Native
Molothrus ater	Brown-headed Cowbird	Present	Common	Native
Quiscalus major	Boat-tailed Grackle	Present	Common	Native
Quiscalus quiscula	Common Grackle	Present	Common	Native
Sturnella magna	Eastern Meadowlark	Present	Uncommon	Native
Passeriformes/Laniidae				
Lanius ludovicianus	Loggerhead Shrike	Present	Uncommon	Native
Passeriformes/Mimidae				
Dumetella carolinensis	Gray Catbird	Present	Common	Native
Mimus polyglottos	Northern Mockingbird	Present	Common	Native
Toxostoma rufum	Brown Thrasher	Present	Uncommon	Native
Passeriformes/Motacillidae				
Anthus rubescens	American Pipit	Present	Uncommon	Native
Passeriformes/Paridae				
Baeolophus bicolor	Tufted Titmouse	Present	Uncommon	Native
Poecile carolinensis	Carolina Chickadee	Present	Common	Native
Passeriformes/Parulidae				
Dendroica caerulescens	Black-throated Blue Warbler	Present	Uncommon	Native
Dendroica coronata	Yellow-rumped Warbler	Present	Common	Native
Dendroica discolor	Prairie Warbler	Present	Common	Native
Dendroica dominica	Yellow-throated Warbler	Present	Uncommon	Native
Dendroica fusca	Blackburnian Warbler	Present	Rare	Native
Dendroica magnolia	Magnolia Warbler	Present	Rare	Native
Dendroica palmarum	Palm Warbler	Present	Uncommon	Native

Table C-9. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Dendroica pensylvanica	Chestnut-sided Warbler	Present	Rare	Native
Dendroica petechia	Yellow Warbler	Present	Unknown	Native
Dendroica pinus	Pine Warbler	Present	Common	Native
Dendroica striata	Blackpoll Warbler	Present	Uncommon	Native
Dendroica tigrina	Cape May Warbler	Present	Uncommon	Native
Geothlypis trichas	Common Yellowthroat	Present	Uncommon	Native
Helmitheros vermivorus	Worm-eating Warbler	Present	Uncommon	Native
Icteria virens	Yellow-breasted Chat	Present	Uncommon	Native
Mniotilta varia	Black-and-white Warbler	Present	Uncommon	Native
Oporornis agilis	Connecticut Warbler	Present	Rare	Native
Oporornis formosus	Kentucky Warbler	Present	Rare	Native
Parula americana	Northern Parula	Present	Uncommon	Native
Protonotaria citrea	Prothonotary Warbler	Present	Rare	Native
Seiurus aurocapillus	Ovenbird	Present	Uncommon	Native
Seiurus motacilla	Louisiana Waterthrush	Present	Rare	Native
Seiurus noveboracensis	Northern Waterthrush	Present	Uncommon	Native
Setophaga ruticilla	American Redstart	Present	Common	Native
Vermivora celata	Orange-crowned Warbler	Present	Uncommon	Native
Vermivora peregrina	Tennessee Warbler	Present	Rare	Native
Wilsonia canadensis	Canada Warbler	Present	Rare	Native
Wilsonia citrina	Hooded Warbler	Present	Rare	Native
Passeriformes/Regulidae				
Regulus calendula	Ruby-crowned Kinglet	Present	Common	Native
Regulus satrapa	Golden-crowned Kinglet	Present	Uncommon	Native
Passeriformes/Sittidae				
Sitta canadensis	Red-breasted Nuthatch	Present	Uncommon	Native
Sitta pusilla	Brown-headed Nuthatch	Present	Rare	Native
Passeriformes/Sturnidae				
Sturnus vulgaris	European Starling	Present	Common	Non-native
Passeriformes/Thraupidae				
Piranga rubra	Summer Tanager	Present	Uncommon	Native
Passeriformes/Troglodytidae				
Cistothorus palustris	Marsh Wren	Present	Common	Native
Cistothorus platensis	Sedge Wren	Present	Rare	Native
Thryothorus ludovicianus	Carolina Wren	Present	Common	Native
Troglodytes aedon	House Wren	Present	Uncommon	Native
Passeriformes/Turdidae				
Catharus fuscescens	Veery	Present	Rare	Native
Catharus guttatus	Hermit Thrush	Present	Unknown	Native
Catharus minimus	Gray-cheeked Thrush	Present	Rare	Native
Catharus ustulatus	Swainson's Thrush	Present	Rare	Native
Hylocichla mustelina	Wood Thrush	Present	Uncommon	Native
Sialia sialis	Eastern Bluebird	Present	Uncommon	Native
Turdus migratorius	American Robin	Present	Common	Native

Table C-9. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Passeriformes/Tyrannidae				
Contopus virens	Eastern Wood-pewee	Present	Uncommon	Native
Myiarchus crinitus	Great Crested Flycatcher	Present	Uncommon	Native
Sayornis phoebe	Eastern Phoebe	Present	Uncommon	Native
Tyrannus dominicensis	Gray Kingbird	Present	Rare	Native
Tyrannus forficatus	Scissor-tailed Flycatcher	Present	Occasional	Native
Tyrannus tyrannus	Eastern Kingbird	Present	Common	Native
Tyrannus verticalis	Western Kingbird	Present	Unknown	Native
Passeriformes/Vireonidae				
Vireo griseus	White-eyed Vireo	Present	Common	Native
Vireo olivaceus	Red-eyed Vireo	Present	Common	Native
Vireo philadelphicus	Philadelphia Vireo	Present	Rare	Native
Vireo solitarius	Blue-headed Vireo, Solitary Vireo	Present	Uncommon	Native
Pelecaniformes/Ardeidae				
Ardea alba	Great Egret	Present	Common	Native
Ardea herodias	Great Blue Heron	Present	Common	Native
Bubulcus ibis	Cattle Egret	Present	Common	Native
Butorides virescens	Green Heron	Present	Common	Native
Egretta caerulea	Little Blue Heron	Present	Common	Native
Egretta thula	Snowy Egret	Present	Common	Native
Egretta tricolor	Tricolored Heron	Present	Uncommon	Native
Nycticorax nycticorax	Black-crowned Night-heron	Present	Uncommon	Native
Pelecaniformes/Pelecanidae				
Pelecanus erythrorhynchos	American White Pelican	Present	Rare	Native
Pelecanus occidentalis	Brown Pelican	Present	Common	Native
Pelecaniformes/Threskiornithidae				
Eudocimus albus	White Ibis	Present	Common	Native
Plegadis falcinellus	Glossy Ibis	Present	Uncommon	Native
Piciformes/Picidae				
Colaptes auratus	Northern Flicker	Present	Common	Native
Dryocopus pileatus	Pileated Woodpecker	Present	Rare	Native
Melanerpes carolinus	Red-bellied Woodpecker	Present	Common	Native
Picoides pubescens	Downy Woodpecker	Present	Uncommon	Native
Sphyrapicus varius	Yellow-bellied Sapsucked	Present	Uncommon	Native
Podicipediformes/Podicipedidae				
Podiceps auritus	Horned Grebe	Present	Rare	Native
Podilymbus podiceps	Pied-billed Grebe	Present	Rare	Native
Strigiformes/Caprimulgidae				
Caprimulgus carolinensis	Chuck-will's-widow	Present	Uncommon	Native
Caprimulgus vociferus	Whip-poor-will	Present	Uncommon	Native
Chordeiles minor	Common Nighthawk	Present	Uncommon	Native
Strigiformes/Strigidae				

Table C-9. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Asio flammeus	Short-eared Owl	Present	Rare	Native
Bubo scandiacus	Snowy Owl	Present	Occasional	Native
Bubo virginianus	Great Horned Owl	Present	Uncommon	Native
Strix varia	Barred Owl	Present	Rare	Native
Strigiformes/Tytonidae				
Tyto alba	Barn Owl	Present	Uncommon	Native
Suliformes/Anhingidae				
Anhinga anhinga	Anhinga	Present	Unknown	Native
Suliformes/Phalacrocoracidae				
Phalacrocorax auritus	Double-crested Cormorant	Present	Common	Native
Suliformes/Sulidae				
Morus bassanus	Northern Gannet	Present	Unknown	Native

Table C-10. Bird species known or likely to occur at Fort Sumter National Monument. This species list reflects all NPSpecies/IRMA entries and updates through October 2013, and are currently undergoing review and update.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Accipitriformes/Accipitridae				
Accipiter cooperii	Cooper's Hawk	Present	Uncommon	Native
Accipiter striatus	Sharp-shinned Hawk	Present	Uncommon	Native
Buteo jamaicensis	Red-tailed Hawk	Present	Uncommon	Native
Buteo lineatus	Red-shouldered Hawk	Present	Rare	Native
Circus cyaneus	Northern Harrier	Present	Rare	Native
Haliaeetus leucocephalus	Bald Eagle	Present	Occasional	Native
Accipitriformes/Cathartidae				
Cathartes aura	Turkey Vulture	Present	Uncommon	Native
Coragyps atratus	Black Vulture	Present	Uncommon	Native
Accipitriformes/Pandionidae				
Pandion haliaetus	Osprey, Western Osprey	Present	Common	Native
Anseriformes/Anatidae				
Aythya affinis	Lesser Scaup	Present	Abundant	Native
Bucephala albeola	Bufflehead	Present	Common	Native
Lophodytes cucullatus	Hooded Merganser	Present	Uncommon	Native
Melanitta perspicillata	Surf Scoter	Present	Uncommon	Native
Mergus serrator	Red-breasted Merganser	Present	Common	Native
Apodiformes/Trochilidae				
Archilochus colubris	Ruby-throated Hummingbird	Present	Common	Native
Charadriiformes/Charadriidae				
Charadrius melodus	Piping Plover	Present	Occasional	Native
Charadrius semipalmatus	Semipalmated Plover	Present	Abundant	Native
Charadrius vociferus	Killdeer	Present	Common	Native
Pluvialis squatarola	Black-bellied Plover, Grey Plover	Present	Common	Native
Charadriiformes/Haematopodidae				
Haematopus palliatus	American Oystercatcher	Present	Common	Native
Charadriiformes/Laridae				
Larus argentatus	European Herring Gull, Herring Gull	Present	Abundant	Native
Larus atricilla	Laughing Gull	Present	Abundant	Native
Larus delawarensis	Ring-billed Gull	Present	Abundant	Native
Larus fuscus	Lesser Black-backed Gull	Present	Occasional	Native
Larus marinus	Great Black-backed Gull	Present	Common	Native
Larus philadelphia	Bonaparte's Gull	Present	Uncommon	Native
Rynchops niger	Black Skimmer	Present	Abundant	Native
Sterna antillarum	Least Tern	Present	Abundant	Native
Sterna forsteri	Forster's Tern	Present	Abundant	Native
Sterna hirundo	Common Tern	Present	Uncommon	Native
Sterna maxima	Royal Tern	Present	Abundant	Native

Table C-10. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Sterna sandvicensis	Sandwich Tern	Present	Common	Native
Charadriiformes/Recurvirostridae				
Himantopus mexicanus	Ae'o, Black-necked Stilt, Hawaiian Stilt	Present	Occasional	Native
Charadriiformes/Scolopacidae				
Actitis macularia	Spotted Sandpiper	Probably Present		Native
Arenaria interpres	Ruddy Turnstone	Present	Common	Native
Bartramia longicauda	Upland Sandpiper	Probably Present		Native
Calidris alba	Sanderling	Present	Abundant	Native
Calidris alpina	Dunlin	Present	Abundant	Native
Calidris canutus	Red Knot	Present	Uncommon	Native
Calidris fuscicollis	White-rumped Sandpiper	Present	Occasional	Native
Calidris maritima	Purple Sandpiper	Present	Uncommon	Native
Calidris mauri	Western Sandpiper	Present	Common	Native
Calidris melanotos	Pectoral Sandpiper	Probably Present		Native
Calidris minutilla	Least Sandpiper	Present	Common	Native
Calidris pusilla	Semipalmated Sandpiper	Present	Common	Native
Catoptrophorus semipalmatus	Willet	Present	Common	Native
Gallinago delicata	Wilson's snipe	Present	Occasional	Native
Limnodromus griseus	Short-billed Dowitcher	Present	Abundant	Native
Limosa fedoa	Marbled Godwit	Probably Present		Native
Numenius americanus	Long-billed Curlew	Probably Present		Native
Numenius phaeopus	Whimbrel	Present	Occasional	Native
Tringa flavipes	Lesser Yellowlegs	Present	Common	Native
Tringa melanoleuca	Greater Yellowlegs	Present	Common	Native
Tringa solitaria	Solitary Sandpiper	Probably Present		Native
Columbiformes/Columbidae				
Columba livia	Common Pigeon, Rock Dove, Rock Pigeon	Present	Common	Non-native
Columbina passerina	Common Ground Dove, Common Ground-dove	Present	Common	Native
Streptopelia decaocto	Eurasian Collared Dove, Eurasian Collared-dove	Present	Abundant	Non-native
Zenaida asiatica	White-winged Dove	Present	Occasional	Native
Zenaida macroura	Mourning Dove	Present	Abundant	Native
Cuculiformes/Cuculidae				
Coccyzus americanus	Yellow-billed Cuckoo	Present	Rare	Native
Coccyzus erythropthalmus	Black-billed Cuckoo	Present	Occasional	Native
Falconiformes/Falconidae				
Falco columbarius	Merlin	Present	Occasional	Native
Falco peregrinus	Peregrine Falcon	Present	Occasional	Native
Falco sparverius	American Kestrel	Present	Uncommon	Native
Gaviiformes/Gaviidae				
Gavia immer	Common Loon, Great	Present	Common	Native

Table C-10. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
	Northern Diver, Great Northern Loon			
Gavia stellata	Red-throated Diver, Red-throated Loon	Present	Uncommon	Native
Gruiformes/Rallidae				
Gallinula chloropus	Common Moorhen	Probably Present		Native
Porphyrula martinica	Purple Gallinule	Probably Present		Native
Porzana carolina	Sora	Present	Occasional	Native
Rallus limicola	Virginia Rail	Probably Present		Native
Rallus longirostris	Clapper Rail	Present	Common	Native
Passeriformes/Alaudidae				
Eremophila alpestris	Horned Lark	Present	Occasional	Native
Passeriformes/Bombycillidae				
Bombycilla cedrorum	Cedar Waxwing	Present	Common	Native
Passeriformes/Cardinalidae				
Cardinalis cardinalis	Northern Cardinal	Present	Abundant	Native
Guiraca caerulea	Blue Grosbeak	Present	Uncommon	Native
Passerina ciris	Painted Bunting	Present	Common	Native
Passerina cyanea	Indigo Bunting	Present	Uncommon	Native
Spiza americana	Dickcissel	Probably Present		Native
Passeriformes/Certhiidae				
Certhia americana	Brown Creeper	Present	Rare	Native
Passeriformes/Corvidae				
Corvus brachyrhynchos	American Crow	Present	Rare	Native
Corvus ossifragus	Fish Crow	Present	Common	Native
Passeriformes/Emberizidae				
Ammodramus caudacutus	Saltmarsh Sharp-tailed Sparrow, Saltmarsh Sparrow	Probably Present		Native
Ammodramus maritimus	Seaside Sparrow	Probably Present		Native
Ammodramus nelsoni	Nelson's Sharp-tailed Sparrow, Nelson's Sparrow	Probably Present		Native
Junco hyemalis	Dark-eyed Junco	Present	Rare	Native
Melospiza georgiana	Swamp Sparrow	Present	Abundant	Native
Melospiza lincolnii	Lincoln's Sparrow	Present	Occasional	Native
Melospiza melodia	Song Sparrow	Present	Common	Native
Passerculus sandwichensis	Savannah Sparrow	Present	Common	Native
Passerella iliaca	Fox Sparrow	Present	Rare	Native
Pipilo erythrophthalmus	Eastern Towhee, Rufous-sided Towhee	Present	Rare	Native
Plectrophenax nivalis	Snow Bunting	Present	Occasional	Native
Pooecetes gramineus	Vesper Sparrow	Present	Rare	Native
Spizella passerina	Chipping Sparrow	Present	Unknown	Native
Spizella pusilla	Field Sparrow	Present	Uncommon	Native
Zonotrichia albicollis	White-throated Sparrow	Present	Abundant	Native

Table C-10. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Zonotrichia leucophrys	White-crowned Sparrow	Present	Rare	Native
Passeriformes/Fringillidae				
Carduelis pinus	Pine Siskin	Probably Present		Native
Carduelis tristis	American Goldfinch	Present	Uncommon	Native
Carpodacus mexicanus	House Finch	Present	Common	Native
Carpodacus purpureus	Purple Finch	Probably Present		Native
Coccothraustes vespertinus	Evening Grosbeak	Probably Present		Native
Passeriformes/Hirundinidae				
Hirundo pyrrhonota	Cliff Swallow	Probably Present		Native
Hirundo rustica	Barn Swallow	Present	Abundant	Native
Progne subis	Purple Martin	Present	Abundant	Native
Riparia riparia	Bank Swallow, Sand Martin	Present	Uncommon	Native
Stelgidopteryx serripennis	Northern Rough-winged Swallow	Present	Uncommon	Native
Tachycineta bicolor	Tree Swallow	Present	Abundant	Native
Passeriformes/Icteridae				
Agelaius phoeniceus	Red-winged Blackbird	Present	Abundant	Native
Euphagus carolinus	Rusty Blackbird	Present	Uncommon	Native
Molothrus ater	Brown-headed Cowbird	Present	Common	Native
Molothrus bonariensis	Shiny Cowbird	Present	Uncommon	Native
Quiscalus major	Boat-tailed Grackle	Present	Abundant	Native
Quiscalus quiscula	Common Grackle	Present	Common	Native
Sturnella magna	Eastern Meadowlark	Present	Rare	Native
Xanthocephalus xanthocephalus	Yellow-headed Blackbird	Present	Occasional	Native
Passeriformes/Laniidae				
Lanius ludovicianus	Loggerhead Shrike	Present	Rare	Native
Passeriformes/Mimidae				
Dumetella carolinensis	Gray Catbird, Grey Catbird	Present	Abundant	Native
Mimus polyglottos	Northern Mockingbird	Present	Common	Native
Toxostoma rufum	Brown Thrasher	Present	Common	Native
Passeriformes/Motacillidae				
Anthus rubescens	American Pipit, Buff-bellied Pipit	Present	Common	Native
Passeriformes/Paridae				
Baeolophus bicolor	Tufted Titmouse	Present	Rare	Native
Poecile carolinensis	Carolina Chickadee	Present	Rare	Native
Passeriformes/Parulidae				
Dendroica caerulescens	Black-throated Blue Warbler	Present	Common	Native
Dendroica coronata	Yellow-rumped Warbler	Present	Abundant	Native
Dendroica discolor	Prairie Warbler	Present	Common	Native
Dendroica dominica	Yellow-throated Warbler	Present	Rare	Native
Dendroica magnolia	Magnolia Warbler	Present	Rare	Native

Table C-10. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Dendroica palmarum	Palm Warbler	Present	Abundant	Native
Dendroica petechia	American Yellow Warbler, Yellow Warbler	Present	Uncommon	Native
Dendroica pinus	Pine Warbler	Present	Uncommon	Native
Dendroica striata	Blackpoll Warbler	Present	Rare	Native
Dendroica tigrina	Cape May Warbler	Present	Uncommon	Native
Geothlypis trichas	Common Yellowthroat	Present	Abundant	Native
Helmitheros vermivorus	Worm-eating Warbler	Present	Rare	Native
Icteria virens	Yellow-breasted Chat	Present	Uncommon	Native
Limnothlypis swainsonii	Swainson's Warbler	Present	Occasional	Native
Mniotilta varia	Black-and-white Warbler	Present	Uncommon	Native
Oporornis agilis	Connecticut Warbler	Present	Occasional	Native
Oporornis formosus	Kentucky Warbler	Present	Occasional	Native
Oporornis philadelphia	Mourning Warbler	Present	Occasional	Native
Parula americana	Northern Parula	Present	Uncommon	Native
Protonotaria citrea	Prothonotary Warbler	Present	Common	Native
Seiurus aurocapillus	Ovenbird	Present	Uncommon	Native
Seiurus motacilla	Louisiana Waterthrush	Probably Present		Native
Seiurus noveboracensis	Northern Waterthrush	Present	Common	Native
Setophaga ruticilla	American Redstart	Present	Common	Native
Vermivora celata	Orange-crowned Warbler	Present	Uncommon	Native
Vermivora peregrina	Tennessee Warbler	Present	Occasional	Native
Vermivora ruficapilla	Nashville Warbler	Present	Occasional	Native
Wilsonia citrina	Hooded Warbler	Present	Occasional	Native
Wilsonia pusilla	Wilson's Warbler	Present	Occasional	Native
Passeriformes/Passeridae				
Passer domesticus	House Sparrow	Present	Common	Non-native
Passeriformes/Regulidae				
Regulus calendula	Ruby-crowned Kinglet	Present	Common	Native
Passeriformes/Sittidae				
Sitta canadensis	Red-breasted Nuthatch	Present	Occasional	Native
Sitta carolinensis	White-breasted Nuthatch	Present	Rare	Native
Passeriformes/Sturnidae				
Sturnus vulgaris	Common Starling, European Starling	Present	Common	Non-native
Passeriformes/Thraupidae				
Piranga olivacea	Scarlet Tanager	Present	Occasional	Native
Passeriformes/Troglodytidae				
Cistothorus palustris	Marsh Wren	Present	Common	Native
Cistothorus platensis	Sedge Wren	Present	Uncommon	Native
Thryothorus ludovicianus	Carolina Wren	Present	Common	Native
Troglodytes aedon	House Wren	Present	Rare	Native
Troglodytes troglodytes	Winter Wren	Present	Uncommon	Native
Passeriformes/Turdidae				
Catharus fuscescens	Veery	Present	Uncommon	Native

Table C-10. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Catharus ustulatus	Swainson's Thrush	Present	Uncommon	Native
Sialia sialis	Eastern Bluebird	Present	Uncommon	Native
Turdus migratorius	American Robin	Present	Common	Native
Passeriformes/Tyrannidae				
Empidonax alnorum	Alder Flycatcher	Present	Rare	Native
Empidonax flaviventris	Yellow-bellied Flycatcher	Present	Occasional	Native
Empidonax minimus	Least Flycatcher	Present	Rare	Native
Empidonax traillii	Willow Flycatcher	Present	Occasional	Native
Sayornis phoebe	Eastern Phoebe	Present	Common	Native
Tyrannus dominicensis	Gray Kingbird, Grey Kingbird	Present	Occasional	Native
Tyrannus verticalis	Western Kingbird	Probably Present		Native
Passeriformes/Vireonidae				
Vireo griseus	White-eyed Vireo	Present	Common	Native
Vireo olivaceus	Red-eyed Vireo	Present	Abundant	Native
Vireo solitarius	Blue-headed Vireo, Solitary Vireo	Present	Rare	Native
Pelecaniformes/Ardeidae				
Ardea alba	Great Egret	Present	Common	Native
Ardea herodias	Great Blue Heron	Present	Common	Native
Egretta thula	Snowy Egret	Present	Common	Native
Egretta tricolor	Tricolored Heron	Present	Common	Native
Pelecaniformes/Pelecanidae				
Pelecanus occidentalis	Brown Pelican	Present	Abundant	Native
Pelecaniformes/Threskiornithidae				
Eudocimus albus	American White Ibis, White Ibis	Present	Abundant	Native
Piciformes/Picidae				
Melanerpes carolinus	Red-bellied Woodpecker	Present	Uncommon	Native
Melanerpes erythrocephalus	Red-headed Woodpecker	Present	Occasional	Native
Picoides pubescens	Downy Woodpecker	Present	Rare	Native
Picoides villosus	Hairy Woodpecker	Present	Occasional	Native
Sphyrapicus varius	Yellow-bellied Sapsucker	Present	Occasional	Native
Podicipediformes/Podicipedidae				
Podiceps auritus	Horned Grebe	Present	Common	Native
Podiceps grisegena	Red-necked Grebe	Probably Present		Native
Podilymbus podiceps	Pied-billed Grebe	Present	Rare	Native
Strigiformes/Caprimulgidae				
Caprimulgus carolinensis	Chuck-will's-widow	Present	Rare	Native
Caprimulgus vociferus	Whip-poor-will	Present	Rare	Native
Chordeiles minor	Common Nighthawk	Present	Uncommon	Native
Strigiformes/Strigidae				
Aegolius acadicus	Northern Saw-whet Owl	Probably Present		Native
Bubo virginianus	Great Horned Owl	Present	Uncommon	Native

Table C-10. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Megascops asio	Eastern Screech Owl, Eastern Screech-Owl	Present	Uncommon	Native
Strigiformes/Tytonidae				
Tyto alba	Barn Owl, Common Barn-owl	Probably Present		Native
Suliformes/Phalacrocoracidae				
Phalacrocorax auritus	Double-crested Cormorant	Present	Abundant	Native
Suliformes/Sulidae				
Morus bassanus	Northern Gannet	Present	Abundant	Native

Table C-11. Bird species known or likely to occur at Horseshoe Bend National Military Park. This species list reflects all NPSpecies/IRMA entries and updates through October 2013, and are currently undergoing review and update.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Accipitriformes/Accipitridae				
Accipiter cooperii	Cooper's Hawk	Present	Common	Native
Buteo jamaicensis	Red-tailed Hawk	Present	Uncommon	Native
Buteo lineatus	Red-shouldered Hawk	Present	Common	Native
Buteo platypterus	Broad-winged Hawk	Present	Occasional	Native
Circus cyaneus	Northern Harrier	Present	Occasional	Native
Accipitriformes/Cathartidae				
Cathartes aura	Turkey Vulture	Present	Common	Native
Coragyps atratus	Black Vulture	Present	Occasional	Native
Anseriformes/Anatidae				
Aix sponsa	Wood Duck	Present	Uncommon	Native
Apodiformes/Apodidae				
Chaetura pelagica	Chimney Swift	Present	Uncommon	Native
Apodiformes/Trochilidae				
Archilochus colubris	Ruby-throated Hummingbird	Present	Uncommon	Native
Charadriiformes/Laridae				
Larus delawarensis	Ring-billed Gull	Present	Unknown	Native
Charadriiformes/Scolopacidae				
Actitis macularia	Spotted Sandpiper	Present	Rare	Native
Columbiformes/Columbidae				
Zenaida macroura	Mourning Dove	Present	Uncommon	Native
Coraciiformes/Alcedinidae				
Ceryle alcyon	Belted Kingfisher	Present	Uncommon	Native
Cuculiformes/Cuculidae				
Coccyzus americanus	Yellow-billed Cuckoo	Present	Common	Native
Falconiformes/Falconidae				
Falco sparverius	American Kestrel	Present	Rare	Native
Galliformes/Odontophoridae				
Colinus virginianus	Northern Bobwhite	Present	Unknown	Native
Galliformes/Phasianidae				
Meleagris gallopavo	Wild Turkey	Present	Common	Native
Gaviiformes/Gaviidae				
Gavia immer	Common Loon	Present	Unknown	Native
Passeriformes/Bombycillidae				
Bombycilla cedrorum	Cedar Waxwing	Present	Unknown	Native
Passeriformes/Cardinalidae				
Cardinalis cardinalis	Northern Cardinal	Present	Common	Native
Guiraca caerulea	Blue Grosbeak	Present	Uncommon	Native
Passerina cyanea	Indigo Bunting	Present	Uncommon	Native
Pheucticus ludovicianus	Rose-breasted Grosbeak	Present	Unknown	Native

Table C-11. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Passeriformes/Certhiidae				
Polioptila caerulea	Blue-gray Gnatcatcher	Present	Common	Native
Passeriformes/Corvidae				
Corvus brachyrhynchos	American Crow	Present	Abundant	Native
Corvus ossifragus	Fish Crow	Present	Unknown	Native
Cyanocitta cristata	Blue Jay	Present	Common	Native
Passeriformes/Emberizidae				
Junco hyemalis	Dark-eyed Junco	Present	Uncommon	Native
Melospiza melodia	Song Sparrow	Present	Unknown	Native
Passerella iliaca	Fox Sparrow	Present	Unknown	Native
Pipilo erythrophthalmus	Eastern Towhee, Rufous-sided Towhee	Present	Uncommon	Native
Spizella passerina	Chipping Sparrow	Present	Common	Native
Spizella pusilla	Field Sparrow	Present	Common	Native
Zonotrichia albicollis	White-throated Sparrow	Present	Common	Native
Passeriformes/Fringillidae				
Carduelis pinus	Pine Siskin	Present	Unknown	Native
Carduelis tristis	American Goldfinch	Present	Common	Native
Carpodacus mexicanus	House Finch	Present	Unknown	Non-native
Carpodacus purpureus	Purple Finch	Present	Unknown	Native
Coccothraustes vespertinus	Evening Grosbeak	Present	Uncommon	Native
Passeriformes/Hirundinidae				
Hirundo rustica	Barn Swallow	Present	Abundant	Native
Progne subis	Purple Martin	Present	Uncommon	Native
Stelgidopteryx serripennis	Northern Rough-winged Swallow	Present	Uncommon	Native
Passeriformes/Icteridae				
Agelaius phoeniceus	Red-winged Blackbird	Present	Common	Native
Euphagus carolinus	Rusty Blackbird	Present	Unknown	Native
Icterus spurius	Orchard Oriole	Present	Uncommon	Native
Molothrus ater	Brown-headed Cowbird	Present	Common	Native
Quiscalus quiscula	Common Grackle	Present	Common	Native
Sturnella magna	Eastern Meadowlark	Present	Rare	Native
Passeriformes/Mimidae				
Dumetella carolinensis	Gray Catbird	Present	Unknown	Native
Mimus polyglottos	Northern Mockingbird	Present	Uncommon	Native
Toxostoma rufum	Brown Thrasher	Present	Uncommon	Native
Passeriformes/Motacillidae				
Anthus rubescens	American Pipit, Buff-bellied Pipit	Present	Unknown	Native
Passeriformes/Paridae				
Baeolophus bicolor	Tufted Titmouse	Present	Common	Native
Poecile carolinensis	Carolina Chickadee	Present	Uncommon	Native
Passeriformes/Parulidae				
Dendroica coronata	Yellow-rumped Warbler	Present	Common	Native

Table C-11. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Dendroica discolor	Prairie Warbler	Present	Uncommon	Native
Dendroica dominica	Yellow-throated Warbler	Present	Uncommon	Native
Dendroica fusca	Blackburnian Warbler	Present	Unknown	Native
Dendroica magnolia	Magnolia Warbler	Present	Unknown	Native
Dendroica palmarum	Palm Warbler	Present	Uncommon	Native
Dendroica pensylvanica	Chestnut-sided Warbler	Present	Unknown	Native
Dendroica pinus	Pine Warbler	Present	Common	Native
Dendroica virens	Black-throated Green Warbler	Present	Unknown	Native
Geothlypis trichas	Common Yellowthroat	Present	Unknown	Native
Helmitheros vermivorus	Worm-eating Warbler	Present	Unknown	Native
Icteria virens	Yellow-breasted Chat	Present	Common	Native
Limnothlypis swainsonii	Swainson's Warbler	Present	Unknown	Native
Mniotilta varia	Black-and-white Warbler	Present	Common	Native
Oporornis formosus	Kentucky Warbler	Present	Uncommon	Native
Parula americana	Northern Parula	Present	Uncommon	Native
Protonotaria citrea	Prothonotary Warbler	Present	Common	Native
Seiurus aurocapillus	Ovenbird	Present	Unknown	Native
Seiurus motacilla	Louisiana Waterthrush	Present	Common	Native
Seiurus noveboracensis	Northern Waterthrush	Present	Unknown	Native
Setophaga ruticilla	American Redstart	Present	Unknown	Native
Vermivora celata	Orange-crowned Warbler	Present	Unknown	Native
Vermivora ruficapilla	Nashville Warbler	Present	Rare	Native
Wilsonia citrina	Hooded Warbler	Present	Uncommon	Native
Passeriformes/Regulidae				
Regulus calendula	Ruby-crowned Kinglet	Present	Common	Native
Regulus satrapa	Golden-crowned Kinglet	Present	Unknown	Native
Passeriformes/Sittidae				
Sitta carolinensis	White-breasted Nuthatch	Present	Unknown	Native
Sitta pusilla	Brown-headed Nuthatch	Present	Uncommon	Native
Passeriformes/Sturnidae				
Sturnus vulgaris	European Starling	Present	Uncommon	Non-native
Passeriformes/Thraupidae				
Piranga olivacea	Scarlet Tanager	Present	Uncommon	Native
Piranga rubra	Summer Tanager	Present	Common	Native
Passeriformes/Troglodytidae				
Thryothorus ludovicianus	Carolina Wren	Present	Common	Native
Troglodytes aedon	House Wren	Present	Unknown	Native
Troglodytes troglodytes	Winter Wren	Present	Unknown	Native
Passeriformes/Turdidae				
Catharus fuscescens	Veery	Present	Unknown	Native
Catharus guttatus	Hermit Thrush	Present	Common	Native

Table C-11. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Hylocichla mustelina	Wood Thrush	Present	Uncommon	Native
Sialia sialis	Eastern Bluebird	Present	Uncommon	Native
Turdus migratorius	American Robin	Present	Uncommon	Native
Passeriformes/Tyrannidae				
Contopus virens	Eastern Wood-pewee	Present	Common	Native
Empidonax minimus	Least Flycatcher	Present	Unknown	Native
Empidonax virescens	Acadian Flycatcher	Present	Uncommon	Native
Myiarchus crinitus	Great Crested Flycatcher	Present	Common	Native
Sayornis phoebe	Eastern Phoebe	Present	Common	Native
Tyrannus tyrannus	Eestern Kingbird	Present	Uncommon	Native
Passeriformes/Vireonidae				
Vireo flavifrons	Yellow-throated Vireo	Present	Uncommon	Native
Vireo griseus	White-eyed Vireo	Present	Uncommon	Native
Vireo olivaceus	Red-eyed Vireo	Present	Abundant	Native
Vireo solitarius	Blue-headed Vireo, Solitary Vireo	Present	Unknown	Native
Pelecaniformes/Ardeidae				
Ardea alba	Great Egret	Present	Rare	Native
Ardea herodias	Great Blue Heron	Present	Uncommon	Native
Butorides virescens	Green Heron	Present	Occasional	Native
Egretta caerulea	Little Blue Heron	Present	Occasional	Native
Piciformes/Picidae				
Colaptes auratus	Northern Flicker	Present	Uncommon	Native
Dryocopus pileatus	Pileated Woodpecker	Present	Common	Native
Melanerpes carolinus	Red-bellied Woodpecker	Present	Abundant	Native
Melanerpes erythrocephalus	Red-headed Woodpecker	Present	Unknown	Native
Picoides pubescens	Downy Woodpecker	Present	Uncommon	Native
Picoides villosus	Hairy Woodpecker	Present	Occasional	Native
Sphyrapicus varius	Yellow-bellied Sapsucker	Present	Uncommon	Native
Strigiformes/Caprimulgidae				
Caprimulgus carolinensis	Chuck-will's-widow	Present	Uncommon	Native
Strigiformes/Strigidae				
Bubo virginianus	Great Horned Owl	Present	Uncommon	Native
Otus asio	Eastern Screech-owl	Present	Uncommon	Native
Strix varia	Barred Owl	Present	Uncommon	Native

Table C-12. Bird species known or likely to occur at Kennesaw Mountain National Battlefield Park. This species list reflects all NPSpecies/IRMA entries and updates through October 2013, and are currently undergoing review and update.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Accipitriformes/Accipitridae				
Accipiter cooperii	Cooper's Hawk	Present	Uncommon	Native
Accipiter striatus	Sharp-shinned Hawk	Present	Uncommon	Native
Buteo jamaicensis	Red Tailed Hawk, Red-tailed Hawk	Present	Uncommon	Native
Buteo lineatus	Red Shouldered Hawk, Red-shouldered Hawk	Present	Uncommon	Native
Buteo platypterus	Broad-winged Hawk	Present	Uncommon	Native
Circus cyaneus	Northern Harrier	Present	Rare	Native
Haliaeetus leucocephalus	Bald Eagle	Present	Occasional	Native
Ictinia mississippiensis	Mississippi Kite	Present	Occasional	Native
Accipitriformes/Cathartidae				
Cathartes aura	Turkey Vulture	Present	Common	Native
Coragyps atratus	Black Vulture	Present	Rare	Native
Accipitriformes/Pandionidae				
Pandion haliaetus	Osprey	Present	Occasional	Native
Anseriformes/Anatidae				
Aix sponsa	Wood Duck	Present	Uncommon	Native
Anas acuta	Northern Pintail	Present	Occasional	Native
Anas americana	American Wigeon	Present	Occasional	Native
Anas crecca	Eurasian Teal, Green-winged Teal	Present	Occasional	Native
Anas discors	Blue-winged Teal	Present	Rare	Native
Anas platyrhynchos	Mallard	Present	Common	Native
Anas rubripes	American Black Duck	Present	Occasional	Native
Anas strepera	Gadwall	Present	Occasional	Native
Branta canadensis	Canada Goose	Present	Common	Native
Lophodytes cucullatus	Hooded Merganser	Present	Occasional	Native
Mergus merganser	Common Merganser	Present	Occasional	Native
Apodiformes/Apodidae				
Chaetura pelagica	Chimney Swift	Present	Common	Native
Apodiformes/Trochilidae				
Archilochus colubris	Ruby-throated Hummingbird	Present	Common	Native
Charadriiformes/Charadriidae				
Charadrius vociferus	Killdeer	Present	Rare	Native
Charadriiformes/Laridae				
Larus delawarensis	Ring-billed Gull	Present	Occasional	Native
Larus philadelphia	Bonaparte's Gull	Present	Occasional	Native
Charadriiformes/Scolopacidae				
Actitis macularia	Spotted Sandpiper	Present	Occasional	Native
Calidris melanotos	Pectoral Sandpiper	Present	Occasional	Native
Calidris minutilla	Least Sandpiper	Present	Occasional	Native

Table C-12. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Calidris pusilla	Semipalmated Sandpiper	Present	Occasional	Native
Gallinago delicata	Wilson's Snipe	Present	Uncommon	Native
Scolopax minor	American Woodcock	Present	Rare	Native
Tringa flavipes	Lesser Yellowlegs	Present	Occasional	Native
Tringa melanoleuca	Greater Yellowlegs	Present	Occasional	Native
Tringa solitaria	Solitary Sandpiper	Present	Occasional	Native
Columbiformes/Columbidae				
Columba livia	Rock Dove, Rock Pigeon	Present	Uncommon	Non-native
Zenaida macroura	Mourning Dove	Present	Common	Native
Coraciiformes/Alcedinidae				
Megaceryle alcyon	Belted Kingfisher	Present	Uncommon	Native
Cuculiformes/Cuculidae				
Coccyzus americanus	Yellow-billed Cuckoo	Present	Uncommon	Native
Coccyzus erythropthalmus	Black Billed Cuckoo, Black-billed Cuckoo	Present	Occasional	Native
Falconiformes/Falconidae				
Falco columbarius	Merlin	Present	Occasional	Native
Falco peregrinus	Peregrine Falcon	Present	Occasional	Native
Falco sparverius	American Kestrel	Present	Rare	Native
Galliformes/Odontophoridae				
Colinus virginianus	Bobwhite	Present	Rare	Native
Galliformes/Phasianidae				
Meleagris gallopavo	Wild Turkey	Present	Rare	Native
Gaviiformes/Gaviidae				
Gavia immer	Common Loon	Present	Occasional	Native
Gavia stellata	Red-throated Diver, Red-throated Loon	Present	Occasional	Native
Gruiformes/Gruidae				
Grus canadensis	Sandhill Crane	Present	Occasional	Native
Gruiformes/Rallidae				
Fulica americana	American Coot	Present	Rare	Native
Porphyrula martinica	Purple Gallinule	Present	Occasional	Native
Porzana carolina	Sora	Present	Uncommon	Native
Rallus elegans	King Rail	Present	Occasional	Native
Rallus limicola	Virginia Rail	Present	Uncommon	Native
Passeriformes/Bombycillidae				
Bombycilla cedrorum	Cedar Waxwing	Present	Uncommon	Native
Passeriformes/Cardinalidae				
Cardinalis cardinalis	Northern Cardinal	Present	Common	Native
Passerina caerulea	Blue Grosbeak	Present	Uncommon	Native
Passerina cyanea	Indigo Bunting	Present	Common	Native
Pheucticus ludovicianus	Rose-breasted Grosbeak	Present	Common	Native
Passeriformes/Certhiidae				
Certhia americana	Brown Creeper	Present	Uncommon	Native

Table C-12. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Polioptila caerulea	Blue-gray Gnatcatcher	Present	Common	Native
Passeriformes/Corvidae				
Corvus brachyrhynchos	American Crow	Present	Common	Native
Corvus ossifragus	Fish Crow	Present	Rare	Native
Cyanocitta cristata	Blue Jay	Present	Common	Native
Passeriformes/Emberizidae				
Ammodramus henslowii	Henslow's Sparrow	Present	Occasional	Native
Ammodramus leconteii	Le Conte's Sparrow	Present	Occasional	Native
Ammodramus savannarum	Grasshopper Sparrow	Present	Occasional	Native
Junco hyemalis	Dark-eyed Junco	Present	Common	Native
Melospiza georgiana	Swamp Sparrow	Present	Common	Native
Melospiza lincolnii	Lincoln's Sparrow	Present	Occasional	Native
Melospiza melodia	Song Sparrow	Present	Common	Native
Passerculus sandwichensis	Savannah Sparrow	Present	Occasional	Native
Passerella iliaca	Fox Sparrow	Present	Occasional	Native
Pipilo erythrophthalmus	Eastern Towhee	Present	Common	Native
Pooecetes gramineus	Vesper Sparrow	Present	Occasional	Native
Spizella passerina	Chipping Sparrow	Present	Uncommon	Native
Spizella pusilla	Field Sparrow	Present	Uncommon	Native
Zonotrichia albicollis	White Throated Sparrow, White-throated Sparrow	Present	Common	Native
Zonotrichia leucophrys	White-crowned Sparrow	Present	Occasional	Native
Passeriformes/Fringillidae				
Carduelis pinus	Pine Siskin	Present	Uncommon	Native
Carduelis tristis	American Goldfinch	Present	Uncommon	Native
Carpodacus mexicanus	House Finch	Present	Uncommon	Non-native
Carpodacus purpureus	Prothonotary Warbler, Purple Finch	Present	Rare	Native
Coccothraustes vespertinus	Evening Grosbeak	Present	Occasional	Native
Loxia curvirostra	Red Crossbill	Present	Occasional	Native
Passeriformes/Hirundinidae				
Hirundo rustica	Barn Swallow	Present	Uncommon	Native
Petrochelidon pyrrhonota	Cliff Swallow	Present	Occasional	Native
Progne subis	Purple Martin	Present	Uncommon	Native
Riparia riparia	Bank Swallow, Sand Martin	Present	Occasional	Native
Stelgidopteryx serripennis	Northern Rough-winged Swallow	Present	Uncommon	Native
Tachycineta bicolor	Tree Swallow	Present	Rare	Native
Passeriformes/Icteridae				
Agelaius phoeniceus	Red Winged Blackbird, Red-winged Blackbird	Present	Common	Native
Dolichonyx oryzivorus	Bobolink	Present	Rare	Native
Icterus galbula	Baltimore Oriole	Present	Uncommon	Native
Icterus spurius	Orchard Oriole	Present	Rare	Native
Molothrus ater	Brown-headed Cowbird	Present	Uncommon	Native

Table C-12. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Quiscalus quiscula	Common Grackle	Present	Uncommon	Native
Sturnella magna	Eastern Meadowlark	Present	Rare	Native
Passeriformes/Mimidae				
Dumetella carolinensis	Gray Catbird	Present	Uncommon	Native
Mimus polyglottos	Northern Mockingbird	Present	Uncommon	Native
Toxostoma rufum	Brown Thrasher	Present	Common	Native
Passeriformes/Paridae				
Baeolophus bicolor	Tufted Titmouse	Present	Common	Native
Poecile carolinensis	Carolina Chickadee	Present	Common	Native
Passeriformes/Parulidae				
Dendroica caerulescens	Black-throated Blue Warbler	Present	Uncommon	Native
Dendroica castanea	Bay-breasted Warbler	Present	Uncommon	Native
Dendroica cerulea	Cerulean Warbler	Present	Common	Native
Dendroica coronata	Yellow Rumped Warbler, Yellow-rumped Warbler	Present	Common	Native
Dendroica discolor	Prairie Warbler	Present	Uncommon	Native
Dendroica dominica	Yellow Throated Warbler, Yellow-throated Warbler, Yellow-throated Warblers	Present	Uncommon	Native
Dendroica fusca	Blackburnian Warbler	Present	Common	Native
Dendroica magnolia	Magnolia Warbler	Present	Common	Native
Dendroica nigrescens	Black-throated Gray Warbler	Present	Occasional	Native
Dendroica palmarum	Palm Warbler	Present	Uncommon	Native
Dendroica palmarum hypochrysea	Eastern Palm Warbler	Present	Uncommon	Native
Dendroica palmarum palmarum	Western Palm Warbler	Present	Common	Native
Dendroica pensylvanica	Chestnut-sided Warbler	Present	Common	Native
Dendroica petechia	Yellow Warbler	Present	Rare	Native
Dendroica pinus	Pine Warbler	Present	Common	Native
Dendroica striata	Blackpoll Warbler	Present	Common	Native
Dendroica tigrina	Cape May Warbler	Present	Uncommon	Native
Dendroica virens	Black-throated Green Warbler	Present	Common	Native
Geothlypis trichas	Common Yellowthroat	Present	Common	Native
Helmitheros vermivorus	Worm-eating Warbler	Present	Uncommon	Native
Icteria virens	Yellow-breasted Chat	Present	Rare	Native
Limnothlypis swainsonii	Swainson's Warbler	Present	Occasional	Native
Mniotilta varia	Black and White Warbler	Present	Uncommon	Native
Oporornis agilis	Connecticut Warbler	Present	Occasional	Native
Oporornis formosus	Kentucky Warbler	Present	Uncommon	Native
Oporornis philadelphia	Mourning Warbler	Present	Occasional	Native
Parula americana	Northern Parula	Present	Uncommon	Native
Protonotaria citrea	Prothonotary Warbler	Present	Occasional	Native
Seiurus aurocapillus	Ovenbird	Present	Uncommon	Native

Table C-12. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Seiurus motacilla	Louisiana Waterthrush	Present	Occasional	Native
Seiurus noveboracensis	Northern Waterthrush	Present	Occasional	Native
Setophaga ruticilla	American Redstart	Present	Common	Native
Vermivora celata	Orange-crowned warbler	Present	Uncommon	Native
Vermivora chrysoptera	Golden-winged Warbler	Present	Uncommon	Native
Vermivora lawrencii	Lawrence's Warbler	Present	Occasional	Native
Vermivora leucobronchialis	Brewster's Warbler	Present	Occasional	Native
Vermivora peregrina	Tennessee Warbler	Present	Abundant	Native
Vermivora pinus	Blue-winged Warbler	Present	Uncommon	Native
Vermivora ruficapilla	Nashville Warbler	Present	Uncommon	Native
Vermivora virginiae	Virginia's Warbler	Present	Occasional	Native
Wilsonia canadensis	Canada warbler	Present	Uncommon	Native
Wilsonia citrina	Hooded Warbler	Present	Common	Native
Wilsonia pusilla	Wilson's Warbler	Present	Rare	Native
Passeriformes/Passeridae				
Passer domesticus	House Sparrow	Present	Occasional	Non-native
Passeriformes/Regulidae				
Regulus calendula	Ruby-crowned Kinglet	Present	Common	Native
Regulus satrapa	Golden-crowned Kinglet	Present	Common	Native
Passeriformes/Sittidae				
Sitta canadensis	Red-breasted Nuthatch	Present	Rare	Native
Sitta carolinensis	White-breasted Nuthatch	Present	Uncommon	Native
Sitta pusilla	Brown-headed Nuthatch	Present	Common	Native
Passeriformes/Sturnidae				
Sturnus vulgaris	European Starling	Present	Uncommon	Non-native
Passeriformes/Thraupidae				
Piranga olivacea	Scarlet Tanager	Present	Uncommon	Native
Piranga rubra	Summer Tanager	Present	Common	Native
Passeriformes/Troglodytidae				
Cistothorus palustris	Marsh Wren	Present	Occasional	Native
Cistothorus platensis	Sedge Wren	Present	Rare	Native
Thryothorus ludovicianus	Carolina Wren	Present	Common	Native
Troglodytes aedon	House Wren	Present	Uncommon	Native
Troglodytes troglodytes	Winter Wren	Present	Uncommon	Native
Passeriformes/Turdidae				
Catharus fuscescens	Veery	Present	Uncommon	Native
Catharus guttatus	Hermit thrush	Present	Uncommon	Native
Catharus minimus	Gray-cheeked thrush	Present	Uncommon	Native
Catharus ustulatus	Swainson's Thrush	Present	Common	Native
Hylocichla mustelina	Wood Thrush	Present	Uncommon	Native
Sialia sialis	Eastern Bluebird	Present	Uncommon	Native
Turdus migratorius	American Robin, Northern Robin	Present	Common	Native
Passeriformes/Tyrannidae				
Contopus cooperi	Olive-sided Flycatcher	Present	Occasional	Native

Table C-12. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Contopus virens	Eastern Wood-pewee	Present	Common	Native
Empidonax alnorum	Alder Flycatcher	Present	Occasional	Native
Empidonax flaviventris	Yellow-bellied Flycatcher, Yellow-bellied Sapsucker	Present	Occasional	Native
Empidonax minimus	Least Flycatcher	Present	Occasional	Native
Empidonax traillii	Willow Flycatcher	Present	Occasional	Native
Empidonax virescens	Acadian Flycatcher	Present	Rare	Native
Myiarchus crinitus	Great Crested Flycatcher	Present	Uncommon	Native
Sayornis phoebe	Eastern Phoebe	Present	Uncommon	Native
Tyrannus tyrannus	Eastern Kingbird	Present	Uncommon	Native
Passeriformes/Vireonidae				
Vireo bellii	Bell's Vireo	Present	Occasional	Native
Vireo flavifrons	Yellow Throated Vireo, Yellow-throated Vireo	Present	Uncommon	Native
Vireo gilvus	Warbling Vireo	Present	Occasional	Native
Vireo griseus	White-Eyed Vireo	Present	Common	Native
Vireo olivaceus	Red-eyed Vireo	Present	Common	Native
Vireo philadelphicus	Philadelphia Vireo	Present	Uncommon	Native
Vireo solitarius	Blue-headed Vireo	Present	Uncommon	Native
Pelecaniformes/Ardeidae				
Ardea alba	Great Egret	Present	Occasional	Native
Ardea herodias	Great Blue Heron	Present	Uncommon	Native
Butorides virescens	Green Heron	Present	Uncommon	Native
Egretta caerulea	Little Blue Heron	Present	Occasional	Native
Nyctanassa violacea	Yellow-crowned Night Heron, Yellow-crowned Night-heron	Present	Occasional	Native
Nycticorax nycticorax	Black-crowned Night Heron, Black-crowned Night-heron	Present	Occasional	Native
Piciformes/Picidae				
Colaptes auratus	Northern Flicker	Present	Uncommon	Native
Dryocopus pileatus	Pileated Woodpecker	Present	Uncommon	Native
Melanerpes carolinus	Red-bellied Woodpecker	Present	Common	Native
Melanerpes erythrocephalus	Red-headed Woodpecker	Present	Uncommon	Native
Picoides pubescens	Downy Woodpecker	Present	Common	Native
Picoides villosus	Hairy Woodpecker	Present	Common	Native
Sphyrapicus varius	Yellow-bellied Sapsucker	Present	Uncommon	Native
Podicipediformes/Podicipedidae				
Podilymbus podiceps	Pied-billed Grebe	Present	Rare	Native
Strigiformes/Caprimulgidae				
Caprimulgus carolinensis	Chuck-will's-widow	Present	Uncommon	Native
Caprimulgus vociferus	Whip-poor-will	Present	Occasional	Native
Chordeiles minor	Common Nighthawk	Present	Rare	Native
Strigiformes/Strigidae				

Table C-12. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Asio flammeus	Short-eared Owl	Present	Occasional	Native
Bubo virginianus	Great Horned Owl	Present	Uncommon	Native
Megascops asio	Eastern Screech Owl, Eastern Screech-owl	Present	Uncommon	Native
Strix varia	Barred Owl	Present	Rare	Native
Suliformes/Phalacrocoracidae				
Phalacrocorax auritus	Double-crested Cormorant	Present	Rare	Native

Table C-13. Bird species known or likely to occur at Moores Creek National Battlefield. This species list reflects all NPSpecies/IRMA entries and updates through October 2013, and are currently undergoing review and update.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Accipitriformes/Accipitridae				
Accipiter cooperii	Cooper's Hawk	Present	Unknown	Native
Accipiter striatus	Sharp-shinned Hawk	Present	Unknown	Native
Buteo jamaicensis	Red-tailed Hawk	Present	Unknown	Native
Buteo lineatus	Red-shouldered Hawk	Present	Unknown	Native
Circus cyaneus	Northern Harrier	Present	Unknown	Native
Accipitriformes/Cathartidae				
Cathartes aura	Turkey Vulture	Present	Unknown	Native
Coragyps atratus	Black Vulture	Present	Unknown	Native
Anseriformes/Anatidae				
Aix sponsa	Wood Duck	Present	Unknown	Native
Anas rubripes	American Black Duck	Present	Unknown	Native
Branta canadensis	Canada Goose	Present	Unknown	Native
Apodiformes/Apodidae				
Chaetura pelagica	Chimney Swift	Present	Unknown	Native
Apodiformes/Trochilidae				
Archilochus colubris	Ruby-throated Hummingbird	Present	Unknown	Native
Charadriiformes/Scolopacidae				
Scolopax minor	American Woodcock	Present	Unknown	Native
Columbiformes/Columbidae				
Zenaida macroura	Mourning Dove	Present	Unknown	Native
Coraciiformes/Alcedinidae				
Megaceryle alcyon	Belted Kingfisher	Present	Unknown	Native
Cuculiformes/Cuculidae				
Coccyzus americanus	Yellow-billed Cuckoo	Present	Unknown	Native
Galliformes/Odontophoridae				
Colinus virginianus	Northern Bobwhite	Present	Unknown	Native
Passeriformes/Bombycillidae				
Bombycilla cedrorum	Cedar Waxwing	Present	Unknown	Native
Passeriformes/Cardinalidae				
Cardinalis cardinalis	Northern Cardinal	Present	Unknown	Native
Pheucticus ludovicianus	Rose-breasted Grosbeak	Present	Unknown	Native
Passeriformes/Certhiidae				
Certhia americana	Brown Creeper	Present	Unknown	Native
Polioptila caerulea	Blue-gray Gnatcatcher	Present	Unknown	Native
Passeriformes/Corvidae				
Corvus brachyrhynchos	American Crow	Present	Unknown	Native
Corvus ossifragus	Fish Crow	Present	Unknown	Native
Cyanocitta cristata	Blue Jay	Present	Unknown	Native
Passeriformes/Emberizidae				

Table C-13. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Junco hyemalis	Dark-eyed Junco	Present	Unknown	Native
Melospiza georgiana	Swamp Sparrow	Present	Unknown	Native
Melospiza melodia	Song Sparrow	Present	Unknown	Native
Passerella iliaca	Fox Sparrow	Present	Unknown	Native
Pipilo erythrophthalmus	Eastern Towhee, Rufous-sided Towhee	Present	Unknown	Native
Spizella passerina	Chipping Sparrow	Present	Unknown	Native
Spizella pusilla	Field Sparrow	Present	Unknown	Native
Zonotrichia albicollis	White-throated Sparrow	Present	Unknown	Native
Passeriformes/Fringillidae				
Carduelis tristis	American Goldfinch	Present	Unknown	Native
Carpodacus mexicanus	House Finch	Present	Unknown	Non-native
Passeriformes/Hirundinidae				
Tachycineta bicolor	Tree Swallow	Present	Unknown	Native
Passeriformes/Icteridae				
Agelaius phoeniceus	Red-winged Blackbird	Present	Unknown	Native
Euphagus carolinus	Rusty Blackbird	Present	Unknown	Native
Molothrus ater	Brown-headed Cowbird	Present	Unknown	Native
Quiscalus quiscula	Common Grackle	Present	Unknown	Native
Passeriformes/Mimidae				
Mimus polyglottos	Northern Mockingbird	Present	Unknown	Native
Toxostoma rufum	Brown Thrasher	Present	Unknown	Native
Passeriformes/Paridae				
Baeolophus bicolor	Tufted Titmouse	Present	Unknown	Native
Poecile carolinensis	Carolina Chickadee	Present	Unknown	Native
Passeriformes/Parulidae				
Dendroica coronata	Yellow-rumped Warbler	Present	Unknown	Native
Dendroica discolor	Prairie Warbler	Present	Unknown	Native
Dendroica dominica	Yellow-throated Warbler	Present	Unknown	Native
Dendroica fusca	Blackburnian Warbler	Present	Unknown	Native
Dendroica palmarum	Palm Warbler	Present	Unknown	Native
Dendroica pensylvanica	Chestnut-sided Warbler	Present	Unknown	Native
Dendroica petechia	Yellow Warbler	Present	Unknown	Native
Dendroica pinus	Pine Warbler	Present	Unknown	Native
Geothlypis trichas	Common Yellowthroat	Present	Unknown	Native
Mniotilta varia	Black-and-white Warbler	Present	Unknown	Native
Oporornis formosus	Kentucky Warbler	Present	Unknown	Native
Parula americana	Northern Parula	Present	Unknown	Native
Protonotaria citrea	Prothonotary Warbler	Present	Unknown	Native
Seiurus aurocapillus	Ovenbird	Present	Unknown	Native
Setophaga ruticilla	American Redstart	Present	Unknown	Native
Wilsonia citrina	Hooded Warbler	Present	Unknown	Native
Passeriformes/Regulidae				
Regulus calendula	Ruby-crowned Kinglet	Present	Unknown	Native

Table C-13. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Regulus satrapa	Golden-crowned Kinglet	Present	Unknown	Native
Passeriformes/Sittidae				
Sitta canadensis	Red-breasted Nuthatch	Present	Unknown	Native
Sitta carolinensis	White-breasted Nuthatch	Present	Unknown	Native
Sitta pusilla	Brown-headed Nuthatch	Present	Unknown	Native
Passeriformes/Sturnidae				
Sturnus vulgaris	Common Starling, European Starling	Present	Unknown	Non-native
Passeriformes/Thraupidae				
Piranga rubra	Summer Tanager	Present	Unknown	Native
Passeriformes/Troglodytidae				
Thryothorus ludovicianus	Carolina Wren	Present	Unknown	Native
Troglodytes aedon	House Wren	Present	Unknown	Native
Troglodytes troglodytes	Winter Wren	Present	Unknown	Native
Passeriformes/Turdidae				
Catharus fuscescens	Veery	Present	Unknown	Native
Catharus guttatus	Hermit Thrush	Present	Unknown	Native
Catharus minimus	Gray-cheeked Thrush, Grey-cheeked Thrush	Present	Unknown	Native
Hylocichla mustelina	Wood Thrush	Present	Unknown	Native
Sialia sialis	Eastern Bluebird	Present	Unknown	Native
Turdus migratorius	American Robin	Present	Unknown	Native
Passeriformes/Tyrannidae				
Contopus virens	Eastern Wood Pewee, Eastern Wood-pewee	Present	Unknown	Native
Empidonax virescens	Acadian Flycatcher	Present	Unknown	Native
Myiarchus crinitus	Great Crested Flycatcher	Present	Unknown	Native
Sayornis phoebe	Eastern Phoebe	Present	Unknown	Native
Tyrannus tyrannus	Eastern Kingbird	Present	Unknown	Native
Passeriformes/Vireonidae				
Vireo griseus	White-eyed Vireo	Present	Unknown	Native
Vireo olivaceus	Red-eyed Vireo	Present	Unknown	Native
Vireo solitarius	Blue-headed Vireo, Solitary Vireo	Present	Unknown	Native
Pelecaniformes/Ardeidae				
Ardea alba	Great Egret	Present	Unknown	Native
Ardea herodias	Great Blue Heron	Present	Unknown	Native
Butorides virescens	Green Heron	Present	Unknown	Native
Pelecaniformes/Threskiornithidae				
Eudocimus albus	White Ibis	Present	Unknown	Native
Piciformes/Picidae				
Colaptes auratus	Northern Flicker	Present	Unknown	Native
Dryocopus pileatus	Pileated Woodpecker	Present	Unknown	Native

Table C-13. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Melanerpes carolinus	Red-bellied Woodpecker	Present	Unknown	Native
Melanerpes erythrocephalus	Red-headed Woodpecker	Present	Unknown	Native
Picoides pubescens	Downy Woodpecker	Present	Unknown	Native
Picoides villosus	Hairy Woodpecker	Present	Unknown	Native
Sphyrapicus varius	Yellow-bellied Sapsucker	Present	Unknown	Native
Strigiformes/Caprimulgidae				
Caprimulgus carolinensis	Chuck-will's-widow	Present	Unknown	Native
Chordeiles minor	Common Nighthawk	Present	Unknown	Native
Strigiformes/Strigidae				
Strix varia	Barred Owl	Present	Unknown	Native

Table C-14. Bird species known or likely to occur at Ocmulgee National Monument. This species list reflects all NPSpecies/IRMA entries and updates through October 2013, and are currently undergoing review and update.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Accipitriformes/Accipitridae				
Accipiter cooperii	Cooper's Hawk	Present	Unknown	Native
Accipiter striatus	Sharp-shinned Hawk	Present	Unknown	Native
Buteo jamaicensis	Red-tailed Hawk	Present	Unknown	Native
Buteo lineatus	Red-shouldered Hawk	Present	Unknown	Native
Buteo platypterus	Broad-winged Hawk	Present	Unknown	Native
Circus cyaneus	Northern Harrier	Present	Unknown	Native
Ictinia mississippiensis	Mississippi Kite	Present	Unknown	Native
Accipitriformes/Cathartidae				
Cathartes aura	Turkey Vulture	Present	Unknown	Native
Coragyps atratus	Black Vulture	Present	Unknown	Native
Accipitriformes/Pandionidae				
Pandion haliaetus	Osprey	Present	Unknown	Native
Anseriformes/Anatidae				
Aix sponsa	Wood Duck	Present	Unknown	Native
Anas americana	American Wigeon	Present	Unknown	Native
Anas clypeata	Northern Shoveler	Probably Present		Native
Anas crecca	Green-winged Teal	Present	Unknown	Native
Anas discors	Blue-winged Teal	Present	Unknown	Native
Anas platyrhynchos	Mallard	Present	Unknown	Native
Anas strepera	Gadwall	Probably Present		Native
Aythya collaris	Ring-necked Duck	Present	Unknown	Native
Branta canadensis	Canada Goose	Present	Unknown	Native
Apodiformes/Apodidae				
Chaetura pelagica	Chimney Swift	Present	Unknown	Native
Apodiformes/Trochilidae				
Archilochus colubris	Ruby-throated Hummingbird	Present	Unknown	Native
Charadriiformes/Charadriidae				
Charadrius vociferus	Killdeer	Present	Unknown	Native
Charadrius wilsonia	Wilson's Plover	Present	Unknown	Native
Charadriiformes/Laridae				
Larus delawarensis	Ring-billed Gull	Present	Unknown	Native
Charadriiformes/Scolopacidae				
Actitis macularia	Spotted Sandpiper	Present	Unknown	Native
Calidris minutilla	Least Sandpiper	Probably Present		Native
Calidris pusilla	Semipalmated Sandpiper	Present	Unknown	Native
Gallinago gallinago	Common Snipe	Present	Unknown	Native
Tringa flavipes	Lesser Yellowlegs	Present	Unknown	Native
Tringa melanoleuca	Greater Yellowlegs	Present	Unknown	Native
Tringa solitaria	Solitary Sandpiper	Present	Unknown	Native

Table 14. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Ciconiiformes/Ciconiidae				
Mycteria americana	Wood Stork	Present	Unknown	Native
Columbiformes/Columbidae				
Columba livia	Rock Dove	Present	Unknown	Non-native
Columbina passerina	Common Ground-dove	Present	Unknown	Native
Zenaida macroura	Mourning Dove	Present	Unknown	Native
Coraciiformes/Alcedinidae				
Megaceryle alcyon	Belted Kingfisher	Present	Unknown	Native
Cuculiformes/Cuculidae				
Coccyzus americanus	Yellow-billed Cuckoo	Present	Unknown	Native
Falconiformes/Falconidae				
Falco columbarius	Merlin	Present	Unknown	Native
Falco sparverius	American Kestrel	Present	Unknown	Native
Galliformes/Odontophoridae				
Colinus virginianus	Northern Bobwhite	Present	Unknown	Native
Galliformes/Phasianidae				
Meleagris gallopavo	Wild Turkey	Present	Unknown	Native
Gruiformes/Gruidae				
Grus canadensis	Sandhill Crane	Present	Unknown	Native
Gruiformes/Rallidae				
Fulica americana	American Coot	Present	Unknown	Native
Passeriformes/Bombycillidae				
Bombycilla cedrorum	Cedar Waxwing	Present	Unknown	Native
Passeriformes/Cardinalidae				
Cardinalis cardinalis	Northern Cardinal	Present	Unknown	Native
Guiraca caerulea	Blue Grosbeak	Present	Unknown	Native
Passerina cyanea	Indigo Bunting	Present	Unknown	Native
Pheucticus ludovicianus	Rose-breasted Grosbeak	Present	Unknown	Native
Passeriformes/Certhiidae				
Certhia americana	Brown Creeper	Present	Unknown	Native
Polioptila caerulea	Blue-gray Gnatcatcher	Present	Unknown	Native
Passeriformes/Corvidae				
Corvus brachyrhynchos	American Crow	Present	Unknown	Native
Corvus ossifragus	Fish Crow	Present	Unknown	Native
Cyanocitta cristata	Blue Jay	Present	Unknown	Native
Passeriformes/Emberizidae				
Junco hyemalis	Dark-eyed Junco	Present	Unknown	Native
Melospiza georgiana	Swamp Sparrow	Present	Unknown	Native
Melospiza melodia	Song Sparrow	Present	Unknown	Native
Passerculus sandwichensis	Savannah Sparrow	Present	Unknown	Native
Passerella iliaca	Fox Sparrow	Present	Unknown	Native
Pipilo erythrophthalmus	Eastern Towhee, Rufous-sided Towhee	Present	Unknown	Native
Spizella passerina	Chipping Sparrow	Present	Unknown	Native

Table 14. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Spizella pusilla	Field Sparrow	Present	Unknown	Native
Zonotrichia albicollis	White-throated Sparrow	Present	Unknown	Native
Zonotrichia leucophrys	White-crowned Sparrow	Present	Unknown	Native
Passeriformes/Fringillidae				
Carduelis pinus	Pine Siskin	Present	Unknown	Native
Carduelis tristis	American Goldfinch	Present	Unknown	Native
Carpodacus mexicanus	House Finch	Present	Unknown	Native
Carpodacus purpureus	Purple Finch	Present	Unknown	Native
Coccothraustes vespertinus	Evening Grosbeak	Present	Unknown	Native
Passeriformes/Hirundinidae				
Hirundo rustica	Barn Swallow	Present	Unknown	Native
Progne subis	Purple Martin	Present	Unknown	Native
Riparia riparia	Bank Swallow	Present	Unknown	Native
Stelgidopteryx serripennis	Northern Rough-winged Swallow	Present	Unknown	Native
Passeriformes/Icteridae				
Agelaius phoeniceus	Red-winged Blackbird	Present	Unknown	Native
Euphagus carolinus	Rusty Blackbird	Present	Unknown	Native
Icterus galbula	Baltimore Oriole, Northern Oriole	Present	Unknown	Native
Icterus spurius	Orchard Oriole	Present	Unknown	Native
Molothrus ater	Brown-headed Cowbird	Present	Unknown	Native
Quiscalus quiscula	Common Grackle	Present	Unknown	Native
Sturnella magna	Eastern Meadowlark	Present	Unknown	Native
Passeriformes/Laniidae				
Lanius ludovicianus	Loggerhead Shrike	Present	Unknown	Native
Passeriformes/Mimidae				
Dumetella carolinensis	Gray Catbird	Present	Unknown	Native
Mimus polyglottos	Northern Mockingbird	Present	Unknown	Native
Toxostoma rufum	Brown Thrasher	Present	Unknown	Native
Passeriformes/Paridae				
Baeolophus bicolor	Tufted Titmouse	Present	Unknown	Native
Poecile carolinensis	Carolina Chickadee	Present	Unknown	Native
Passeriformes/Parulidae				
Dendroica caerulescens	Black-throated Blue Warbler	Present	Unknown	Native
Dendroica castanea	Bay-breasted Warbler	Present	Unknown	Native
Dendroica cerulea	Cerulean Warbler	Present	Unknown	Native
Dendroica coronata	Yellow-rumped Warbler	Present	Unknown	Native
Dendroica discolor	Prairie Warbler	Present	Unknown	Native
Dendroica dominica	Yellow-throated Warbler	Present	Unknown	Native
Dendroica fusca	Blackburnian Warbler	Present	Unknown	Native
Dendroica magnolia	Magnolia Warbler	Present	Unknown	Native
Dendroica palmarum	Palm Warbler	Present	Unknown	Native
Dendroica pensylvanica	Chestnut-sided Warbler	Present	Unknown	Native

Table 14. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Dendroica petechia	Yellow Warbler	Present	Unknown	Native
Dendroica pinus	Pine Warbler	Present	Unknown	Native
Dendroica striata	Blackpoll Warbler	Present	Unknown	Native
Dendroica tigrina	Cape May Warbler	Present	Unknown	Native
Dendroica virens	Black-throated Green Warbler	Present	Unknown	Native
Geothlypis trichas	Common Yellowthroat	Present	Unknown	Native
Helmitheros vermivorus	Worm-eating Warbler	Present	Unknown	Native
Icteria virens	Yellow-breasted Chat	Present	Unknown	Native
Limnothlypis swainsonii	Swainson's Warbler	Present	Unknown	Native
Mniotilta varia	Black-and-white Warbler	Present	Unknown	Native
Oporornis formosus	Kentucky Warbler	Present	Unknown	Native
Parula americana	Northern Parula	Present	Unknown	Native
Protonotaria citrea	Prothonotary Warbler	Present	Unknown	Native
Seiurus aurocapillus	Ovenbird	Present	Unknown	Native
Seiurus motacilla	Louisiana Waterthrush	Present	Unknown	Native
Seiurus noveboracensis	Northern Waterthrush	Present	Unknown	Native
Setophaga ruticilla	American Redstart	Present	Unknown	Native
Vermivora celata	Orange-crowned Warbler	Present	Unknown	Native
Vermivora chrysoptera	Golden-winged Warbler	Present	Unknown	Native
Vermivora peregrina	Tennessee Warbler	Present	Unknown	Native
Vermivora pinus	Blue-winged Warbler	Present	Unknown	Native
Wilsonia canadensis	Canada Warbler	Present	Unknown	Native
Wilsonia citrina	Hooded Warbler	Present	Unknown	Native
Passeriformes/Passeridae				
Passer domesticus	House Sparrow	Present	Unknown	Non-native
Passeriformes/Regulidae				
Regulus calendula	Ruby-crowned Kinglet	Present	Unknown	Native
Regulus satrapa	Golden-crowned Kinglet	Present	Unknown	Native
Passeriformes/Sittidae				
Sitta canadensis	Red-breasted Nuthatch	Present	Unknown	Native
Sitta carolinensis	White-breasted Nuthatch	Present	Unknown	Native
Sitta pusilla	Brown-headed Nuthatch	Present	Unknown	Native
Passeriformes/Sturnidae				
Sturnus vulgaris	European Starling	Present	Unknown	Non-native
Passeriformes/Thraupidae				
Piranga olivacea	Scarlet Tanager	Present	Unknown	Native
Piranga rubra	Summer Tanager	Present	Unknown	Native
Passeriformes/Troglodytidae				
Thryothorus ludovicianus	Carolina Wren	Present	Unknown	Native
Troglodytes aedon	House Wren	Present	Unknown	Native
Troglodytes troglodytes	Winter Wren	Present	Unknown	Native
Passeriformes/Turdidae				
Catharus fuscescens	Veery	Present	Unknown	Native

Table 14. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Catharus guttatus	Hermit Thrush	Present	Unknown	Native
Catharus minimus	Gray-cheeked Thrush	Present	Unknown	Native
Catharus ustulatus	Swainson's Thrush	Present	Unknown	Native
Hylocichla mustelina	Wood Thrush	Present	Unknown	Native
Sialia sialis	Eastern Bluebird	Present	Unknown	Native
Turdus migratorius	American Robin	Present	Unknown	Native
Passeriformes/Tyrannidae				
Contopus virens	Eastern Wood-pewee	Present	Unknown	Native
Empidonax flaviventris	Yellow-bellied Flycatcher	Present	Unknown	Native
Empidonax virescens	Acadian Flycatcher	Present	Unknown	Native
Myiarchus crinitus	Great Crested Flycatcher	Present	Unknown	Native
Sayornis phoebe	Eastern Phobe	Present	Unknown	Native
Tyrannus tyrannus	Eastern Kingbird	Present	Unknown	Native
Passeriformes/Vireonidae				
Vireo flavifrons	Yellow-throated Vireo	Present	Unknown	Native
Vireo griseus	White-eyed Vireo	Present	Unknown	Native
Vireo olivaceus	Red-eyed Vireo	Present	Unknown	Native
Vireo philadelphicus	Philadelphia Vireo	Present	Unknown	Native
Vireo solitarius	Blue-headed Vireo, Solitary Vireo	Present	Unknown	Native
Pelecaniformes/Ardeidae				
Ardea alba	Great Egret	Present	Unknown	Native
Ardea herodias	Great Blue Heron	Present	Unknown	Native
Bubulcus ibis	Cattle Egret	Present	Unknown	Native
Butorides virescens	Green Heron	Present	Unknown	Native
Egretta caerulea	Little Blue Heron	Present	Unknown	Native
Egretta thula	Snowy Egret	Present	Unknown	Native
Pelecaniformes/Threskiornithidae				
Eudocimus albus	White Ibis	Present	Unknown	Native
Plegadis falcinellus	Glossy Ibis	Present	Unknown	Native
Piciformes/Picidae				
Colaptes auratus	Northern Flicker	Present	Unknown	Native
Dryocopus pileatus	Pileated Woodpecker	Present	Unknown	Native
Melanerpes carolinus	Red-bellied Woodpecker	Present	Unknown	Native
Melanerpes erythrocephalus	Red-headed Woodpecker	Present	Unknown	Native
Picoides pubescens	Downy Woodpecker	Present	Unknown	Native
Picoides villosus	Hairy Woodpecker	Present	Unknown	Native
Sphyrapicus varius	Yellow-bellied Sapsucker	Present	Unknown	Native
Podicipediformes/Podicipedidae				
Podilymbus podiceps	Pied-billed Grebe	Present	Unknown	Native
Strigiformes/Caprimulgidae				
Caprimulgus carolinensis	Chuck-will's-widow	Probably Present		Native
Caprimulgus vociferus	Whip-poor-will	Probably Present		Native
Chordeiles minor	Common Nighthawk	Present	Unknown	Native

Table 14. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Strigiformes/Strigidae				
Bubo virginianus	Great Horned Owl	Present	Unknown	Native
Megascops asio	Eastern Screech Owl, Eastern Screech-owl	Present	Unknown	Native
Strix varia	Barred Owl	Present	Unknown	Native
Suliformes/Anhingidae				
Anhinga anhinga	Anhinga	Present	Unknown	Native
Suliformes/Phalacrocoracidae				
Phalacrocorax auritus	Double-crested Cormorant	Present	Unknown	Native

Table C-15. Bird species known or likely to occur at Timucuan Ecological and Historic Preserve and Fort Caroline National Memorial. This species list reflects all NPSpecies/IRMA entries and updates through October 2013, and are currently undergoing review and update.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Accipitriformes/Accipitridae				
Accipiter cooperii	Cooper's Hawk	Present	Uncommon	Native
Accipiter striatus	Sharp-shinned Hawk	Present	Uncommon	Native
Buteo jamaicensis	Red-tailed Hawk	Present	Common	Native
Buteo lineatus	Red-shouldered Hawk	Present	Common	Native
Buteo platypterus	Broad-winged Hawk	Present	Occasional	Native
Circus cyaneus	Northern Harrier	Present	Uncommon	Native
Elanoides forficatus	American Swallow-tailed Kite	Present	Rare	Native
Haliaeetus leucocephalus	Bald Eagle	Present	Uncommon	Native
Ictinia mississippiensis	Mississippi Kite	Present	Occasional	Native
Accipitriformes/Cathartidae				
Cathartes aura	Turkey Vulture	Present	Common	Native
Coragyps atratus	Black Vulture	Present	Common	Native
Accipitriformes/Pandionidae				
Pandion haliaetus	Osprey	Present	Common	Native
Anseriformes/Anatidae				
Aix sponsa	Wood Duck	Present	Uncommon	Native
Anas acuta	Northern Pintail	Present	Occasional	Native
Anas americana	American Wigeon	Present	Rare	Native
Anas clypeata	Northern Shoveler	Present	Uncommon	Native
Anas crecca	Green-winged Teal	Present	Rare	Native
Anas discors	Blue-winged Teal	Present	Uncommon	Native
Anas fulvigula	Mottled Duck	Present	Uncommon	Native
Anas platyrhynchos	Mallard	Present	Uncommon	Native
Anas rubripes	American Black Duck	Present	Occasional	Native
Anas strepera	Gadwall	Present	Rare	Native
Aythya affinis	Lesser Scaup	Present	Uncommon	Native
Aythya americana	Redhead	Present	Occasional	Native
Aythya collaris	Ring-necked Duck	Present	Uncommon	Native
Aythya marila	Greater Scaup	Present	Occasional	Native
Aythya valisineria	Canvasback	Present	Occasional	Native
Branta canadensis	Canada Goose	Present	Common	Native
Bucephala albeola	Bufflehead	Present	Uncommon	Native
Bucephala clangula	Common Goldeneye	Present	Occasional	Native
Cairina moschata	Muscovy Duck	Present	Rare	Non-native
Chen caerulescens	Snow Goose	Present	Occasional	Native
Clangula hyemalis	Long-tailed Duck, Oldsquaw	Present	Occasional	Native
Lophodytes cucullatus	Hooded Merganser	Present	Common	Native
Melanitta fusca	White-winged Scoter	Present	Occasional	Native
Melanitta nigra	Black Scoter	Present	Uncommon	Native

Table 15. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Melanitta perspicillata	Surf Scoter	Present	Occasional	Native
Mergus serrator	Red-breasted Merganser	Present	Common	Native
Oxyura jamaicensis	Ruddy Duck	Present	Uncommon	Native
Apodiformes/Apodidae				
Chaetura pelagica	Chimney Swift	Present	Common	Native
Apodiformes/Trochilidae				
Archilochus colubris	Ruby-throated Hummingbird	Present	Common	Native
Charadriiformes/Charadriidae				
Charadrius alexandrinus	Kentish Plover, Snowy Plover	Present	Occasional	Native
Charadrius melodus	Piping Plover	Present	Uncommon	Native
Charadrius semipalmatus	Semipalmated Plover	Present	Common	Native
Charadrius vociferus	Killdeer	Present	Common	Native
Charadrius wilsonia	Wilson’s Plover	Present	Uncommon	Native
Pluvialis dominica	American Golden Plover	Present	Occasional	Native
Pluvialis squatarola	Black-bellied Plover	Present	Common	Native
Charadriiformes/Haematopodidae				
Haematopus palliatus	American Oystercatcher	Present	Uncommon	Native
Charadriiformes/Laridae				
Chlidonias niger	Black Tern	Present	Uncommon	Native
Larus argentatus	Herring Gull	Present	Common	Native
Larus atricilla	Laughing Gull	Present	Common	Native
Larus delawarensis	Ring-billed Gull	Present	Common	Native
Larus fuscus	Lesser Black-backed Gull	Present	Uncommon	Native
Larus glaucoides	Iceland Gull	Present	Unknown	Native
Larus hyperboreus	Glaucou Gull	Present	Occasional	Native
Larus marinus	Great Black-backed Gull	Present	Uncommon	Native
Larus philadelphia	Bonaparte’s Gull	Present	Uncommon	Native
Larus pipixcan	Franklin's Gull	Present	Unknown	Native
Larus ridibundus	Black-headed Gull, Common Black-headed Gull	Present	Unknown	Native
Rynchops niger	Black Skimmer	Present	Common	Native
Sterna anaethetus	Bridled Tern	Present	Occasional	Native
Sterna antillarum	Least Tern	Present	Common	Native
Sterna caspia	Caspian Tern	Present	Uncommon	Native
Sterna forsteri	Forster’s Tern	Present	Common	Native
Sterna fuscata	Sooty Tern	Present	Occasional	Native
Sterna hirundo	Common Tern	Present	Common	Native
Sterna maxima	Royal Tern	Present	Common	Native
Sterna nilotica	Gull-billed Tern	Present	Uncommon	Native
Sterna paradisaea	Arctic Tern	Present	Unknown	Native
Sterna sandvicensis	Sandwich Tern	Present	Uncommon	Native
Xema sabini	Sabine's Gull	Present	Unknown	Native

Table 15. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Charadriiformes/Recurvirostridae				
Himantopus mexicanus	Black-necked Stilt	Present	Uncommon	Native
Recurvirostra americana	American Avocet	Present	Rare	Native
Charadriiformes/Scolopacidae				
Actitis macularia	Spotted Sandpiper	Present	Uncommon	Native
Arenaria interpres	Ruddy Turnstone	Present	Common	Native
Bartramia longicauda	Upland Sandpiper	Present	Occasional	Native
Calidris alba	Sanderling	Present	Common	Native
Calidris alpina	Dunlin	Present	Common	Native
Calidris bairdii	Baird's Sandpiper	Present	Occasional	Native
Calidris canutus	Red Knot	Present	Common	Native
Calidris ferruginea	Curlew Sandpiper	Present	Unknown	Native
Calidris fuscicollis	White-rumped Sandpiper	Present	Rare	Native
Calidris himantopus	Stilt Sandpiper	Present	Uncommon	Native
Calidris maritima	Purple Sandpiper	Present	Occasional	Native
Calidris mauri	Western Sandpiper	Present	Common	Native
Calidris melanotos	Pectoral Sandpiper	Present	Uncommon	Native
Calidris minutilla	Least Sandpiper	Present	Common	Native
Calidris pusilla	Semipalmated Sandpiper	Present	Common	Native
Catoptrophorus semipalmatus	Willet	Present	Common	Native
Gallinago delicata	Wilson's Snipe	Present	Uncommon	Native
Limnodromus griseus	Short-billed Dowitcher	Present	Common	Native
Limnodromus scolopaceus	Long-billed Dowitcher	Present	Rare	Native
Limosa fedoa	Marbled Godwit	Present	Uncommon	Native
Limosa lapponica	Bar-tailed Godwit	Present	Unknown	Native
Numenius americanus	Long-billed Curlew	Present	Occasional	Native
Numenius phaeopus	Whimbrel	Present	Uncommon	Native
Phalaropus fulicaria	Red Phalarope	Present	Occasional	Native
Phalaropus lobatus	Red-necked Phalarope	Present	Occasional	Native
Phalaropus tricolor	Wilson's Phalarope	Present	Rare	Native
Scolopax minor	American Woodcock	Present	Rare	Native
Tringa flavipes	Lesser Yellowlegs	Present	Uncommon	Native
Tringa melanoleuca	Greater Yellowlegs	Present	Common	Native
Tringa solitaria	Solitary Sandpiper	Present	Uncommon	Native
Tryngites subruficollis	Buff-breasted Sandpiper	Present	Occasional	Native
Charadriiformes/Stercorariidae				
Stercorarius longicaudus	Long-tailed Jaeger	Present	Occasional	Native
Stercorarius parasiticus	Parasitic Jaeger	Present	Rare	Native
Stercorarius pomarinus	Pomarine Jaeger	Present	Rare	Native
Ciconiiformes/Ciconiidae				
Mycteria americana	Wood Stork	Present	Common	Native
Columbiformes/Columbidae				
Columba livia	Rock Dove	Present	Common	Non-native
Columbina passerina	Common Ground-dove	Present	Uncommon	Native

Table 15. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Streptopelia decaocto	Eurasian Collared Dove	Present	Common	Non-native
Zenaida asiatica	White-winged Dove	Present	Occasional	Native
Zenaida macroura	Mourning Dove	Present	Common	Native
Coraciiformes/Alcedinidae				
Megaceryle alcyon	Belted Kingfisher	Present	Common	Native
Cuculiformes/Cuculidae				
Coccyzus americanus	Yellow-billed Cuckoo	Present	Uncommon	Native
Coccyzus erythropthalmus	Black-billed Cuckoo	Present	Occasional	Native
Falconiformes/Falconidae				
Falco columbarius	Merlin	Present	Uncommon	Native
Falco peregrinus	Peregrine Falcon	Present	Uncommon	Native
Falco sparverius	American Kestrel	Present	Uncommon	Native
Galliformes/Odontophoridae				
Colinus virginianus	Northern Bobwhite	Present	Uncommon	Native
Galliformes/Phasianidae				
Meleagris gallopavo	Wild Turkey	Present	Common	Native
Gaviiformes/Gaviidae				
Gavia immer	Common Loon	Present	Uncommon	Native
Gavia stellata	Red-throated Loon	Present	Rare	Native
Gruiformes/Gruidae				
Grus canadensis	Sandhill Crane	Present	Occasional	Native
Gruiformes/Rallidae				
Fulica americana	American Coot	Present	Uncommon	Native
Gallinula chloropus	Common Moorhen	Present	Common	Native
Porzana carolina	Sora	Present	Uncommon	Native
Rallus elegans	King Rail	Present	Occasional	Native
Rallus limicola	Virginia Rail	Present	Occasional	Native
Rallus longirostris	Clapper Rail	Present	Common	Native
Passeriformes/Alaudidae				
Eremophila alpestris	Horned Lark	Present	Unknown	Native
Passeriformes/Bombycillidae				
Bombycilla cedrorum	Cedar Waxwing	Present	Uncommon	Native
Passeriformes/Cardinalidae				
Cardinalis cardinalis	Northern Cardinal	Present	Common	Native
Guiraca caerulea	Blue Grosbeak	Present	Uncommon	Native
Passerina ciris	Painted Bunting	Present	Uncommon	Native
Passerina cyanea	Indigo Bunting	Present	Uncommon	Native
Pheucticus ludovicianus	Rose-breasted Grosbeak	Present	Rare	Native
Passeriformes/Certhiidae				
Polioptila caerulea	Blue-gray Gnatcatcher	Present	Uncommon	Native
Passeriformes/Corvidae				
Corvus brachyrhynchos	American Crow	Present	Common	Native
Corvus ossifragus	Fish Crow	Present	Common	Native
Cyanocitta cristata	Blue Jay	Present	Common	Native

Table 15. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Passeriformes/Emberizidae				
Aimophila aestivalis	Bachman's Sparrow	Present	Rare	Native
Ammodramus caudacutus	Saltmarsh Sharp-tailed Sparrow	Present	Uncommon	Native
Ammodramus henslowii	Henslow's Sparrow	Present	Occasional	Native
Ammodramus leconteii	Le Conte's Sparrow	Present	Occasional	Native
Ammodramus maritimus	Seaside Sparrow	Present	Common	Native
Ammodramus nelsoni	Nelson's Sharp-tailed Sparrow, Nelson's Sparrow	Present	Uncommon	Native
Ammodramus savannarum	Grasshopper Sparrow	Present	Occasional	Native
Calcarius lapponicus	Lapland Longspur	Present	Occasional	Native
Chondestes grammacus	Lark Sparrow	Present	Occasional	Native
Junco hyemalis	Dark-eyed Junco	Present	Occasional	Native
Melospiza georgiana	Swamp Sparrow	Present	Common	Native
Melospiza lincolnii	Lincoln's Sparrow	Present	Occasional	Native
Melospiza melodia	Song Sparrow	Present	Uncommon	Native
Passerculus sandwichensis	Savannah Sparrow	Present	Common	Native
Passerella iliaca	Fox Sparrow	Present	Occasional	Native
Pipilo erythrophthalmus	Eastern Towhee	Present	Uncommon	Native
Plectrophenax nivalis	Snow Bunting	Present	Unknown	Native
Pooecetes gramineus	Vesper Sparrow	Present	Rare	Native
Spizella pallida	Clay-colored Sparrow	Present	Occasional	Native
Spizella passerina	Chipping Sparrow	Present	Common	Native
Spizella pusilla	Field Sparrow	Present	Rare	Native
Zonotrichia albicollis	White-throated Sparrow	Present	Rare	Native
Zonotrichia leucophrys	White-crowned Sparrow	Present	Rare	Native
Passeriformes/Fringillidae				
Carduelis pinus	Pine Siskin	Present	Unknown	Native
Carduelis tristis	American Goldfinch	Present	Uncommon	Native
Carpodacus mexicanus	House Finch	Present	Rare	Non-native
Carpodacus purpureus	Purple Finch	Present	Unknown	Native
Passeriformes/Hirundinidae				
Hirundo rustica	Barn Swallow	Present	Common	Native
Petrochelidon fulva	Cave Swallow	Present	Unknown	Native
Petrochelidon pyrrhonota	American Cliff Swallow, Cliff Swallow	Present	Rare	Native
Progne subis	Purple Martin	Present	Common	Native
Riparia riparia	Bank Swallow	Present	Rare	Native
Stelgidopteryx serripennis	Northern Rough-winged Swallow	Present	Uncommon	Native
Tachycineta bicolor	Tree Swallow	Present	Common	Native
Passeriformes/Icteridae				
Agelaius phoeniceus	Red-winged Blackbird	Present	Common	Native
Dolichonyx oryzivorus	Bobolink	Present	Uncommon	Native
Euphagus carolinus	Rusty Blackbird	Present	Occasional	Native

Table 15. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Icterus galbula	Baltimore Oriole	Present	Uncommon	Native
Icterus spurius	Orchard Oriole	Present	Rare	Native
Molothrus aeneus	Bronzed Cowbird	Present	Unknown	Native
Molothrus ater	Brown-headed Cowbird	Present	Common	Native
Quiscalus major	Boat-tailed Grackle	Present	Common	Native
Quiscalus quiscula	Common Grackle	Present	Common	Native
Sturnella magna	Eastern Meadowlark	Present	Uncommon	Native
Passeriformes/Laniidae				
Lanius ludovicianus	Loggerhead Shrike	Present	Uncommon	Native
Passeriformes/Mimidae				
Dumetella carolinensis	Gray Catbird	Present	Common	Native
Mimus polyglottos	Northern Mockingbird	Present	Common	Native
Toxostoma rufum	Brown Thrasher	Present	Uncommon	Native
Passeriformes/Motacillidae				
Anthus rubescens	American Pipit	Present	Uncommon	Native
Passeriformes/Paridae				
Baeolophus bicolor	Tufted Titmouse	Present	Common	Native
Poecile carolinensis	Carolina Chickadee	Present	Common	Native
Passeriformes/Parulidae				
Dendroica caerulescens	Black-throated Blue Warbler	Present	Uncommon	Native
Dendroica castanea	Bay-breasted Warbler	Present	Uncommon	Native
Dendroica cerulea	Cerulean Warbler	Present	Occasional	Native
Dendroica coronata	Yellow-rumped Warbler	Present	Common	Native
Dendroica discolor	Prairie Warbler	Present	Common	Native
Dendroica dominica	Yellow-throated Warbler	Present	Common	Native
Dendroica fusca	Blackburnian Warbler	Present	Uncommon	Native
Dendroica magnolia	Magnolia Warbler	Present	Uncommon	Native
Dendroica palmarum	Palm Warbler	Present	Common	Native
Dendroica pensylvanica	Chestnut-sided Warbler	Present	Uncommon	Native
Dendroica petechia	Yellow Warbler	Present	Uncommon	Native
Dendroica pinus	Pine Warbler	Present	Common	Native
Dendroica striata	Blackpoll Warbler	Present	Uncommon	Native
Dendroica tigrina	Cape May Warbler	Present	Uncommon	Native
Dendroica virens	Black-throated Green Warbler	Present	Rare	Native
Geothlypis trichas	Common Yellowthroat	Present	Common	Native
Helmitheros vermivorus	Worm-eating Warbler	Present	Uncommon	Native
Icteria virens	Yellow-breasted Chat	Present	Rare	Native
Limnothlypis swainsonii	Swainson's Warbler	Present	Occasional	Native
Mniotilta varia	Black-and-white Warbler	Present	Uncommon	Native
Oporornis agilis	Connecticut Warbler	Present	Occasional	Native
Oporornis formosus	Kentucky Warbler	Present	Occasional	Native
Parula americana	Northern Parula	Present	Common	Native
Protonotaria citrea	Prothonotary Warbler	Present	Uncommon	Native

Table 15. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Seiurus aurocapillus	Ovenbird	Present	Uncommon	Native
Seiurus motacilla	Louisiana Waterthrush	Present	Rare	Native
Seiurus noveboracensis	Northern Waterthrush	Present	Common	Native
Setophaga ruticilla	American Redstart	Present	Common	Native
Vermivora celata	Orange-crowned Warbler	Present	Uncommon	Native
Vermivora chrysoptera	Golden-winged Warbler	Present	Occasional	Native
Vermivora peregrina	Tennessee Warbler	Present	Uncommon	Native
Vermivora pinus	Blue-winged Warbler	Present	Uncommon	Native
Vermivora ruficapilla	Nashville Warbler	Present	Occasional	Native
Wilsonia canadensis	Canada Warbler	Present	Occasional	Native
Wilsonia citrina	Hooded Warbler	Present	Rare	Native
Wilsonia pusilla	Wilson's Warbler	Present	Occasional	Native
Passeriformes/Passeridae				
Passer domesticus	House Sparrow	Present	Common	Non-native
Passeriformes/Regulidae				
Regulus calendula	Ruby-crowned Kinglet	Present	Uncommon	Native
Regulus satrapa	Golden-crowned Kinglet	Present	Occasional	Native
Passeriformes/Sittidae				
Sitta canadensis	Red-breasted Nuthatch	Present	Unknown	Native
Sitta pusilla	Brown-headed Nuthatch	Present	Uncommon	Native
Passeriformes/Sturnidae				
Sturnus vulgaris	European Starling	Present	Common	Non-native
Passeriformes/Thraupidae				
Piranga ludoviciana	Western Tanager	Present	Unknown	Native
Piranga olivacea	Scarlet Tanager	Present	Uncommon	Native
Piranga rubra	Summer Tanager	Present	Common	Native
Passeriformes/Troglodytidae				
Cistothorus palustris	Marsh Wren	Present	Common	Native
Cistothorus platensis	Sedge Wren	Present	Uncommon	Native
Thryothorus ludovicianus	Carolina Wren	Present	Common	Native
Troglodytes aedon	House Wren	Present	Uncommon	Native
Troglodytes troglodytes	Winter Wren	Present	Occasional	Native
Passeriformes/Turdidae				
Catharus fuscescens	Veery	Present	Uncommon	Native
Catharus guttatus	Hermit Thrush	Present	Common	Native
Catharus minimus	Gray-cheeked Thrush	Present	Rare	Native
Catharus ustulatus	Swainson's Thrush	Present	Uncommon	Native
Hylocichla mustelina	Wood Thrush	Present	Occasional	Native
Sialia sialis	Eastern Bluebird	Present	Uncommon	Native
Turdus migratorius	American Robin	Present	Common	Native
Passeriformes/Tyrannidae				
Contopus virens	Eastern Wood-pewee	Present	Rare	Native
Empidonax alnorum	Alder Flycatcher	Present	Occasional	Native
Empidonax flaviventris	Yellow-bellied Flycatcher	Present	Occasional	Native
Empidonax minimus	Least Flycatcher	Present	Occasional	Native

Table 15. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Empidonax traillii	Willow Flycatcher	Present	Occasional	Native
Empidonax virescens	Acadian Flycatcher	Present	Rare	Native
Myiarchus crinitus	Great Crested Flycatcher	Present	Common	Native
Sayornis phoebe	Eastern Phobe	Present	Common	Native
Tyrannus dominicensis	Gray Kingbird	Present	Occasional	Native
Tyrannus forficatus	Scissor-tailed Flycatcher	Present	Unknown	Native
Tyrannus melancholicus	Tropical Kingbird	Present	Unknown	Native
Tyrannus tyrannus	Eastern Kingbird	Present	Uncommon	Native
Tyrannus verticalis	Western Kingbird	Present	Occasional	Native
Passeriformes/Vireonidae				
Vireo bellii	Bell's Vireo	Present	Unknown	Native
Vireo flavifrons	Yellow-throated Vireo	Present	Rare	Native
Vireo gilvus	Warbling Vireo	Present	Occasional	Native
Vireo griseus	White-eyed Vireo	Present	Common	Native
Vireo olivaceus	Red-eyed Vireo	Present	Common	Native
Vireo philadelphicus	Philadelphia Vireo	Present	Occasional	Native
Vireo solitarius	Blue-headed Vireo	Present	Uncommon	Native
Pelecaniformes/Ardeidae				
Ardea alba	Great Egret	Present	Common	Native
Ardea herodias	Great Blue Heron	Present	Common	Native
Botaurus lentiginosus	American Bittern	Present	Rare	Native
Bubulcus ibis	Cattle Egret	Present	Common	Non-native
Butorides virescens	Green Heron	Present	Common	Native
Egretta caerulea	Little Blue Heron	Present	Common	Native
Egretta rufescens	Reddish Egret	Present	Uncommon	Native
Egretta thula	Snowy Egret	Present	Common	Native
Egretta tricolor	Tricolored Heron	Present	Common	Native
Ixobrychus exilis	Leaster Bittern	Present	Rare	Native
Nyctanassa violacea	Yellow-crowned Night-heron	Present	Uncommon	Native
Nycticorax nycticorax	Black-crowned Night-heron	Present	Common	Native
Pelecaniformes/Pelecanidae				
Pelecanus erythrorhynchos	American White Pelican	Present	Uncommon	Native
Pelecanus occidentalis	Brown Pelican	Present	Common	Native
Pelecaniformes/Threskiornithidae				
Ajaia ajaja	Roseate Spoonbill	Present	Common	Native
Eudocimus albus	White Ibis	Present	Common	Native
Plegadis falcinellus	Glossy Ibis	Present	Rare	Native
Piciformes/Picidae				
Colaptes auratus	Northern Flicker	Present	Uncommon	Native
Dryocopus pileatus	Pileated Woodpecker	Present	Uncommon	Native
Melanerpes carolinus	Red-bellied Woodpecker	Present	Common	Native
Melanerpes erythrocephalus	Red-headed Woodpecker	Present	Rare	Native

Table 15. Continued.

Scientific Name	Preferred Common Names	Park Occurrence	Abundance	Nativity
Picoides pubescens	Downy Woodpecker	Present	Common	Native
Sphyrapicus varius	Yellow-bellied Sapsucker	Present	Uncommon	Native
Podicipediformes/Podicipedidae				
Podiceps auritus	Horned Grebe	Present	Uncommon	Native
Podilymbus podiceps	Pied-billed Grebe	Present	Uncommon	Native
Procellariiformes/Hydrobatidae				
Oceanites oceanicus	Wilson's Storm-petrel	Present	Occasional	Native
Oceanodroma leucorhoa	Leach's Storm Petrel, Leach's Storm-petrel	Present	Occasional	Native
Procellariiformes/Procellariidae				
Calonectris diomedea	Cory's Shearwater	Present	Occasional	Native
Psittaciformes/Psittacidae				
Myiopsitta monachus	Monk Parakeet	Present	Rare	Non-native
Strigiformes/Caprimulgidae				
Caprimulgus carolinensis	Chuck-will's-widow	Present	Common	Native
Caprimulgus vociferus	Whip-poor-will	Present	Uncommon	Native
Chordeiles minor	Common Nighthawk	Present	Common	Native
Strigiformes/Strigidae				
Asio flammeus	Short-eared Owl	Present	Unknown	Native
Bubo virginianus	Great Horned Owl	Present	Common	Native
Megascops asio	Eastern Screech Owl, Eastern Screech-owl	Present	Common	Native
Strix varia	Barred Owl	Present	Common	Native
Strigiformes/Tytonidae				
Tyto alba	Barn Owl	Present	Occasional	Native
Suliformes/Anhingidae				
Anhinga anhinga	Anhinga	Present	Uncommon	Native
Suliformes/Fregatidae				
Fregata magnificens	Magnificent Frigatebird	Present	Unknown	Native
Suliformes/Phalacrocoracidae				
Phalacrocorax auritus	Double-crested Comorant	Present	Common	Native
Suliformes/Sulidae				
Morus bassanus	Northern Gannet	Present	Common	Native

Appendix D. Landbird Community Monitoring Job Hazards and Risk Assessment

This appendix describes application of the GREEN-AMBER-RED (GAR) Risk Assessment Model as outlined in the National Park Service (NPS) Operational Leadership Student Manual (Version 2; July 2011) to the SECN Landbird Community Monitoring Protocol. This GAR was written by the Southeast Coast Network (SECN) Program Manager (Joe DeVivo) on 21 May 2012 and approved by the NPS Southeast Region Inventory and Monitoring (I&M) Program Manager (Lisa Garrett) on September 7, 2014.

The GAR model allows for a general assessment of a task or operation and generates communication concerning the risks of an activity; in this case, conducting the field-based activities of the SECN Landbird Monitoring Protocol. The most important part of the process is the team discussions leading to an understanding of the risks and how they will be managed.

The GAR is a seven step process. Each step is defined and explained in the context of the SECN Landbird Community Monitoring Protocol below.

Step 1: Define the Mission or Task

The SECN Landbird Community Monitoring Protocol includes two field-based monitoring activities: deployment and retrieval of automated recording devices, and variable circular plot point counts. Additionally, sampling conducted as a part of this protocol is conducted concurrently with data collection for two other protocols (i.e., vegetation communities and amphibian communities). Sampling an individual location can take as much as four hours to complete, with a target of completing data collection at two sampling locations each day. Individual field crew members are part of a team, but may work in multiple pairs when conducting the monitoring activities. The activity is conducted in all SECN parks, frequently away from trails. Potential safety hazards and mitigation measures are identified below.

Issues of specific concern are:

- Daily tours of duty routinely exceed 10 hours for parks because of travel times to, from, and between locations sampled.
- Crew members will be regularly working in park areas outside of communications range, either by park radio or by cell phone.

Injury or loss of life while in transit to and from field sites is the most significant risk encountered when conducting this activity.

Step 2: Define the Threats

General field work threats/hazards as well as those that are specific for implementing this protocol are described in the associated Protocol JHA (Table D-1).

Table D-1. Threats and hazards associated with implementing the Southeast Coast Network (SECN) Landbird Community Monitoring Protocol.

Category	Threats
Supervision	The SECN Landbird Community Monitoring Protocol clearly identifies personnel, roles and responsibilities, and a chain of command. A field crew lead (the SECN Wildlife Technician) is on-site with the SECN Botanist and two crew members. The crew often works in teams of two, but in doing so are in sight/sound range of each other (within a 0.5 ha sampling area). The supervisor has many tasks to accomplish in the implementation of the protocol, so is not always focusing only on supervision. No one is allowed to work solo and out of sight of at least one other team member. A score of 2 was assigned due to on-site supervision and the fact that the team is not large, and all crew members are in immediate contact with one another.
Planning	The SECN Landbird Community Monitoring Protocol includes numerous SOPs that explain hiring, training, personal safety, emergency communication (equipment and contacts), and appropriate field activities (See Appendix A). Crew members are required to review these materials during training, and crew members are required to have first aid and CPR training. Due to this advanced planning, written documentation, and training procedures, a low score (2) was assigned.
Communication	Routine and emergency communication equipment and procedures are explained in the relevant SOPs. This includes coordination with park natural resource managers, rangers, and dispatch as preferred by each park. It also includes procedures for daily crew check-out/check-in with the SECN Program Manager and Terrestrial Ecologist to ensure that a responsible party knows if someone has not returned from the field activity in a timely manner. Due to this advanced planning, written documentation, and training procedures, a low score (2) was assigned for most parks. Communication may be restricted at some parks, especially CALO, HOBE, and CONG. CALO and HOBE have little to no cell phone coverage, and have limited—or no—monitoring of radio frequencies. At these parks, due to the decreased ability to communicate while in the field, a higher score (5) is assigned. Morning and evening communication for check-out/check-in is possible from the housing location, justifying a score no higher than 5. CONG has limited to no cell phone coverage, but has excellent monitoring of radio frequencies, and a score of 4 is assigned for this park.
Contingency Resources **Contingency Resources (continued)**	Contingency resources include communication equipment and procedures that explicitly involve park rangers, park dispatch, and 9-1-1. Crew members always have at least one mode of communication as outlined in SOP 3.1.7 (park communications), though at some parks radios are not monitored and cell phone coverage is often unreliable. Notification of emergency services should happen within minutes of an incident, but there may be delays depending on where incidents occur. A score of 4 was assigned instead of a lower score because of the potential delay before emergency services could reach the crew.
Team Selection	The monitoring protocol clearly identifies the essential skills and abilities required to execute this protocol in a competent

Category	Threats
	manner. Prior experience is required for most team members. All team members should have basic first aid and CPR skills. A score of 3 was assigned (instead of a lower score) because some crew members may have limited experience. While some of these skills can be improved during crew training, there is no substitute for experience.
Team Fitness	Team selection should ensure an overall high level of initial team fitness. Crew members are in the field for approximately eight hours per day (not including drive times). Sampling always occurs during daylight hours. A score of 6 was assigned because the shifts are long, and the work can be physically strenuous. In addition, the cumulative effects of long field days with few days off can cause increasing team fatigue over the course of the field season. Crew members must be diligent about adequate rest and nourishment to ensure that fatigue does not become a factor.
Environment	Environment was assigned a higher score (7) primarily because of the inherent dangers associated with field work and transit to field sites. Activities occur during spring and summer months, which exposes crews to a variety of weather conditions, including extreme heat and strong localized storm cells, including exposure to lightning strikes. Additionally, transit times to, from, and between sites can be up to an hour, which (in addition to data collection) can result in work days exceeding 10 hours and return trips by vehicle at the end of long days in the field.
Incident Complexity	Incident complexity was also assigned a higher score (5) mostly because daily field conditions change due to weather that can change unpredictably. Individual crew members must use judgment and experience to respond appropriately.

Step 3: Assess Risk and Assign a Numerical Value

Initial risk-level scores were assigned to protocol elements following the process as described in the NPS Operational Leadership Student Manual (Table D-1 - D-3). Scores were initially assigned by Joe DeVivo, the SECN Program Manager with input from SECN and park staff. Final numbers are presented below with concurrence from Michael Byrne, the NPS Lead for the SECN Landbird Community Monitoring Protocol (Table D-3). It should be noted that at the time final numerical values were assigned (26 July 2012) the protocol had been in development for several years and considerable time and effort had already gone into evaluating and mitigating risks. Additionally, because of the variability in sites among parks, many element scores are presented as ranges.

Table D-2. Activity elements and descriptions of major tasks associated with the implementation of Southeast Coast Network (SECN) Landbird Community Monitoring Protocol.

Activity Element	Element Description
Supervision	Supervisory Control considers if supervision is present, how qualified the supervisor is, and whether effective supervision is taking place. Even if a person is qualified to perform a task, supervision acts as a control to minimize risk. This may simply be someone checking what is being done to ensure it is being done correctly. The higher the risk, the more the supervisor needs to be focused on observing and checking. A supervisor who is actively involved in a task (doing something) is easily distracted and should not be considered an effective safety observer in moderate to high risk conditions.
Planning	Planning and preparation should consider how much information you have, how clear it is, and how much time you have to plan the evolution or evaluate the situation, and the presence of Standard Operating Procedures or pre-plans.
Communication	Communication should include physical (dispatch present, effective repeaters) communication and an assessment of personal communication among team members (assertiveness, climate that values input, high degree of accountability) and the presence of briefs and debriefs.
Contingency Resources	Contingency resources refer to readily available trained assets, and whether there is an established agreement and SOP with the cooperating agency (i.e., local law enforcement agencies, fire departments, ambulance, military units, etc.).
Team Selection	Team selection should consider the qualifications and experience level of the individuals used for the specific event/evolution/incident. Individuals may need to be replaced during the incident. The same concerns apply to the reliefs.
Team Fitness	Team fitness should consider the physical and mental state of the team. This is a function of the amount and quality of rest a team member has had. Quality of rest should consider potential sleep length and any interruptions. Fatigue normally becomes a factor after 18 hours without rest; however, lack of quality sleep builds a deficit and worsens the effects of fatigue.
Environment	Environment should consider factors affecting personnel performance and factors affecting equipment. This includes, but is not limited to, time of day, temperature, humidity, precipitation, wind, terrain, and elevation.
Event or Evolution Complexity	Event/Evolution complexity should consider both the required time and the situation. Generally, the longer one is exposed to a hazard, the greater are the risks. However, each circumstance is unique. For example, more iterations of an evolution can increase the opportunity for a loss to occur, but may have the positive effect of improving the proficiency of the team, thus possibly decreasing the chance of error. This would depend upon the experience level of the team. The situation includes considering how long the environmental conditions will remain stable and the complexity of the work.

Table D-3. GREEN-AMBER-RED (GAR) Evaluation Scale for color coding the level of risk. The activity risk can be visualized using the colors of a traffic light. If the total risk value falls in the GREEN ZONE (1-35), risk is rated as low. If the total risk value falls in the AMBER ZONE (36-60), risk is moderate and you should consider adopting procedures to minimize the risk. If the total value falls in the RED ZONE (61-80), you should implement measures to reduce the risk prior to starting the event or evolution.

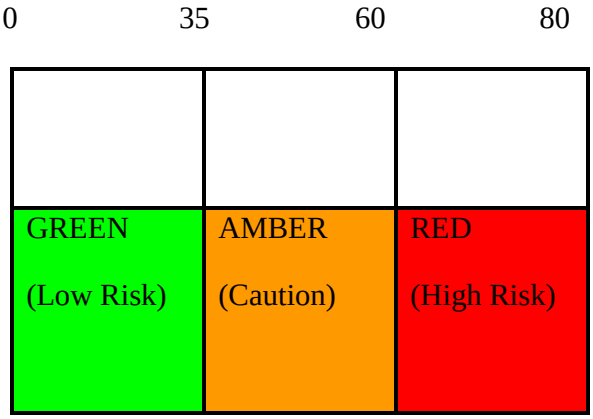


Table D-4. Assigned risk codes of 0 (For No Risk) through 10 (For Maximum Risk) to each of the eight elements for the Southeast Coast Network (SECN) Landbird Community Monitoring Protocol. Zero indicates no known risk and 10 indicates maximum level of risk, or a highly dangerous task.

Category	Fixed Station
Supervision	2
Planning	2
Communication	2–5
Contingency Resources	4
Team Selection	3
Team Fitness	6
Environment	7
Event/Evolution Complexity	5
Total Risk Score	**31-34**

Step 4: Identify Risk Control Options

A Protocol Job Hazard Analysis was performed by the SECN Safety Officer (Sarah Corbett) and abatement actions and requisite training needs were identified to mitigate hazards associated with protocol implementation (Tables D-5, D-6).

Table D-5. Job Hazard Analysis and recommended abatement actions required for safe implementation of the Southeast Coast Network (SECN) Landbird Community Monitoring Protocol.

TASK/PROCEDURES	HAZARDS	ABATEMENT ACTION
FIELD WORK	General Field Safety/ Training	• Complete an annual (American Red Cross) or biannual (American Heart Association) First Aid and CPR training course. • Always carry standard personal protective equipment (PPE), which includes a first aid kit, compass, safety whistle, hydration bladder/water bottles.
	Tick Bites (Lyme Disease, Rocky Mountain Spotted Fever)	• Spray clothing with insect repellant such as Permethrin, as a barrier. • Wear light colored clothing that fits tightly at the wrists, ankles, and waist. • Each outer garment should overlap the one above it. • Cover trouser legs with high socks, boots, or nylon gaiters OR duct tape pant legs to shoes. • Tuck in shirttails. • Search the body on a regular basis, especially hair and clothing; ticks generally do not attach for a couple of hours. Run your fingers across your skull feeling for any atypical bumps. • If a tick becomes attached, use tweezers to grasp the tick as close as possible to the point of attachment and pull straight out with gentle pressure. If tweezers are not available, use fingernails or pliers. Wash skin with soap and water then cleanse with rubbing alcohol. Place the tick in an empty container for later identification, if the victim should have a reaction. Record dates of exposure and removal. • Do not try to remove the tick by burning with a match or covering it with chemical agents. • If you cannot remove the tick, or the head detaches, seek prompt medical help. • If you are bitten by a tick, first document it on a calendar or injury log, then watch for warning signs of illness: a large red spot on the bite area; fever, chills, headache, joint and muscle ache, significant fatigue, and facial paralysis are reactions that may appear within two weeks of the bite. Symptoms specific to Lyme disease include: confusion, short-term memory loss, and disorientation. • Review the CDC documents relating to tick-borne diseases at http://www.cdc.gov/ticks/diseases.
	Tetanus	• Ensure tetanus booster is up-to-date. • Wear all-leather-upper protective footwear.
	Allergic reactions, insect stings	• If a bite/sting victim develops hives, asthmatic breathing, tissue swelling, or a drop in blood pressure, seek medical help immediately. • Be alert to insect hives in brush or in hollow logs. Watch for insects travelling in and out of one location.

TASK/PROCEDURES	HAZARDS	ABATEMENT ACTION
FIELDWORK (continued)	Allergic reactions, insect sting (continued)	• If you or anyone you are working with is known to have allergic reactions to bee, wasp, hornet, yellow jacket, or other insect stings, tell the rest of the crew and your supervisor. Make sure you carry emergency medication (Epipen, etc.) with you at all times, AND know how to administer that medication.
		• Wear long sleeve shirts and trousers; tuck in shirt. Bright colors and metal objects may attract bees.
		• If you are stung, cold compresses may bring relief. Also, it is advisable to take Benadryl immediately if multiple stings are received.
		• If a stinger is left behind, scrape it off the skin. Do not use tweezers as this squeezes the venom sack, worsening the injury.
		• Minimize exposure to plants that cause contact dermatitis (poison ivy, Brazilian peppertree, poison sumac, etc.), EVEN if you do not typically react to them (immunity breaks down with continued exposure). If you are known to have severe reactions, wear ivy block before exposure, and use neutralizing soaps (Technu, etc.) if exposure occurs. Wear long sleeves, long pants, and gloves if working in dense areas with dermatitis-inducing plant species.
	Mosquito Bites - Skin irritation, encephalitis	• Wear long sleeves and trousers.
		• Avoid heavy scents, such as strong soap, lotion, or perfume.
		• Use insect repellents. If using Permethrin, do not apply directly to skin, apply to clothing only.
		• Carry after-bite medication to reduce skin irritation.
	Dehydration	• Drink at least 1/2 qt. of water every hour.
		• Limit caffeine intake, as caffeine dehydrates you.
		• Carry sufficient amounts of water.
		• Avoid long exposure to sun.
		• Wear hat with wide brim for shade.
		• Use electrolyte supplements or drink sports drinks (i.e., Gatorade).
	Uneven terrain, tripping over rocks	• Wear all leather-upper, lace up, 6" minimum high boots with nonskid rubber soles.
		• Test and use secure footing. Walk, never run, down slopes.

TASK/PROCEDURES	HAZARDS	ABATEMENT ACTION
		• Maintain a safe walking distance between people.
		• In heavy undergrowth, lift knees high to clear obstacles. Know how to fall. Try to land in the least obstructed spot. Protect your head and back. Roll with the fall. Do not stick out your arms to break a fall.
		• Use the entire sole of your boots to increase traction and reduce the fatigue associated with walking on the toes.
	Solar Ultraviolet Radiation	• Keep exposed skin covered by wearing a hat, a bandanna, and a long sleeved shirt.
FIELDWORK (continued)	Solar Ultraviolet Radiation (continued)	• Use protective sunscreen lotion.
	Venomous Snakes	• Wear high top boots and snake gaiters or chaps. When going through thick underbrush, be alert. Walk slowly and give snakes ample time to move out of the way. Walk on clear paths as much as possible. Be careful where placing feet and hands at all times. Always step ON the log, not OVER the log!
	Trailblazing with Machetes	• Be aware of sharp edges and angle of cuts. Be aware of briars.
		• Be alert of location of team members when using machete. Stay at least 10 feet away from anyone using a machete. Use a security strap around wrist connected to machete handle to prevent accidental slippage.
		• Swing machete in an angular plane away from the body so if the target is missed it will not impact the lower extremities.
		• Carry tools safely; in a case specifically designed for the tool preferably.
		• Always use PPE, including goggles and leather-palmed gloves.
	Working in Isolated Areas	• Use the buddy system and carry a cellular phone or NPS park radio. Always be alert. Never work alone or leave partner alone. Exceptions may apply to the coastal ecology program when an individual may be required to work alone, but will always have access to communications (VHF radio, park radio, etc.) However, when possible, it is strongly advised to work in pairs.
	Hunting Season	• Wear bright colored clothing, hat or orange vests during hunting season. Observe the area for possible hunters.
	Recently Burned Areas and Fire Operations	• Use caution when working in burned areas for fire weakened trees, stump holes, and accumulated fuels (jackpots). Do not walk beneath leaning burned trees. Do not put pressure on downed trees or limbs that may already be under stress. WHEN IN DOUBT, WALK AROUND!
		• Wear all PPE in recently burned areas (and during fire operations), including hard hats in areas with overhead burned debris and standing snags.

TASK/PROCEDURES	HAZARDS	ABATEMENT ACTION
		• Use tools and equipment properly and handle with care. Be aware of surroundings.
		• SECN employees are neither expected nor authorized to participate in prescribed burning activities as a part of their I&M job duties.
	Heat Stress	• Take appropriate breaks.
		• Maintain proper hydration and electrolyte consumption.
FIELDWORK (continued)	Heat Stress (continued)	• Slow pace or reduce field hours if heat index is high (over 95 degrees Fahrenheit).
	Cold Stress/Hypothermia	• Wear layered clothing, gloves, hard hat with winter liner, etc.
		• During cold weather - layer clothing and wear wind impervious outerwear; during warm months – wear a long sleeve cotton.
	Fatigue	• Know the limits of your own body (i.e., tolerance to heat, cold, allergies, strength, endurance, etc.), pursue physical conditioning prior to the field season if necessary, and do not over-exert yourself.
		• Use proper mechanics when bending over of lifting objects (i.e., lift with your knees, bend knees when bending over). Tighten stomach muscles when standing for long periods of time to support the lower back.
		• When hiking up/down hills, avoid walking on your toes as this cause muscle fatigue rapidly. Using the entire sole of your foot uses the large muscles of your legs thus avoiding leg-muscle fatigue.
	Weather	• Know the weather forecast prior to going into the field.
		• Enable weather alerts on GPS units or portable radio.
		• If a tornado approaches and you are caught in the field, take shelter in low area, lie flat on belly and cover head.
		• There is no safe place outdoors in a lightning storm, but if lightning approaches and you are caught in the field, avoid: standing water if possible, isolated trees, picnic tables, pavilions, flagpoles, metal objects, and fences. Seek shelter under a large grove of trees (preferably shorter than those around it), squat close to ground, keep feet together, tuck head down, close eyes and cover ears, stay 50 feet apart from other people, and remove metal objects from your person.
		• When conducting boat operations, refer also to the SECN Boat Operation SOP.
	Flash Floods	• DO NOT TRY TO WALK, DRIVE, OR OTHERWISE CROSS FLOODWATERS. Keep in mind that floodwaters are swift moving, even if they do not appear to be on the surface. It is possible to drown in just a few inches of water if swept away by floodwaters.
		• Especially important when working in stream and river areas, workers should be aware of the possibility of flash

TASK/PROCEDURES	HAZARDS	ABATEMENT ACTION
		floods. When working in stream and river environments, at least one team member should watch nightly weather reports, or monitor weather band radio, to assess if weather conditions for flash floods may exist.
FIELDWORK (continued)	Flash Floods (continued)	• If caught in a flash flood while in a boat, point the boat downstream and continue with the flow until it is safe to pull to the bank. • If caught in a flash flood while in an automobile, abandon the vehicle immediately and move to higher ground. If the vehicle is submerged, do not panic, allow the vehicle to fill with water, and open the doors when the vehicle is full (doors will not open until the water pressure is equal outside and in). Opening windows will expedite the process. Hold your breath, and swim for the surface and toward the bank if possible. • If caught in a flash flood while on foot, immediately move to higher ground.
SHOP/WAREHOUSE ACTIVITIES	Power Tool Usage	• Care will be taken when using power tools in the shop/warehouse area. Use of power tools must be in accordance with all safety recommendations of the manufacturer. When appropriate, the safety guidelines for tool usage from the user manual will be reviewed prior to tool use. • Appropriate protective equipment will be worn at all times, including safety glasses or goggles, air filtration masks (when dealing with materials that produce sawdust or fine particulate matter), ear protection (when dealing with loud tools), work gloves, and closed-toe shoes. • Long sleeves and long pants will be worn if any tool emits flames or sparks.
	Hand Tools	• Always take care to use hand tools for the purpose for which they are intended (use the “right tool for the job”). • Wear protective eyewear and clothing while using hand tools if there is any chance of flying debris.
VEHICLE OPERATION	Type of Vehicle, Training	• Select appropriate vehicle for work needs and location. • Familiarize yourself with the vehicle and know where the controls are located. • Make the "circle of safety" check of vehicle condition. • Review maps and plan route prior to beginning your trip. • Report any accident (government, leased, or POV), regardless of extent. Complete forms SF-91 and SF-94 immediately if involved in an accident. Copies of these forms should ALWAYS be present in the vehicle. If you are using a POV for government travel, obtain copies of the forms before departure. • Obey speed limit, drive defensively. • Obtain general safety training from a qualified operator before hauling trailers behind any vehicle. • Be conscientious of other drivers (i.e., the left lane is the passing lane and not a cruising lane, pass then get over; do not park too closely to other vehicles).

TASK/PROCEDURES	HAZARDS	ABATEMENT ACTION
		• Always keep your eyes on the road, do not eat and drive, and do not talk on phone and drive.
		• All SECN field staff should take a defensive driving course.
	Driver Fatigue	• NPS policy prohibits driving more than 10 hours per day unless the supervisor has conducted a risk assessment and determined that the risk is acceptable.
VEHICLE OPERATION (continued)	Driver Fatigue (continued)	
		• Driving while towing a vehicle for more than 10 hours in one day is prohibited.
		• Field crews working full days can exceed the combined ten-hour work-plus-driving maximum provided the following:
		• Driving in excess of 10 hours is limited to return trip to temporary housing.
		• All passengers are expected to monitor the selection of driver (and their alertness) to ensure that unsafe driving does not occur. Any passenger may “veto” a driver if he/she feels they are not able to safely operate a vehicle.
	Vehicle Fires	• All vehicles must be equipped with a working fire extinguisher (the extinguisher should be appropriate for the use, class type, in date and fully charged).
		• Never park a warm engine vehicle in tall grass. Avoid engine fuel spills.
		• Be alert of fire conditions. Do not enter uncontrolled burning areas with a vehicle. Minimize flammables in and near vehicle and work area.
		• If a vehicle is on fire and the fire cannot be suppressed with an extinguisher, MOVE AWAY FROM THE VEHICLE. Under no circumstances should you re-enter the vehicle to remove belongings or equipment when a vehicle is burning.
		•
	Vehicle Security/Visibility	• Always lock vehicle, do not leave valuables in vehicle, and cover or otherwise keep from view any equipment left in vehicle.
		• Conduct a full walk-around of vehicle and place orange marker cones behind and/or in front of the vehicle to increase visibility if leaving the vehicle in a generally unsecure area (on a roadside or narrow road shoulder, in a road median, or in an otherwise high-traffic area).
	Vehicle Maintenance	• Check oil and all fluids during every refueling. Document.
		• Perform vehicle inspection for obvious items such as tire inflation, windshield wipers, and sufficient fuel to get to destination.
		• Observe federal guidelines for use of a federal vehicle. Make certain procedures regarding accidents, injuries, vehicular breakdowns, or roadside emergencies are available in vehicle (Forms SF-91 and SF-94).
		• Replace windshield wipers annually, and replace tires when they exceed wear.

TASK/PROCEDURES	HAZARDS	ABATEMENT ACTION
	Weather Conditions	• Changes in climatic conditions require adjusting to different weather situations. • When using windshield wipers during rain, turn on headlights. • Do not drive in adverse weather conditions if the trip can be delayed.
VEHICLE OPERATION (continued)	Weather Conditions (continued)	• Avoid being rushed; you will need more time to prepare the vehicle and get to your destination. • Remove all frost and snow prior to starting your trip. Make sure vents are clear of snow to provide adequate airflow for defrosting.
	Off-Highway Driving/Driving in Mud and Soft Sand	• Check with local unit as necessary prior to driving on back roads, for items such as construction, washouts, blow-downs, and closures. • Obey all posted travel signs. • Proceed slowly around corners and drive on the right side. • Use 4-wheel drive in appropriate situations. • Always put vehicle in 4WD long before you think you might need it; if you begin to get stuck, it is too late for the 4WD to engage. • Do not cause extensive damage to unpaved roads by driving on them when too saturated. • Avoid driving in ruts because the vehicle is susceptible to bottoming out. • Get out of the vehicle to investigate all puddles to determine depth and if the bottom of the puddle is hard enough to support a vehicle. Walk through the puddle if necessary. • Drive SLOWLY through puddles, as driving fast can flood the engine, and/or cause the vehicle to slide laterally. It may also cause more erosion and damage in the road. • Turn around in areas only where enough space on solid ground is available; have passengers get out to help direct; take your time.
	Towing	• Do not exceed recommended towing weight of tow or tow vehicle. • Be aware that states may have speed limits when towing that are not published on speed limit signage. • Ensure tow vehicle has proper mirrors installed to view trailer appropriately. • Load trailer per manufacturer's guidance. • Use a hitch lock or safety pin at all times when towing. • Organize load logically so trailer can be hitched and unhitched easily (i.e., not too much weight in the front of the trailer).

TASK/PROCEDURES	HAZARDS	ABATEMENT ACTION
		• Ensure all trailer lights and brakes are operational before driving. • Ensure safety chains are installed correctly, crossed under the trailer and connected to the tow vehicle. • Check tire pressure, spare tire, and jack. • Maintain bearing grease, checking regularly. • Practice driving vehicle with trailer attached in a safe area until a comfort level is obtained. • Be careful when towing in strong crosswinds.
WATERCRAFT OPERATION	Watercraft Safety and Training	• All SECN Employees who will tow a boat or cargo trailer must read and understand the brochure "Towing a Trailer: Being Equipped for Safety" available from the U.S. Department of Transportation website at: www.nhtsa.gov/cars/problems/equipment/towing/index.htm • All SECN employees operating or riding in a watercraft MUST read and understand the SECN Boat Operation Standard Operating Procedure (SOP). This document provides more comprehensive guidance than provided here. • All SECN employees who operate a motorized vessel must complete the USDI Motorboat Operators Certification Course. Complete an 8-hour refresher course every 5 years. • All DOI employees must wear approved life vests while underway. • Carry cell phone and vhf radio. • File a float plan and work in pairs when possible. • Do not exceed the rated capacity of the vessel (includes personnel and cargo). • It is advisable that all personnel know how to swim OR know what to do if thrown overboard. Life vests MUST be worn. • All new employees will complete a safety orientation with the boat operator or the SECN Safety Officer prior to getting underway.
	Vessel Maintenance	• Perform vessel inspection for obvious items such seaworthiness of craft, oil levels and motor is in working order. Maintain vessel and proper safety equipment. Look for any damage to the hull. • For non-motorized vessels, ensure craft is in good condition. Before the start of the field season, fill the craft with water while on land and watch for leaks. Repair leaks immediately.
	Onboard Safety Equipment	• All motorized vessels shall carry U.S. Coast Guard (USCG) and state required safety equipment, including USCG approved life jackets, throw-able device, fire extinguisher, working marine radio, sufficient chain/rope and proper anchor, oar/paddle, flares and signaling device, approved navigation lights, and tool kit.

TASK/PROCEDURES	HAZARDS	ABATEMENT ACTION
	Weather Conditions	• Changes in climatic conditions require adjusting to different weather situations. • Do not operate vessels in adverse weather conditions if the trip can be delayed. • Avoid travelling in high winds or rough water. • Avoid being rushed; you will need more time to prepare the vehicle and get to your destination.
WATERCRAFT OPERATION (continued)	Overturned/Capsized Vessels	• To avoid the likelihood of capsizing, keep a lookout facing the direction of movement of the vessel (motorized vessels), and take extreme care when navigating in areas with shallowly submerged objects or sandbars by moving slowly and avoiding sudden port or starboard movements (motorized and non-motorized vessels). • In the event that a motorized or non-motorized vessel overturns or capsizes, first account for the location of all passengers and ensure that they are wearing life vests. If not wearing a vest, get one to them as soon as possible. • If a vessel does capsize, assess whether or not you can safely upright it. If so, upright the craft and bail all water out of it before reentering the craft. • If a vessel is unable to be righted, for non-motorized vessels including rowboats, canoes, and kayaks, drag the vessel to the shore if you can and upright it there. This is not advisable with motorized craft, generally due to their size and weight and the additional danger and effort of recovering a beached craft. For motorized vessels, it is advised to remain with the vessel and signal for help (flare, whistle, cell phone, radio if operable).
OFFICE WORK	Computer Use Fatigue	• Take appropriate breaks. • Perform other job duties. • Trade appropriate and assigned duties with coworker. • Apply work/rest ratio guidelines.
	Computer Use Eye Strain	• Take appropriate breaks. • Perform other job duties for a time. • Use a non-glare screen or an anti-glare device on screens. • Trade appropriate and assigned duties with coworker. • Individuals requiring prescription eye wear should ensure proper focal distance is achieved without having to tilt the head. • Adjust screen refresh rate as needed to eliminate screen flicker.
	Carpal Tunnel Syndrome	• Take appropriate breaks. • Use wrist exercises. • Stretch hands. • Ensure proper keyboard position.

TASK/PROCEDURES	HAZARDS	ABATEMENT ACTION
		• Adjust chair height so that forearms are parallel to the work surface.
	Physical Stress	• Take appropriate breaks.
		• Ensure proper keyboard, chair, and computer monitor positions.
	Electrical Cords and Electrical Hazards	• Do not overload outlets.
OFFICE WORK (continued)	Electrical Cords and Electrical Hazards (continued)	• Use surge protection for computer equipment.
		• Keep cords organized and out of walkways. • Never use personal space heaters in government buildings unless approved by facility maintenance supervisor.
	Indoor Supplies and Activities	• Keep area clean and organized.
		• Use stepladder for out-of-reach supplies. NEVER use a chair as a stepladder. • Use proper containers and storage for supplies. • Follow MSDS rules and recommendations if applicable. If using volatile chemicals (including paints), supply appropriate ventilation or conduct activities outdoors. For all stored chemicals, keep a Materials Data Safety Sheet nearby (includes volatile glues, insect repellants, and cleaners). • Walk in the office, do not run. • Watch out for tripping hazards. Follow good housekeeping practices, including closing drawers, properly disposing of waste, and properly storage of materials and equipment not in use. • Report maintenance issues that pose a fall/trip hazard to maintenance staff immediately (ex. Wet floor from leaky toilet, torn carpet, etc.).
	Inadequate Lighting and Poor Air Circulation	• Take appropriate breaks.
		• Alternate indoor and outdoor activities. • Adjust thermostat and open windows as needed. • Turn lights on or off. •
	Lacerations and Punctures	• Do not use paper cutters if the guard is removed or blade is dull. • Keep fingers and hands away from point of operation.
QUALIFIED	Untrained/Unqualified	Personnel will have the correct qualifications for the job assigned.

TASK/PROCEDURES	HAZARDS	ABATEMENT ACTION
PERSONNEL	Personnel	
		• Trainees will work under the supervision of an appropriately qualified individual. • Trainees will be trained locally or attend appropriate safety courses. • Non-DOI or other government agency personnel (interns and contractors working for SECN or a park are considered government agency personnel) will never accompany SECN staff during work operations UNLESS specifically approved by the SECN Coordinator or a Park Superintendent.
CONTACT WITH VISITORS, ADJACENT LANDOWNERS, AND CONCESSIONERS	Aggressive or Inappropriate Behavior	Act professionally (do not yell or antagonize) but ALWAYS protect yourself. • Do not confront an angry landowner/visitor when alone. • Leave quickly if the situation is unsafe. • Call 911 if situation is or becomes dangerous. • If the opportunity exists, listen to grievances, use a calm voice. • Immediately report incident to supervisor. •
GENERAL WORKER SAFETY AND REPORTING	Emergency and Hazard Reporting	Know where fire or emergency alarm pull stations are located in the building. Know the emergency evacuation routes for the building and the rally point once outside. Perform periodic workplace assessments for potential hazards. • Know your building Maintenance Supervisor and report hazards to them for correction. • Know procedures for reporting work related injuries. All SECN employees are required to read and understand the document “On-Duty Injury and Illnesses Standard Operating Procedure.” • Keep a copy of the SECN Emergency Status Reporting Card with you at all times. Follow instructions on back of card in the event of natural or other disaster situations.

Table D-6. Training and proficiencies required or recommended for the safe implementation of the Southeast Coast Network (SECN) Landbird Community Monitoring Protocol.

Required Training and Proficiencies
• First Aid and CPR training for field workers (terrestrial ecology, coastal ecology, and water quality positions) [renewed annually (American Red Cross training) or biannually (American Heart Association training].
• USDI Motorboat Operators Safety Training for positions that require operation of a motorized vessel.
• Read and understand the "SECN Boat Operation SOP" for positions that require operation or riding in a motorized vessel and complete a short written exam.
• All Employees riding or operating a motorized or non-motorized vessel will undergo a safety briefing by a certified operator or the SECN Safety Officer.
• Read and understand the document "Towing a Trailer: Being Equipped for Safety" for all positions requiring towing of a trailer and complete a short written exam.
• All field staff must read and understand the document "On-Duty Injury and Illnesses SOP" and complete a short written exam.
• All SECN staff implementing terrestrial Vital Signs Monitoring protocols must complete a defensive driving course.
• All employees required to operate a government vehicle must read and understand the document "Government Motor Vehicle Accident SOP" and complete a short written exam.
Optional / Recommended Training and Proficiencies
• Cool Ideas on a Hot Topic (free DOI LEARN online course)
• Authorities, Roles, and Responsibilities (free DOI LEARN online course)
• Bloodborne Pathogens (free DOI LEARN online course)
• Fall Protection (free DOI LEARN online course)
• Fire Protection (free DOI LEARN online course)
• Office Safety (free DOI LEARN online course)
• Flammable and Combustible Liquids (free DOI LEARN online course)
• Hand and Portable Powered Tools (free DOI LEARN online course)
• Walking and Working Surfaces (free DOI LEARN online course)
• Resources, References, and Standards (free DOI LEARN online course)
• Personal Safety Through Awareness (free DOI LEARN online course)
• Laboratory Safety (free DOI LEARN online course)
• Hazard Communication (free DOI LEARN online course)
• First Responder Awareness Level (free DOI LEARN online course)
• NSC Defensive Driving II (free DOI LEARN online course)
• Personal Protective Equipment (free DOI LEARN online course)
• Stress Management (free DOI LEARN online course)

Step 5: Evaluate Risk vs. Gain

The SECN Program Manager has determined that the activity has an acceptable level of risk, if carried out in accordance with all SOPs and risk abatement measures as outlined in Appendix D.

Step 6: Execute Decision

The decision made by the SECN Program Manager is to conduct the activity in accordance with SECN Landbird Community Monitoring Protocol Standard Operating Procedures and risk abatement measures as outlined in Appendix D.

Step 7: Supervise – Watch for Change

The SECN Program Manager and Terrestrial Ecologist continually solicit feedback from the NPS and cooperator staff on safe execution of the protocol including risk control options not considered thus far.

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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