



Appendix 5 – Summaries of Natural Resource Issues at Southeast Coast Network Parks



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Canaveral National Seashore (CANA)

Park Description

Canaveral National Seashore (CANA) consists of approximately 58,000 acres within the Mosquito Lagoon watershed. This National Park unit represents an excellent example of a relatively stable barrier beach backed by a productive lagoon system. Mosquito Lagoon is the northernmost part of the Indian River Lagoon (IRL) system, which contains the highest species diversity of any estuary in North America (Schmalzer 1995) and provides critical habitat for 14 federally listed threatened and endangered species, including the green sea turtle (*Chelonia mydas*), loggerhead turtle (*Caretta caretta*), and West Indian manatee (*Trichechus manatus*). The far-reaching, ecological importance of this area has been demonstrated by the EPA in listing it as an Estuary of National Significance and by the state of Florida in classifying it as a Florida Outstanding Waterway and Aquatic Preserve, the highest level of state protection. Under these designations, ambient water quality must be maintained and protected, and any degradation must be short-term or temporary.

Park Mission relative to Natural Resource Management

CANA was established in 1975 to preserve and protect the outstanding natural, scenic, scientific, ecologic, and historic values of certain lands, shoreline, and waters of the State of Florida, and to provide for public outdoor recreation use and enjoyment of the same (16 USC 459j).

Natural Resources Issues

Environmental Setting	Resources	Agents of Change
<u>Water Resources</u> <ul style="list-style-type: none">• Water Quality• Surface Waters	<u>Species of Concern (TERS)</u> <ul style="list-style-type: none">• Sea Turtles• RTE Species (general)	<u>Park NR Management</u> <ul style="list-style-type: none">• Exotic Animal Control• Exotic Plant Management• Mosquito Control• Fire Management
<u>Air Resources</u> <ul style="list-style-type: none">• Air Quality• Ozone• Particulates	<u>Exotic / Invasive Species</u> <ul style="list-style-type: none">• Fire Ants• Exotic Plants• Exotic Animals	<u>External Stressors</u> <ul style="list-style-type: none">• Atlantic Intracoastal Waterway• Aquaculture and Shellfish Harvesting• Septic Systems
<u>Geologic Resources</u> <ul style="list-style-type: none">• Shoreline Erosion• Overwash	<u>Habitats & Communities</u> <ul style="list-style-type: none">• Salt Marshes• Coastal Dunes• Estuaries	<u>Ecosystem Functions</u> <ul style="list-style-type: none">• Fire
<u>Weather & Climate</u> <ul style="list-style-type: none">• Hurricanes• Lightning Strikes		<u>Other Issues</u> <ul style="list-style-type: none">• Visitor Use• Disease Transmission

Water Resources

Water Quality: Surface waters within the study area are, with the exception of certain metals, generally of good quality and typical of the area (National Park Service 1994a). The source of elevated silver concentrations in Mosquito Lagoon that frequently exceed the acute marine criterion should be considered as a potential topic for research by the park. Potential anthropogenic sources of contaminants include municipal and residential development, septic tank systems, and wastewater discharges.

Surface Waters: Surface water resources in the CANA study area include the Indian River and Mosquito Lagoon.

Air Resources

Air Quality: Because surface waters associated with the park are either saline or tidally influenced, surface water acidification is not a concern for the park. Atmospheric deposition of nitrogen resulting in eutrophication is not an issue for the park.

Ozone: The low levels of ozone exposure and the relatively dry soil moisture conditions at Canaveral National Seashore make the risk of foliar ozone injury to plants low (National Park Service 2004a). While the Sum06 exposures exceed threshold levels for injury, the W126 do not since the N100 criterion is not satisfied. Soil moisture conditions of mild to severe drought reduce the effectiveness of the higher ozone exposures, and hourly concentrations of ozone only occasionally exceeded 80 ppb. If the level of risk increases in the future, a program to assess the incidence of foliar ozone injury on plants at the site could use one or both of the following bioindicator species: and American elder (*Sambucus nigra canadensis*).

Geologic Resources

Shoreline Erosion: A revetment has been installed immediately north of the northern park boundary. New current patterns can potentially cause erosion on park lands. Also, changes due to sea level change are unknown.

Overwash: In the event of hurricanes or big storm events, overwashes can weaken the overall dune system, particularly in places where the dune elevation is low. Following overwash disturbance, the dune system typically regenerates, but overwashes might also potentially threaten the road located behind a portion of the dune system.

Weather & Climate

Hurricanes:

Lightning: Canaveral NS is located in one of the most active lightning strike areas in the country.

Species of Concern (Threatened, Endangered, Rare, Special)

Sea Turtles: The Park documents 3,000 to 4,000 sea turtle nests each year. In the early 1980's, more than 95 percent were destroyed by raccoons (*Procyon lotor*). In 1984, the park began a nest screening program and has reduced depredation to less than 20 percent. However, this program is costly, averaging about \$45,000 a year, and raises questions about the diverted predation pressure on other ground nesting species. Some parties recommend removing raccoons as a solution; in fact, MINWR does so with considerable success. Light pollution from directional sources is also a concern during nesting and hatching season.

Rare, Threatened, and Endangered Species (General): Canaveral is second only to Everglades National Park in number of federally protected species with 14. These include such species as the highly endangered West Indian manatee, right whale (*Balaena glacialis*) and little known Atlantic salt marsh snake (*Nerodia fasciata taeniata*), whose entire known range consists of a two counties in Florida. Canaveral's 24 miles of beach provides a critical nesting area for sea turtles, harboring 3,000 to 4,000 nests each year. The majority are loggerhead, with a smaller number of green (*Chelonia mydas*) and an occasional leatherback (*Dermochelys coriacea*). Mosquito Lagoon provides an important nursery area for juvenile sea turtles.

Exotic / Invasive Species

Fire Ants (*Solenopsis* spp.): Potentially a threat for nesting sea turtles.

Exotic Plants: Like a number of other parks in the southeast, Canaveral faces a serious threat from the invasion of exotic plants, including Brazilian pepper (*Schinus terebinthifolius*), Australian pine (*Casuarina equisetifolia*) and century plant / sisal hemp (*Agave sisalana*). Brazilian pepper has spread throughout virtually all of the disturbed areas of Canaveral. A small number of punktree (*Melaleuca quinquenervia*), a species that has severely impacted the Everglades, have been found in MINWR, less than 5 miles from the park boundary.

Exotic Animals: Exotic animals are also a threat to park resources. Feral hog (*Sus scrofa*) populations have become established in the southern half of Canaveral NS, particularly in the joint area, resulting in consistent disturbance of native vegetation and potentially improving habitat for exotic / invasive plant species. A voracious snake eater, it may also be affecting native snakes, including the protected eastern indigo snake (*Drymarchon corais couperi*). Another exotic animal impacting the park is the feral cat (*Felis catus*). During a two-year survey to determine the distribution of the southeastern beach mouse within Canaveral NS, no mice were captured in the northernmost section of the park (Stiner, 1991; Stiner, 1992). In addition, a number of potentially harmful amphibian and reptiles are expanding their ranges into Florida from tropical areas throughout the world. The park is attempting to detect these invaders through the long-term herpetofaunal monitoring program established by Southeastern Louisiana University in 1992.

Habitats & Communities

Salt Marshes / Mangrove Forests: A sign that CANA lies along a major transitional zone is the significant shift in vegetation along the edge of the lagoon from saltmarsh cordgrass (*Spartina alterniflora*), which predominates in areas north of Canaveral, to mangrove species that predominate to the south.

Coastal Dunes: Unlike many barrier islands, Canaveral has only a single dune ridge, averaging 12 feet in height. For the vast majority of its length the dune is quite stable, backed by a dense growth of saw palmetto (*Serenoa repens*) and several other species of hardy shrubs and grasses.

Estuaries: Mosquito Lagoon, extending along the backside of Canaveral's barrier island, is the northernmost part of the Indian River Lagoon. Containing the most diverse assemblage of aquatic species on the entire Eastern Seaboard, this 155-mile long lagoon has been designated as an Estuary of National Significance by the Environmental Protection Agency and an Outstanding Florida Water by the State of Florida. It contains one of the last significant populations of oysters on the entire Atlantic Coast that has not been depleted by over harvesting or pollution. Commercial shell fishing is extremely important to the local economy, while recreational fishing and shrimping in the lagoon support a multimillion-dollar tourist industry. The estuary also acts as an important nursery area for a number of commercially important ocean-going species such as flounder, mullet, black drum and shrimp.

Transitional Plant Communities: The Park is located along the "frost line", resulting in a unique combination of temperate and subtropical plants found nowhere else in the Western Hemisphere. Several temperate species extend no farther south than Canaveral, while a number of subtropical species occur no farther north. Signs of this unusual mixture include Canaveral's hammocks, which contain an overstory dominated by temperate species and an understory comprised of subtropical plants.

Oak Scrub: Major habitat for scrub jays, indigo snake and gopher tortoise

Pine Flatwoods: Harbors eagle nests on site.

Coastal Strands:

Oak / Cabbage Palm Hammocks:

Park NR Management

Mosquito Control: In the designation of lands for NPS management, both NASA and the State of Florida stipulated that CANA must cooperate with the local mosquito control districts to control salt marsh mosquitoes (*Aedes sollicitans*). The influence of various mosquito control techniques (e.g., impoundments, larvicides, etc.) and impoundment restoration measures on CANA's water resources are not fully understood (Walters et al. 2001).

Fire Management: High lightning strike frequency, combined with the volatile fuels (particularly saw palmetto) and the extremely high fuel loads, resulting from fire suppression and/or a lack of fire management, makes naturally- or human-ignited fire a serious threat. In addition, many vegetation communities are dependent on frequent light to moderate fires, as are the animals these communities support. A fire management plan has been completed which will allow the park to utilize prescribed fire to maintain and restore habitat for protected species such as the Florida scrub jay (*Aphelocoma coerulescens coerulescens*), gopher tortoise (*Gopherus polyphemus*) and indigo snake (*Drymarchon corais*) (National Park Service 1998c).

Long-term fire monitoring will measure the influence of fire on ecosystem structure and dynamics, identify areas for future research and validate the use of fire in perpetuating CANA ecosystems. The variables to be monitored will be those included in immediate postfire effects and variables which have been determined to be primary indicators of long-term change. CANA will determine primary indicators by examining park fire management goals and objectives and by consulting fire effects specialists (National Park Service 1998c).

Exotic Animal Management: CANA assists USFWS with hog trapping efforts (through field time, funding, traps bait, etc.), but the Refuge maintains primary responsibility for feral hog management. Overall, hog management is not currently as successful as desired / necessary to protect Park resources.

Exotic Plant Management: CANA is included in the Florida EPMT unit, managed out of Miami.

External Stressors

Atlantic Intracoastal Waterway: A survey by the Florida Inland Navigation District (FIND) in 1996 revealed significant shoaling of the Intracoastal Waterway (ICW), which is adjacent to or within CANA boundaries. FIND estimates that approximately 529,000 yd³ of material will be dredged from the ICW in this area over the next 50 years. A 91.8-acre dredged-material management area 0.3 miles west of Mosquito Lagoon's western shoreline is where the dredged material will be piped in from the ICW and hauled away. A monitoring program is to be in place at all times because the release of contaminants (e.g., heavy metals) into local waters is potentially high during active dredging operations (Walters, Roman, Stiner, and Weeks 2001).

Aquaculture and Shellfish Harvesting: Aquaculture and commercial shellfish harvesting has increased in Mosquito Lagoon since the 1995 gill net ban went into effect in all Florida waters. The recreational harvest of clams, oysters, and crabs that occurs in CANA waters is not adequately monitored and the Park needs to ensure that these populations can sustain this harvest pressure. In addition, the Park is concerned with harvesting methods on associated fauna and flora, especially seagrasses (Walters, Roman, Stiner, and Weeks 2001).

Septic Systems: The nearby Oak Hill community is still on septic, as well as trailer parks on the northwest side of Mosquito Lagoon; both are potential sources of nutrient contamination. Within the Park, only a few buildings still have septic / drain fields.

Ecosystem Functions

Fire: CANA lies within an area that receives more thunderstorms than anywhere else in the entire United States. Until recently, FWS postulated that prehistoric fires burned all of the Canaveral area every 2-5 years.

However, recent research indicates that the natural burn cycle was somewhat longer, possibly 7-20 years, and fires burned in a mosaic, rather than uniform. Fire frequency fluctuated during the 20th Century, mainly in response to changing livestock policies (Davison and Bratton 1986). At the turn of the century, marsh, pine and scrub were deliberately burned every year between November and February to provide better livestock range. Burning in March was avoided because of high winds which could fan fires out of control.

Other Issues

Recreational / Visitor Use: Boaters are coming into Canaveral National Seashore in increasing numbers due to the growing popularity of fly-fishing for redfish. This increases the destruction of seagrass beds, impacts to fisheries are unknown and manatees are highly affected. One of the very controversial and volatile issues among boaters in Florida is the establishment of slow speed zones to protect the West Indian manatee. Canaveral has supplied sighting data and engaged in several discussions with DEP on the proper placement of slow speed zones in the vicinity of the park. The park also assisted DEP with a boating survey to determine boating use patterns and areas that warrant speed restrictions. A proposal was submitted in 2004 to conduct an aerial survey of boating use in the northern (NPS managed) portion of the Park.

Cape Hatteras National Seashore (CAHA) Fort Raleigh National Historic Site (FORA) Wright Brothers National Memorial (WRBR)

Park Description

The Outer Banks Group includes Cape Hatteras National Seashore, Fort Raleigh National Historic Site, and Wright Brothers National Memorial. Cape Hatteras National Seashore is part of the east coast barrier island system. The Seashore contains 35,400 acres of land and 74 miles of virtually unspoiled beach. The U.S. Fish and Wildlife Service administers Pea Island National Wildlife Refuge within the boundary of the seashore. The intensely developed town of Nags Head borders the northern end of the Seashore and eight other villages border the seashore. Seashore marshes contribute heavily to primary estuarine productivity and provide habitat for numerous wildlife and aquatic species. Buxton Woods is located on the widest portion of the Seashore and is one of the largest maritime forests on the east coast. Approximately one-third of the forest, about 1,000 acres, lies within Park Service boundaries. Of the rest, about 800 acres are under state protection. The unique and varied habitats, mature broad-leaved evergreen forest and shrub, freshwater marsh, and bog support an unusual assemblage of aquatic, terrestrial, and avian animals. Buxton Woods also overlies, protects, and provides for recharge of an important freshwater aquifer. The seashore has recently been 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.

The ecological zonation of Cape Hatteras National Seashore is resultant in part on artificial alterations dating from the turn of the twentieth century. The most important perturbations were: (1) early efforts at mosquito control and waterfowl management which involved excavation of drainage ditches and construction of water control structures; and, (2) construction 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 road bed material. For the most part, these actions ended by the 1970's, save for localized projects designed to protect specific and discrete portions of infrastructure.

Fort Raleigh National Historic Site is located on the north end of the forested Roanoke Island between the barrier islands and the mainland of coastal North Carolina. The site's 355 acres vary in elevation from sea level to 20 feet. Approximately 80% of Fort Raleigh is heavily forested with the remainder of the area supporting a visitor center, administrative and maintenance buildings, residences, the Waterside Theatre complex, and maintained open grassed

areas. The maturing mixed deciduous and pine forest occurs on land that was previously disturbed, having been used for farming, grazing, transportation routes, and early settlement activities. Habitats include upland forests dominated by pines or a mixture of pine and hardwoods, brackish marsh, and swamp forests dominated by hardwoods. Species within the forest canopy include live oak (*Quercus virginiana*), laurel oak (*Q. laurifolia*), blackjack oak (*Q. marilandica*), American holly (*Ilex opaca*), dogwood (*Cornus* spp.), persimmon (*Diospyrus virginiana*), and loblolly pine (*Pinus taeda*).

Wright Brothers National Memorial covers over 421 acres in Kill Devil Hills, NC. The area's wind-blown sand flats and hills were the Wright brother's chosen practice field, and in 1903, the site of the first successful powered human flight. WRBR is situated on a barrier island within a rapidly developing residential and commercial community. The site has been transformed from its original relatively barren, dynamic state to a stabilized, dune and grass flat region. Grassed areas are vegetated with native and introduced grasses. Loblolly pine dominates the forested areas with laurel oak and live oak being the more predominant broad-leaved trees. Evergreen broad-leaved shrubs are interspersed within the forested area and between the forested and grassed areas. Much of the site is occupied by a visitor center, reconstructed buildings of the period, a monument, maintenance and residential structures, a paved airstrip, roads, walkways, and parking lots. Only limited vegetation and faunal inventories have been conducted at the site.

Developmental pressures outside the Park and visitor and recreational uses represent the major categories of threat to the integrity of natural resources on the Outer Banks Group parks. Adjacent property development has resulted in direct loss and fragmentation of habitat upon which numerous Park wildlife species were partially dependent. Replacement of natural areas with impervious surfaces increases storm water runoff with its associated contaminants. Two potentially profound adverse impacts associated with adjacent development are contamination of ground and surface water by septic leachate and drawdown of the aquifer associated with excessive groundwater withdrawals. Other threats to natural resources include the introduction of exotic plants and animals, off-road vehicle use, and dredging of channels adjacent to the park.

Park Mission relative to Natural Resource Management

None of the parks in the Outer Banks include language in their enabling legislation that specifically mentions natural resources management. However NPS is responsible for managing lands in accordance with the National Park Service Organic Act (16 USC 1) and National Parks Omnibus Management Act (Pub. L. 105-392) such that the Park makes sound resource decisions based on sound scientific data in an effort to leave resources unimpaired for the enjoyment of future generations.

Natural Resources Issues

The issues noted here are primarily for CAHA, though it is noted where applicable to FORA / WRBR.

Environmental Setting	Resources	Agents of Change
<u>Water Resources</u>	<u>Species of Concern (TERS)</u>	<u>Park NR Management</u>
<ul style="list-style-type: none"> • Septic Tanks • Water Quality • Hydrology • Park Facilities 	<ul style="list-style-type: none"> • Horses • Sea Turtles • Shore Birds 	<ul style="list-style-type: none"> • Exotic Plant / Animal Control • Wildfire Management • Predator Management • T&E Species Protection
<u>Air Resources</u>	<u>Exotic / Invasive Species</u>	<u>External Stressors</u>
<ul style="list-style-type: none"> • Air Quality 	<ul style="list-style-type: none"> • Fire Ants • Exotic Plants • Cactus 	<ul style="list-style-type: none"> • Adjacent Land Use • Shellfishing Industry • Military Overflights
<u>Geologic Resources</u>	<u>Habitats & Communities</u>	<u>Ecosystem Functions</u>
<ul style="list-style-type: none"> • Shoreline Erosion 	<ul style="list-style-type: none"> • Salt Marshes 	<ul style="list-style-type: none"> • Barrier Island Rollover

- Overwash / Inlet Formation
- Soil Quality

Weather & Climate

- High Energy Weather Events

- Coastal Dunes
- Maritime Forests

- Natural Processes
- Biological Diversity

Other Issues

- ORV / Visitor Use
- Beach Nourishment

Water Resources

Septic Tanks: Septic systems from nearby communities present a source of nutrient contamination into estuarine and shallow groundwater bodies.

Water Quality: Surface waters at Cape Hatteras National Seashore include tidal creeks, freshwater creeks, and freshwater ponds, in addition to estuarine and nearshore marine waterbodies. The lands surrounding the rivers, streams and estuaries of the Albemarle-Pamlico estuarine system are undergoing changes (National Park Service 1994b). Increasing population, urbanization and industrialization are reflected in changing surface-water quality. Based on the data inventories and analyses contained in this report, surface waters within the CAHA study area generally appear to be of good quality, with some indications of impacts from development.

Hydrology: Wetlands at Cape Point have been ditched and flood-gated. The area is no longer a natural habitat and represents a high priority for Park management.

Air Resources

Air Quality: The 1994 *Baseline Water Quality Data Inventory and Analysis report* for Cape Hatteras NS suggests that all surface waters associated with the park are either saline or tidally influenced. If this is the case, then surface water acidification is not a concern for the park (National Park Service 1994b). The report did not indicate that nitrogen-associated eutrophication was an issue.

Ozone: The risk of foliar ozone injury at Cape Hatteras National Seashore is moderate (National Park Service 2004a). The threshold level for injury is consistently satisfied by the Sum06 index, while the W126 index satisfies the criteria on occasion. The N-values indicate that in some years there are consistent exposures to concentrations of ozone greater than 80 ppb, and significant hours of exposure at 100 ppb. The lack of a relationship between level of ozone and soil moisture suggests that conditions favorable for the uptake of ozone occur independently of the levels of exposure. This creates the possibility of reaching the threshold for injury when high levels of exposure happen to coincide with favorable soil moisture conditions. A program to assess the incidence of foliar ozone injury on plants at the site could use one or more of the following bioindicator species: yellow-poplar (*Liriodendron tulipifera*), American sycamore (*Platanus occidentalis*), black cherry, American elder, crownbeard (*Verbesina* spp.), and northern fox grape (*Vitis labrusca*).

Geologic Resources

Shoreline Erosion: Active erosion is occurring downshore from revetments / riprap at Fort Raleigh National Historic Site, and is also of concern due to threats to the (old) coast guard station and the beach lot and facilities at Coquina Beach on Bodie Island. This, and its relationship to preserving Rte. NC12 may be the prime natural resource issue for CAHA.

Overwash / Inlet Formation: Large storms, as a part of natural barrier island geomorphology can cause a “flattening” of dunes resulting in the formation of new water channels. Hurricane Isabel created one such overwash inlet (Isabel inlet) in 2003, which has since been restored to pre-hurricane condition levels. Dune building by CCC in the 1930s (and maintenance of dunes until the 1970s) has altered the natural lense topography of Outer Banks barrier islands.

Boc and Langfelder (1977) used aerial photographic analysis to determine the distribution and extent of overwash sites along the North Carolina coast between the years 1938 and 1944. They described the types of overwash that occurred in each county during the study period, and assessed the susceptibility of selected areas within each county to overwash. Based on their findings, overwash frequency had declined over the course of the study period. This phenomenon was attributed to a decrease in the number of landfall hurricanes that have hit North Carolina in recent years and an increase in dune heights along the North Carolina coastline (Boc and Langfelder 1977). From 2001 to 2006, the North Carolina Coastal Geology Cooperative Research Program will be working on a model of the Outer Banks past, present, and future.

Soil Quality: Two superfund sites are located at or near Cape Hatteras National Seashore, in addition, the magnitude of contamination and / or impacts from off-road vehicles (i.e., tires and oil) is unclear.

Weather & Climate

Hurricanes: Hosier and Cleary (1978) analyzed storm washover impact and recovery patterns resulting from Hurricane Hazel (1954) and the March 1962 northeaster. The authors detected two basic geomorphic patterns of island recovery which they correlated with grain-size distributions of the washover sediments.

Species of Concern (Threatened, Endangered, Rare, Special)

Sea Turtles: Though nesting occurs at CAHA, numbers are typically lower than at other National Seashores within the network, because CAHA is at the extreme north limit of sea turtle nesting range. Loggerhead turtles are the bulk of nesters with a few green and leatherback sea turtles.

Shore Birds: Piping plovers (*Charadrius melodus*) and American oystercatchers (*Haematopus palliatus*), and other colonial shorebirds are present and nest at CAHA. Primary threats to bird populations are predation and disruption from ORVs and pedestrians through direct mortality of individuals or eggs, or degradation of nesting or foraging habitats.

It is logical that some broad environmental factor, such as prey availability for chicks, is the reason for the poor productivity in North Carolina. Being at the southern extreme of the piping plover nesting range likely has limiting factors on nesting productivity that may not be overcome by the kind of management that is successful in the heart of the nesting range.

Exotic / Invasive Species

Fire Ants: Primarily a visitor use issue.

Exotic/Invasive Plants: At Fort Raleigh NHS, cultivars from the adjacent Elizabethan Gardens are expanding into park lands and present an ongoing control problem. Common reed (*Phragmites australis*) is present in many locations within and surrounding the Parks. Catus throughout much of the grass area at WRBR necessitates shoes and limits area for sitting on the grass.

Habitats & Communities

Salt Marshes: Because of the need to protect route NC12 along the barrier island sand moved west by high energy weather events such as northeasters and hurricanes is seldom allowed to migrate over to the sound side of the barrier island to build or sustain saltmarshes. The saltmarsh habitat in the park is being lost to rising sea level and the presence and maintenance of the only transportation route on the barrier island.

Coastal Dune System: The Enabling legislation allocates much of the park to a “primitive wilderness” (lower case “w”) aspect. Coastal dunes are critical habitat for many species at CAHA, and are under severe pressure from visitor uses including ORV and foot traffic.

Park NR Management

Exotic Plant Management: CAHA is one of fourteen parks included in the Network’s exotic plant management module being funded through CUIS.

Exotic Animal Control: Nutria (*Myocastor coypus*), red fox (*Vulpes vulpes*), and feral cats are the primary exotic animals at CAHA, both of which are growing in numbers. Currently feral cats are a larger problem due to impacts on shorebird and sea turtle nests, but nutria populations are growing in size and present a potential issue for cultural resources (i.e., the runway at Wright Brothers National Memorial). Red foxes, though not exotic, have currently undergone a range expansion into CAHA.

Predator Management: Red foxes, nutria, feral cats, and raccoons are the primary predators and are of extremely high concern for sea turtle and shorebird management. Current management strategies are limited to enclosure and trapping / removal. Ghost crabs (*Ocypode quadrata*) are another potential problem if population levels increase.

External Stressors

Adjacent Land Use: CAHA has seven small coastal villages interspersed within its authorized boundary. Each of which is dominated by residential land uses, primarily vacation rentals. The surrounding area of all of the Outer Banks parks continues to increase as a year-round recreation area.

Shellfishing Industry: Crab, scallops, shrimps, and oysters are all actively harvested by commercial shellfisheries located on the sound side of CAHA but all beyond the 150 foot sound-side boundary of the park.

Military Overflights: Aircraft overflights in CAHA and WRBR are increasing and potentially impacting the visitor experience and the native wildlife of the seashores. Transit ranges of three major military aircraft training facilities overlap the Seashores. In addition, two bombing ranges and the mid-Atlantic electronic warfare range are located only a few air miles from Seashore boundaries. An approximately 500-foot military tracking tower looms over the landscape of Bodie Island. No controlled evaluation of visitors' perceptions of this tower and other military operations has been conducted. Nor has the potential impact(s) of the overflights and structure on wildlife, including the federally threatened bald eagle (*Haliaeetus leucocephalus*), peregrine falcon (*Falco peregrinus*), and piping plover, been determined.

Proposed new U.S. Marine (Cherry Point) overflight areas will increase impacts to both the visitors and the wildlife of the seashores. If implemented, the seashores will experience increasingly active military airspace operations.

Overflights are obvious to the casual observer, but the frequency and type of occurrence are not well documented. Specific overflight studies need to be conducted to determine how best to preserve the natural sound, natural and cultural resources, and quality visitor experiences within the seashores.

Other Issues

ORV / Visitor Use: Area development and ORVs possibly represent the largest anthropogenic impact to natural resources at CAHA. Area growth and related recreation impacts are likely degrading the park resources. Area discussions of limiting development or ORV use are politically sensitive issues. Interpretation of the resource preservation aspect of the NPS and the idea of recreation in the enabling legislation for each of the

sites is difficult to combine. An environmental impact analysis is currently underway to assess the direct and indirect effects of allowing current levels of ORV access.

Beach Nourishment: Area communities are seeking assistance to attempt to prevent the effects of sea level rise and the impacts of frequent high energy weather events such as northeasters and hurricanes. This issue is linked to the methods of preservation of transportation along the Outer Banks.

Cape Lookout National Seashore (CALO)

Park Description

Largely undeveloped and accessible only by boat, Cape Lookout National Seashore is made up of three barrier islands covering 56 miles of the central coast of North Carolina. 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 the infrequently maintained New Drum Inlet. Cape Lookout extends into the Atlantic Ocean from its southern end, and abandoned Portsmouth Village is located at its northern end. The other barrier system within the Seashore, Shackleford Banks, extends westward from Cape Lookout and, while smaller (13 km long), is considered ecologically more diverse than Core Banks.

Core Banks is a long, narrow expanse of low dunes, maritime grasslands, and extensive salt marshes. Shrub thickets border the grassland in many places, and a low maritime forest occupies small areas of higher ground, such as Guthries Hammock. The islands are generally about 1 to 2 meters in elevation and 1 to 2 kilometers wide and are typically open and treeless. Windblown salt spray is carried across the entire barrier.

The wide berm and low, scattered dunes of Core Banks are characteristic of overwash-influenced barrier systems that have not been altered by man-made structures. When storms occur, the dunes here offer little resistance to flooding. Another process that has shaped these islands is the opening and closing of inlets. Dramatic changes in the positions of inlets may take place in the period of a few years or even months. Many of the creeks in the marshes along Core Banks have probably been Inlets in the past.

Although the physiography of Core Banks is more or less uniform along its length, the areas of Portsmouth Village and Cape Lookout are unique. Instead of exhibiting the typical zonation of a wide berm, low dunes, grasslands and shrub thickets, and salt marsh, the northern end of Portsmouth Island is characterized by vast tidal sand flats (averaging 1 km in width) located between the berm and the dunes of a series of marsh-fringed islands. At triangular Cape Lookout, continuous dunes similar to those on Shackleford Banks can be found on the southwest side, with several small freshwater marshes present in depressions between the dunes. With high dunes significantly reducing overwash, thickets have further stabilized the flats of the Cape's interior. 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 dunes at the western end of Shackleford Banks are 10 to 13 meters (34 to 44 ft) above sea level and contain the highest elevations on Shackleford. The presence of high dunes on the western section may be due to the island's east-west orientation. Because the island faces the prevailing southwest winds rather than being parallel to them, sand is continually blown from the accreting beach into the dunes, where it is trapped and stabilized by sea oats (*Uniola paniculata*). In the lee of this wall of rolling dune ridges, there is an impressive maritime forest, as well as several fresh and brackish marshes. On the side of the island that faces Back Sound, the beach is narrow and, in some places, the scarped bank is eroding away. Unlike most of the Outer Banks, the inner shore here is not fringed with salt marsh.

The western end of Shackleford is an accreting sandspit. Young dunes with saltmeadow cordgrass (*Spartina patens*) and marsh fimbry (*Fimbristylis castanea*) are forming along the edge of the curving berm, while areas of salt marsh are developing on the sound side of the spit. The eastern two-thirds of Shackleford Banks consist of low dunes, grassland, and salt marsh. In contrast to the western third, it is influenced by overwash. This part of the

Island is characterized by dunes of less than 3 meters (10 ft) high, open grassland (on overwash terraces), mesic meadows, and salt marsh. Shrub thickets occur in a few areas.

Specific issues of concern to Cape Lookout National Seashore include off-road vehicle use and associated impacts to Dunes, threatened and endangered species, commercial fishing, military overflights, and non-native species.

Park Mission relative to Natural Resource Management

Cape Lookout National Seashore was established in 1966 to “*preserve for public use and enjoyment an area in the State of North Carolina possessing outstanding natural and recreational values.*” Original boundaries comprised the lands and adjoining marshlands and waters on the outer banks of Carteret County, North Carolina, between Ocracoke Inlet and Beaufort Inlet, as generally depicted on the map entitled "Boundary Map, Cape Lookout National Seashore", dated March 1974, and numbered 623-20,009, which is on file in the Office of the National Park Service, Department of the Interior (16 USC 459g).

Natural Resources Issues

Environmental Setting	Resources	Agents of Change
<u>Water Resources</u> <ul style="list-style-type: none"> • Septic Tanks • Water Quality • Groundwater 	<u>Species of Concern (TERS)</u> <ul style="list-style-type: none"> • Horses • Sea Turtles • Shore Birds • Sea Amaranth 	<u>Park NR Management</u> <ul style="list-style-type: none"> • Exotic Animal Control • Exotic Plant Management
<u>Air Resources</u> <ul style="list-style-type: none"> • Ozone 	<u>Exotic / Invasive Species</u> <ul style="list-style-type: none"> • Fire Ants • Nutria • Feral Cats 	<u>External Stressors</u> <ul style="list-style-type: none"> • Adjacent Land Use • Shellfishing Industry
<u>Geologic Resources</u> <ul style="list-style-type: none"> • Shoreline Erosion 	<u>Habitats & Communities</u> <ul style="list-style-type: none"> • Salt Marshes 	<u>Ecosystem Functions</u>
<u>Weather & Climate</u> <ul style="list-style-type: none"> • Hurricanes 		<u>Other Issues</u> <ul style="list-style-type: none"> • Visitor Use

Water Resources

Septic Tanks: Concession cabins, close to the park, are all on septic systems. Many of these were damaged by the Hurricane Isabel and washed out. As the historic structures near the Lighthouse are acquired, they will have to conform to county septic system standards.

Water Quality: Cape Lookout National Seashore comprises a series of undeveloped barrier islands along the Atlantic coast of North Carolina. Surface water resources in the study area include large expanses of salt marsh, bays, the North and Newport Rivers, and the Atlantic Ocean. Based on the data inventories and analyses contained in the baseline water quality report (National Park Service 1994c), surface waters within the study area are generally of good quality with some indications of impacts from human activities. Potential sources of contaminants include industrial and municipal discharges from Beaufort and Morehead City, and public recreational use.

Groundwater: Water samples from the lower confined aquifer, occurring at depths between 150 and 550 feet, generally met Environmental Protection Agency standards, though at some sites excessive concentrations of chloride, iron, and manganese were found. The potential yield for the lower aquifer was estimated at approximately 500 gallons per minute. The overlying unconfined aquifer was estimated to have a potential yield of up to 30 gallons per minute to a horizontal well in protected areas but episodic temporary contamination was expected in this aquifer from overwash during storms. The uppermost confined aquifer

at depths between 90 and 150 feet. yielded fresh water only in the vicinity of Drum Inlet and Harkers Island (Claxon and Renwick 1987).

Air Resources

Ozone: The risk of foliar ozone injury at Cape Lookout National Seashore is moderate (National Park Service 2004a). The threshold level for injury is consistently satisfied by the Sum06 index, while the W126 index satisfies the criteria on occasion. The N-values indicate that in some years there are consistent exposures to concentrations of ozone greater than 80 ppb, and significant hours of exposure at 100 ppb. The lack of a relationship between level of ozone and soil moisture suggests that conditions favorable for the uptake of ozone occur independently of the levels of exposure. This creates the possibility of reaching the threshold for injury when high levels of exposure happen to coincide with favorable soil moisture conditions such as 1996. A program to assess the incidence of foliar ozone injury on plants at the site could use one or more of the following bioindicator species: yellow-poplar, black cherry, and northern fox grape.

Geologic Resources

Shoreline Erosion: CALO is undergoing a beach renourishment project to protect the land near the lighthouse and other sound-side structures. Already, one historic structure (a coal shed) has been lost due to erosion. The renourishment site will be roughly 100' x 1,700'.

Overwash: Boc and Langfelder (1977) used aerial photographic analysis to determine the distribution and extent of overwash sites along the North Carolina coast between the years 1938 and 1944. They described the types of overwash that occurred in each county during the study period, and assessed the susceptibility of selected areas within each county to overwash. Based on their findings, overwash frequency had declined over the course of the study period. This phenomenon was attributed to a decrease in the number of landfall hurricanes that have hit North Carolina in recent years and an increase in dune heights along the North Carolina coastline (Boc and Langfelder 1977).

Soils: Broome et al. (1973), in an investigation of saltmarsh cordgrass propagation, found fresh sediment to be the dominant factor in determining the height and yield of vegetation. More specifically, they found nitrogen availability to be the major limiting factor in productivity of marsh vegetation, with the lack of phosphorus and high salinity also negatively affecting growth. Troutman (Troutman 1980) examined soil-forming factors in Meade River, Alaska, and Portsmouth Island/Core Banks, with particular attention given to the effects of climate and soil on dune vegetation. The study concluded that vastly different climates can support dune soils with similar characteristics (low moisture content, high leaching) and plant communities which show similar adaptive responses. Perkins and Beck (1938) published a soil survey of Carteret County.

Weather & Climate

Hurricanes: Hosier and Cleary (1978) analyzed storm washover impact and recovery patterns resulting from Hurricane Hazel (1954) and the March 1962 northeaster. The authors detected two basic geomorphic patterns of island recovery which they correlated with grain-size distributions of the washover sediments.

Species of Concern (Threatened, Endangered, Rare, Special)

Horses: Horses at CALO are restricted to Shackleford Banks, except when displaced during storm events. The herd is currently ~125 individuals, with a management target between 110 and 130.

Sea Turtles: CALO has been monitoring marine turtles since 1976, and is a significant northern nesting beach that supports the highest number of loggerhead turtles in North Carolina (Cordes and Rikard 2003a). CALO is an index beach and implements a USFWS-standard protocol that allows for data comparison with other

nesting sites along the coast. Threats to turtle success include predation by raccoons, as well as nest disturbances by off-road vehicles.

Shore Birds: Piping plovers and oystercatchers are the two primary shorebirds of concern at CALO, with active management and monitoring to protect both species (through exclosures and restricted access). Like sea turtles, shore bird nests are particularly sensitive to off-road vehicles and predation.

In 2003 piping plovers nested on nine different islands in North Carolina (Cordes and Rikard 2003b). Each of the nine nesting islands had a different combination of predators, susceptibility to flooding and amount of disturbance from people. Productivity continued to be poor throughout the state (0.46 chicks fledged per nesting pair) despite the use of predator exclosures.

It is logical that some broad environmental factor, such as prey availability for chicks, is the reason for the poor productivity in North Carolina. Being at the southern extreme of the piping plover nesting range may have limiting factors on nesting productivity that may not be overcome by comparable management deemed successful in the heart of the nesting range. CALO and North Carolina contribute more to the survival of piping plovers as a migratory stop over and wintering area than as a nesting area.

Sea Beach Amaranth: CALO is home to the largest known populations of Sea Beach Amaranth, and monitoring is ongoing throughout the Park.

Exotic / Invasive Species

Fire Ants: Primarily a visitor use problem, but present.

Nutria: Present a problem due to rooting damage.

Feral Cats: Present at CALO, and of particular concern due to predation on both sea turtle and shore bird nests.

Habitats & Communities

Salt Marshes: Areas of frequent washover are dominated by annuals, plants that withstand frequent burial such as dune grasses, or salt-tolerant species (Hosier 1973). Fresh sediment input to the marsh was the dominant factor in determining the height and yield of saltmarsh cordgrass, and the marsh acts as a buffer for the entire estuarine system, providing a sink for excess nutrients which resulted from municipal wastes and land runoff (Broome et al. 1973).

Park NR Management

Exotic Animal Control: Currently management is limited to fencing out predators. A predator control plan is scheduled for future development.

Exotic Plant Management: Exotic plants are not a large issue at CALO as of yet, but limited populations of common reed exists on site, and when encountered are sprayed. CALO is one of fourteen parks within the network that is included in the EPMT module being coordinated through CUIS.

External Stressors

Adjacent Land Use: The local area is growing, with Beaufort adding commercial and industrial facilities. At the same time, residential land uses are rapidly growing with second-home dwellings being the primary building in the area.

Shellfishing Industry: Crab, oyster, scallops, shrimps, and oysters are all actively harvested by commercial shellfisheries located on the sound side of CALO. Overharvesting and netting issues are of concern to the Park.

Other Issues

Visitor Use: The primary concern with respect to visitor use is with regard to ORV use on beaches, primarily for fishing access. Threats from ORVs include nest disruption for both sea turtles and shorebirds. At the same time, personal watercraft use (boats, jetskis...) is increasing at Shackleford Banks, with landings approaching 300-400 crafts *per day* during the 4th of July weekend. With residential land use in the local area growing, both of these impacts might potentially rise in the future.

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

Park Description

Castillo de San Marcos National Monument

Castillo de San Marcos National Monument comprises approximately 20.48 acres in St. Augustine, St. Johns County, Florida. The park lies north of St. Augustine's central plaza and fronts Matanzas Bay. Built as the northernmost Spanish stronghold in the southeastern United States and as a defense against pirate attacks on St. Augustine, the Castillo was originally located at the northern edge of the city, where it commanded the land and sea routes into the settlement. Today, colonial St. Augustine extends south of the monument, while the modern city has grown around this core in all directions (Brown 1997).

The city of St. Augustine lies on the eastern coastal plain of Florida. It is a low-lying, sandy area protected from the sea by a number of barrier islands. The San Sebastian River runs west of the city and formed a natural boundary for the colony early in its history. A seawall and water battery separate Castillo de San Marcos from the waters of Matanzas Bay on the fort's east side. The site of the Castillo is a rolling, grassy area sprinkled with a few trees. The outer portions of the grounds are flat up to the glacis, which slopes upward toward the fort and roughly follows the contour of the moat and covered way. The park area is irregular in shape, with much of its western boundary following the contour of State Road A-1-A.

Fort Matanzas

Fort Matanzas National Monument (FOMA) is located 14 miles south of St. Augustine on the northeast Atlantic coast of Florida. It encompasses of a total of 298 acres divided between the southern tip of Anastasia Island (108 acres) and the northern end of Rattlesnake Island (190 acres). Both are barrier islands separated from the Florida mainland by the Matanzas River and the Intracoastal Waterway.

The Anastasia Island portion of FOMA consists of stabilized beach dunes rising as much as 7.6 meters above sea level. Predominant habitats in this portion of the park include beaches along both the Matanzas River and the Atlantic shore, stabilized sand dunes supporting maritime forest, secondary dunes further inland, and salt marsh.

Most of Rattlesnake Island is less than 5 feet above sea level, though it rises to 15 ft at one point on its northern end. Much of northern portion of Rattlesnake Island consists of sandy fill pumped in from dredging operations that maintain the boat channels in the Intracoastal Waterway. In addition to the habitats found on Anastasia Island, Rattlesnake Island supports slash pine and red bay woodlands, oyster shell beaches, and developing hardwood forests typified by wax myrtle (*Myrica cerifera*), red cedar (*Juniperus virginianus*), and cabbage palm (*Sabal palmetto*).

Park Mission relative to Natural Resource Management

In both cases, the Parks' enabling legislation does not specifically mention natural resources management, however, the CASA / FOMA is responsible for managing lands in accordance with the National Park Service Organic Act (16 USC 1) and National Parks Omnibus Management Act (Pub. L. 105-392) such that the Park makes sound

resource decisions based on sound scientific data in an effort to leave resources unimpaired for the enjoyment of future generations.

Natural Resources Issues

Environmental Setting	Resources	Agents of Change
<u>Water Resources</u> <ul style="list-style-type: none"> Water Quality Surface Waters 	<u>Species of Concern (TERS)</u> <ul style="list-style-type: none"> Sea Turtles Beach Mice Least Tern 	<u>Park NR Management</u> <ul style="list-style-type: none"> Exotic Plant Management
<u>Air Resources</u> <ul style="list-style-type: none"> Ozone 	<u>Exotic / Invasive Species</u> <ul style="list-style-type: none"> Exotic Plants Feral Animals 	<u>External Stressors</u> <ul style="list-style-type: none"> Shellfish Harvesting Adjacent Land Use
<u>Geologic Resources</u> <ul style="list-style-type: none"> Shoreline Accretion 	<u>Habitats & Communities</u> <ul style="list-style-type: none"> Salt Marshes 	<u>Ecosystem Functions</u>
<u>Weather & Climate</u> <ul style="list-style-type: none"> Hurricanes 		<u>Other Issues</u> <ul style="list-style-type: none"> Visitor Use Impacts Off Road Vehicle Use

Water Resources

Water Quality: Based on the data inventories and analysis contained in this report, surface water quality within the study area appears to have been impacted by human activities. Potential anthropogenic sources of contaminants include municipal wastewater discharges; commercial and residential development; waterway navigation activities; stormwater runoff; recreational activities; and atmospheric deposition (National Park Service 1994d).

Surface Waters: Surface water resources in the FOMA study area include the Atlantic Ocean; portions of the Intracoastal Waterway; Matanzas River; Matanzas Inlet; Pellicer and other creeks; and numerous tidal swamps, marshes, and estuaries. Many of these water resources are influenced by tidal flow and contain fresh and saline waters in transition. Based on the data inventories and analysis contained in this report, surface water quality within the study area appears to have been impacted by human activities. Potential anthropogenic sources of contaminants include municipal wastewater discharges; commercial and residential development; waterway navigation activities; stormwater runoff; recreational activities; and atmospheric deposition.

Air Resources

Ozone: The Sum06 index exceeds the threshold for injury to vegetation (National Park Service 2004a). While the W126 accumulative value exceeded the threshold each year, the N100 count shows that the required number of hours was met in three of the years, although concentrations exceeded 100 ppb every year. The criteria for injury under the W126 exposure index are generally satisfied. It is anticipated that the risk of injury may be greatest in years when ambient levels of ozone are moderately high and soil moisture conditions favor uptake by plants. At present, no ozone-sensitive species have been identified at the site, and the risk remains unrealized.

Air Quality: Acid deposition is of concern to the park to because of the high susceptibility of coquina to dissolution. The fort at Castillo de San Marcos is constructed of coquina.

Geologic Resources

Shoreline Accretion: FOMA has actually increased in size by an estimated 13 acres over the past three decades.

This continuing growth is evident in the expanding shoal banks inside and outside the Matanzas River inlet. Shoals inside currently allow fishermen on Rattlesnake Island to wade into the middle of the Matanzas River west of the inlet bridge, while shallow bars outside break Atlantic waves before they can roll into the mouth of the Matanzas River.

Weather & Climate

Hurricanes:

Species of Concern (Threatened, Endangered, Rare, Special)

Sea Turtles: Moderate threats to sea turtle nests are due to the high level of vehicular traffic on the beach (it is legally a state highway), and the threat of human poaching of new nests.

Beach Mice: Anastasia Island beach mouse (*Peromyscus polionotus phasma*) habitat, a small area (less than 5 acres) of habitat is located just behind the first barrier dunes on the beach, and is also threatened by overwash from extreme weather conditions accelerated by the vehicular traffic.

Least Tern: Minor threats include disturbance of a least tern (*Sterna antillarum*) rookery area by vehicles. In addition, natural plant succession is decreasing the attractiveness of the area as a rookery for the least tern.

Exotic / Invasive Species

Exotic Plants: Introduced plants pose another minor threat, competing with native species in several disturbed areas of the park. They are beginning to threaten the survival of some species and habitat.

Exotic Animals: Exotic Animals such as house cats, both feral and free roaming pets, are a direct threat to the Anastasia Island beach mouse. The common house mouse (*Mus musculus*) and the Norwegian rat (*Rattus norvegicus*) are considered potential threats to the Anastasia Island beach mouse and other indigenous mammals, as well as human health.

Habitats & Communities

Salt Marshes: The main structure of Fort Matanzas is located on a spoil island located in the middle of extensive salt marshes.

Park NR Management

Exotic Plant Management: FOMA / CASA is included in the Florida EPMT unit, managed out of Miami.

External Stressors

Shellfish Harvesting: Offshore shrimp harvesting has an effect of unknown magnitude on sea turtle mortality. However, mortality is documented at FOMA.

Adjacent Land Use: Paper mill and power generation facilities in the local area are contributors to potential air quality contaminants in the local area. The Parks are also potentially affected by airborne contaminants originating from nearby Jacksonville. Noise pollution is also of concern to the management of Fort Matanzas, whose interpretive mission includes the goal of providing an authentic atmosphere to visitors.

Other Issues

Off Road Vehicle Use: FOMA, in cooperation with the State DOT, will be installing two new parking lots and a Dune crossover trail all just north of the bridge and improvement of the parking area at the beach access. This project will help reduce the number of vehicles on the beach and provide a hardened interpretive trail that will help keep visitors out of the delicate dune ecosystem. Unfortunately, a separate threat also exists from occasional illegal "dune busting" by 4-wheel drive vehicles.

Visitor Use Impacts: Foot traffic into the dunes is a constant occurrence, creating blow-outs in the dunes, which reduce their ability to maintain plant life. The dunes directly protect the fort by reducing erosion of the barrier island that shields Fort Matanzas from damaging storms.

Chattahoochee River National Recreation Area (CHAT)

Park Description

On August 15, 1978, Congress passed Public Law 95-344 establishing Chattahoochee River National Recreation Area as a unit of the National Park Service. Congress authorized boundary expansions in 1984 and 1999. The park extends for 48 miles along the Chattahoochee River within the Piedmont Plateau, between the city of Atlanta and the Appalachian Mountains further to the north. The park contains mesic hardwood and pine uplands, scattered cliffs, floodplains, and riparian, aquatic and shoal habitats. The park also contains significant cultural resources, for the river corridor has attracted humans for thousands of years and the remaining features have recorded their passage and story. These natural habitats and cultural resources adjacent to, and partly surrounded by, the growing greater Atlanta metropolitan area, provide a unique opportunity for environmental education and resource-based outreach programs.

Chattahoochee River NRA (CHAT) consists of 15 separate units, however the park is currently acquiring additional land which will eventually link many of these units. The lands surrounding many of these units, especially at the northern end of the park, are experiencing rapid development and urban sprawl. This urbanization of adjacent lands has resulted in significant river and visual impacts. This rapid urbanization has taxed the region's sewer utility capacity. As a consequence, heavy rains and storm water runoff routinely causes sewer spills which flow directly into the Chattahoochee River. Additionally, siltation resulting from adjacent new development and land clearing is a consistent problem.

Park Mission relative to Natural Resource Management

Established in 1978, Congress found that "the natural, scenic, recreation, historic, and other values of a forty-eight-mile segment of the Chattahoochee River and certain adjoining lands in the State of Georgia from Buford Dam downstream to Peachtree Creek are of special national significance, and that such values should be preserved and protected from developments and uses which would substantially impair or destroy them... The recreation area shall consist of the river and its bed together with the lands, waters, and interests therein within the boundary..."

In addition to the lands managed exclusively by the National Park Service, Chattahoochee National Recreation Area has authority to facilitate "Federal technical and other support to State and local governments to assist State and local efforts to protect the scenic, recreational, and natural values of a 2,000 foot wide corridor adjacent to each bank of the Chattahoochee River and its impoundments in the 48-mile segment referred to above, such corridor is hereby declared to be an area of national concern" (16 USC 460ii).

Natural Resources Issues

Environmental Setting	Resources	Agents of Change
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Environmental Setting	Resources	Agents of Change
<u>Water Resources</u>	<u>Species of Concern (TERS)</u>	<u>Park NR Management</u>
<ul style="list-style-type: none"> Natural Hydrology Water Quality Water Quantity River Regulation 	<ul style="list-style-type: none"> Approximately 40 Federally and State Listed Species 	<ul style="list-style-type: none"> Fire Management Fisheries Management Habitat Restoration Exotic Plant Management
<u>Air Resources</u>	<u>Exotic / Invasive Species</u>	<u>External Stressors</u>
Air Quality <ul style="list-style-type: none"> Ozone 	<ul style="list-style-type: none"> Southern Pine Beetle Exotic Aquatic Species Exotic Plants Exotic Animals 	<ul style="list-style-type: none"> Adjacent Land Use Hydropower Generation Drinking Water Storage & Withdrawal
<u>Geologic Resources</u>	<u>Habitats & Communities</u>	<u>Ecosystem Functions</u>
<ul style="list-style-type: none"> Sand and Gravel Mining Shoreline Erosion 	<ul style="list-style-type: none"> Aquatic Communities 	<ul style="list-style-type: none"> Fire Flooding
<u>Weather & Climate</u>		<u>Other Issues</u>
<ul style="list-style-type: none"> Precipitation 		<ul style="list-style-type: none"> Dark Night Sky Visitor Use Impacts

Water Resources

Water Quality: Point- and non point-source contaminants are of major concern to Park managers. Potential contaminants include nutrients, pesticides, heavy metals, sediment, bacteria, most of which originate from the urban landscape beyond the Park’s boundaries.

Water Quantity: Stream water quantity is affected by regional climate (rainfall and drought), power demand, and available drinking water supply in Lake Sidney Lanier, located upstream of CHAT. Each of these three factors operates at different time scales ranging from hours (“peaking” from power generation) to years (water supply and climatic variation). One hundred fourteen direct water withdrawals are also present along the Chattahoochee mainstem and its tributaries within the 48 miles managed by CHAT. The cumulative volume of water withdrawn and its effect on Park resources is currently under study.

River Regulation: At the upstream terminus of the park is Buford Dam, which is operated by the Army Corps of Engineers. Buford Dam generates electricity and the impounded water, Lake Lanier, provides water to the greater Atlanta metropolitan region. The operation of the dam dramatically alters river flows and water temperatures within the park. River regulation has also lowered the temperature of the river to colder-than-natural levels, reducing success of native warm-water aquatic species.

Natural Hydrology: Wetland hydrology is disconnected, driven primarily by storm water management. Ditching and draining alters natural groundwater and surface water flows in both floodplain and riparian wetlands. The increased amount of impervious surface from heavy development has dramatically affected natural hydrologic conditions and has led to severe streambank erosion and siltation.

Air Resources

Air Quality: CHAT is currently designated a Class II air quality park, but the effects of metropolitan Atlanta on air resources is increasing. The effects of smog, ozone, particulates, and other atmospheric contaminants on natural resources are largely unknown. Because the population of Atlanta is expected to continue growing over the next several decades (Atlanta Regional Commission 1993), air quality is likely to be an ongoing and worsening issue.

Ozone: The risk of foliar ozone injury to plants at Chattahoochee River National Recreation Area is high (National Park Service 2004a). While the levels of ozone exposure consistently create the potential for injury, dry

soil conditions may reduce the likelihood of injury in a particular year. However, levels of exposure capable of producing foliar injury also occur under conditions of minor drought. The probability of foliar injury developing may be greatest during years in which ozone levels are somewhat reduced but still exceed the thresholds, and soil moisture levels are normal or under mild drought and do not significantly constrain the uptake of ozone. A program to assess the incidence of foliar ozone injury on plants at the site could use one or more of the following bioindicator species: spreading dogbane (*Apocynum androsaemifolium*), eastern redbud (*Cercis canadensis*), white ash (*Fraxinus americana*), yellow-poplar, American sycamore, black cherry, Allegheny blackberry (*Rubus allegheniensis*), cut-leaf coneflower (*Rudbeckia laciniata*), American elder, crownbeard, and northern fox grape.

Geologic Resources

Sand and Gravel Mining: Currently there are five permitted commercial sand and gravel mining operations within the park. All utilize suction dredging barges along with an upland dewatering plant.

Shoreline Erosion: Drainage / discharge sites, and sites of historic fishing docks along the mainstem Chattahoochee River are often sites of increased erosion. These locations present challenges for both natural resource maintenance programs, and potentially represent public safety hazards. Pulsing water releases from Buford Dam have scoured riverbanks and stream mouths in the northern sections of the park. Streams throughout the park are highly eroded due to adjacent development and increases in impervious surfaces.

Weather & Climate

Precipitation: The average annual precipitation for the Atlanta area is about 51 inches per year (Kunkle and Vana-Miller 2000). The precipitation depths are greater on going further north, and Lake Lanier receives approximately 3 to 4 inches more precipitation per year than Atlanta (according to U.S. Geological Survey isohyet maps for the area). Precipitation in the area occurs predominantly as rain; snowfall is only about 2 inches annually. Most of the thunderstorms in the area on an annual basis are small ones. Dry periods occur mainly during the late summer and early autumn; whereas, thunderstorms in July make that month the second wettest.

Exotic / Invasive Species

Southern Pine Beetle: Pine mortality by the southern pine beetle was exacerbated by drought conditions in the late 1990's. The extent of pine communities declined from roughly 1200 acres in 1999 to roughly 200 acres in 2002. This has increased fuel loading in former pine communities, and the number of hazard trees park-wide.

Aquatic Exotics: Exotic fish, plants, and invertebrates are all major components of the aquatic communities in the Chattahoochee River and its tributaries within the metropolitan Atlanta area. Of particular interest to Park managers are Asiatic clam (*Corbicula corbicula*), Asian rice eel (*Monopterus albus*), parrot feather (*Myriophyllum aquaticum*), and common waterweed (*Egeria* sp.). The diversity and distribution of aquatic exotic plants is currently unknown but inventories are underway. An aquatic plant inventory found four exotic aquatic plant species in the Chattahoochee River National Recreation Area: Brazilian waterweed (*Egeria densa*), wartremoving herb (*Murdannia keisak*), parrot feather watermilfoil (*Myriophyllum aquaticum*), and alligatorweed (*Alternanthera philoxeroides*). These species inhabit the Chattahoochee River and various wetlands throughout the park.

Exotic Plants: Roughly 212 exotic plants are known to exist within CHAT. Of these, *Eleagnus* sp., English ivy (*Hedera helix*), Japanese honeysuckle (*Lonicera japonica*), kudzu, Japanese stilt grass (*Microstegium vimineum*), paulownia (*Paulownia tomentosa*), and privet (*Ligustrum* spp.) are of immediate management

significance. Most species have been introduced to adjacent lands as a result of landscaping or ornamental activities.

Exotic Animals: Fire ants

Habitats & Communities

Aquatic Communities: Fish, invertebrate, and algal communities within the Chattahoochee River and its tributaries are all of concern. Benthic macroinvertebrate communities might be good indicators of overall water quality.

Plant Communities: Plant community structure and composition was historically determined by a balance of flooding and fire cycles, both are now largely missing from the ecosystem. In addition, the influx of exotic plant species has further altered the system.

Park NR Management

Fisheries Management: The Chattahoochee River is inhabited by 22 species of game fish, including the largest stocked trout fishery in Georgia. Georgia Department of Natural Resources actively manages the fishery of the Chattahoochee River; CHAT, in cooperation with the Georgia Department of Natural Resources, is currently developing a fisheries management plan.

Fire Management: Fuel reduction is largely done mechanically due to wildland/urban interface concerns. The goal is to both reduce fuel loading for safety reasons while at the same time mimic ecosystem functions typical of a natural fire regime.

Habitat Restoration: The Park is partnering with the Corporate Wetlands Restoration Partnership, a group consisting of various federal agencies and local and national private corporations, on a multi-year project to restore and enhance habitats in an impacted urban wetland. Main objectives of the project are to control exotic species, restore native vegetation, stabilize hydrologic conditions, and stabilize stream channels. Other restoration projects in the Park include bio-engineered stream channel stabilizations, and re-vegetating Wildland/Urban Interface (WUI) sites. As part of the Park's damage assessment program, the Park is also pursuing several Park System Resource Protection Act (16 USC 19jj) cases in attempt to restore stream channels, river bank, and upland forested areas. The Park is also propagating and replanting Georgia aster (a Federal candidate species) at several locations to increase the populations of this relict species.

Exotic Plant Management: Chattahoochee National Recreation Area is one of fourteen park units included in the Southeast Coast Network's Exotic Plant Management module currently being managed by Cumberland Island National Seashore. The park has a long-standing volunteer program that targets mainly privet at locations throughout the park.

External Stressors

Adjacent Land Use: The highly modified and rapidly changing land uses associated with metropolitan Atlanta act as significant drivers of the environmental setting at CHAT. Soil loss, sedimentation, degradation of aquatic habitats, loss of topsoil, habitat fragmentation, edge effects, and other development pressures (roads, buildings, impervious surfaces) all potentially lead to changes in both the terrestrial and aquatic systems. Conversion of agricultural lands in the northern park units and upstream of the park causes soil loss, sedimentation, nutrients, and subsequent degradation of aquatic habitats. Loss of topsoil and associated organisms is also a potential issue. The high density of commercial / industrial land use with high degree of impervious surface results in both point- and non-point-sources of contaminants into water bodies. Residential land use in the metro Atlanta area has been cited as one of the major sources of contaminants in the Chattahoochee River System and its tributaries because of the application of lawn

fertilizers and pesticides (Hippe et al. 1995). In the watersheds encompassing the park, the residential land use is medium to high density and growing; the combination increases the amount of point source (wastewater treatment effluent) and non-point source contaminants to aquatic systems. Development in the area is a major cause of sediment inputs into river systems (Hippe et al. 1996). Encroachment by adjacent developers also has potential effects at the park boundaries.

Hydropower Generation: Large surges of water flow from upstream Buford Dam during electrical power generation on weekdays, while much less water is released on weekends when water supply demands are high (Kunkle and Vana-Miller 2000). Buford Dam was planned, designed, and constructed in the 1950s, emphasizing flood control, hydropower, navigation, and water supply/quality flows for the metropolitan Atlanta area. However, in 1989, the Corps recommended “reallocation” of water storage in the lake from hydropower use to water supply use (McMahon and Stevens 1995). In recent decades, recreation has assumed a much greater importance at the lake as well as downstream along the river in CHAT.

Morgan Falls Dam is approximately 35 river miles downstream of Buford Dam. Built in 1904 to generate electricity, the facility impounded the river and created Bull Sluice Lake. The lake has gradually filled with sediment, and is now relatively shallow. Below the dam, water temperatures are significantly warmer than above it, and peak releases from Buford Dam are moderated. Georgia Power is currently in the process of FERC re-licensing for Morgan Falls Dam. As part of the re-licensing process, Georgia Power is conducting a series of studies to investigate the effects of the dam operation on the following: geology and soils; water resources; fish and aquatic resources; wildlife and botanical resources; wetland, riparian, and littoral habitats; rare, threatened, and endangered species; recreation and land use; and cultural resources.

Drinking Water Storage and Withdrawal: Minimum flows in the river passing through CHAT are artificially controlled by upstream dam releases because Buford Dam must operate to maintain a minimum flow of 750 cfs for the intake of the City of Atlanta (Kunkle and Vana-Miller 2000).

Ecosystem Functions

Fire: In forested ecosystems such as those found in the Piedmont of North Georgia, and in particular CHAT, decades of fire suppression have led to detrimental effects on ecosystem integrity and loss of fire dependent species [e.g. Georgia aster (*Symphyotrichum georgianum*) and red cockaded woodpecker (*Picoides borealis*)] and an accumulation of woody fuels (National Park Service 2004b). Accumulations of combustible fuels near historic structures pose a high risk to the rich cultural resources on CRNRA. Kudzu, an invasive vine, accumulates flashy fuels quickly and poses a serious threat by providing ladder fuels that can facilitate the spread of wildfires into the forest canopy. Hazard trees pose an immediate risk to park facilities, staff, and visitors; neighboring buildings; and utility lines. Hazard trees, when felled, add to the accumulation of large woody fuels and can increase intensity of fire. Widespread mortality of loblolly pine due to bark beetle infestations in recent years has both added to the accumulation of fuel loads and reduced ecosystem integrity. In grasslands or wetlands, the accumulation of woody shrubs and nonnative vegetation can increase an already flashy fuel source. These fuel accumulations and altered vegetation structure increase the risk of high-intensity fires.

Flooding: Prior to completion of the Buford Dam in 1957, major winter and early-spring floods were a common occurrence and large floods of over 30,000 cfs occurred once or twice during most decades (Cherry et al. 1980; Collier et al. 1996). Extreme floods occurred at Atlanta in December, 1919 (peak of 63,000 cfs) and in January, 1916 (peak of 59,000 cfs). The latter would have been about 53,000 cfs at the upper end of the CRNRA. Since the dam's construction, flood peaks have been controlled (Kunkle and Vana-Miller 2000).

Other Issues

Visitor Use Impacts: CHAT constitutes an important outdoor recreation resource to over 3.7 million people located in the metropolitan Atlanta. The park's green space and the river significantly improve the quality of life by serving as a sanctuary as well as providing a variety of outdoor recreation opportunities such as hiking, nature viewing, paddling, boating, and fishing. The proliferation of unauthorized "social trails" located throughout the park have resulted in trampled vegetation, compacted soils, erosion, and streambank failures.

Dark Night Sky: Adjacent urban and suburban land uses alter the natural night sky. The effects on CHAT natural resources are unknown.

Congaree National Park (CONG)

Park Description

Congaree National Park is situated immediately adjacent to the Congaree and Wateree Rivers in southeast Richland County, South Carolina, approximately 20 miles southeast of the capital city of Columbia. The park protects towering old-growth trees and diverse plant and animal life within the largest contiguous bottomland hardwood forest remaining in the United States. Periodic flood waters from the adjacent rivers sweep through the bottomland forest in winter and spring, carrying the nutrients and sediments that nourish and rejuvenate this unique floodplain ecosystem. 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 superb habitat for fish, birds, reptiles, mammals and other aquatic life. The diversity of flora and fauna, tall tree canopy and giant 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.

Congaree National Park encompasses a 26,800-acre bottomland hardwood forest in central South Carolina. The park borders the northeast side of the Congaree River and the west side of the Wateree River. Densely forested, most of the Park is located within the river floodplain. A wide variety of forest communities are represented, with dominant tree species ranging from upland pines to wetland cypress (*Taxodium* spp.) and tupelo (*Nyssa* spp.). The Congaree River forest environment 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 also flow through it. The significance of CONG lies in its (1) unique old-growth bottomland hardwood forest community associated with the swamp-like floodplain; (2) remarkably large trees, including loblolly pine, bald cypress (*Taxodium distichum*), tupelo, sweet gum (*Liquidambar styraciflua*), American sycamore, cottonwood (*Populus* spp.), oak (*Quercus* spp.), and holly (*Ilex* spp.) trees; (3) the intact floodplain ecosystem, and (4) high biodiversity. On June 30, 1983 Congaree National Park was designated an International Biosphere Reserve, and on July 26, 2001, it was recognized as a Globally Important Bird Area.

Park Mission relative to Natural Resource Management

Congaree National Park's mission calls for accomplishing the long-term goal of "preserving, protecting, and perpetuating the bottomland hardwood ecosystem in a manner that promotes the natural function of the Congaree River floodplain by (a) managing and restoring designated wilderness areas and all-inclusive wetlands, so as to minimize disturbances to natural landforms, vegetation, and wildlife habitat, and (b) conserving the rich and abundant biodiversity within the Congaree and Wateree River alluvial floodplains by controlling, where necessary, the adverse effects caused by human activities.

Natural Resources Issues

Environmental Setting	Resources	Agents of Change
<u>Water Resources</u>	<u>Species of Concern (TERS)</u>	<u>Park NR Management</u>
<ul style="list-style-type: none"> • Water Quality • Surface Waters • Water Quantity • Flooding • Groundwater 	<ul style="list-style-type: none"> • Birds (general) • RCWs • Champion Trees • Listed plants 	<ul style="list-style-type: none"> • Exotic Plant Management • Fire Management
<u>Air Resources</u>	<u>Exotic / Invasive Species</u>	<u>External Stressors</u>
<ul style="list-style-type: none"> • Air Toxics • Surface Water Chemistry • Ozone • Vegetation Effects 	<ul style="list-style-type: none"> • Exotic Aquatic Species • Exotic Plants • Feral Animals • Exotic Animals • Forest Pest Species 	<ul style="list-style-type: none"> • Adjacent Land Use • Hydropower Generation • Hunting
<u>Geologic Resources</u>	<u>Habitats & Communities</u>	<u>Ecosystem Functions</u>
	<ul style="list-style-type: none"> • Fish Communities 	
<u>Weather & Climate</u>	<u>Unique Areas</u>	<u>Other Issues</u>
<ul style="list-style-type: none"> • Droughts 		<ul style="list-style-type: none"> • Noise Pollution • Light Pollution

Water Resources

Water Quality: Baseline water quality inventories and analyses indicate that surface waters within the study area have been impacted by human activities (National Park Service 1998a). Potential anthropogenic sources of contaminants include municipal and industrial wastewater discharges; urban and residential development; storm water runoff; agricultural and silvicultural operations; quarrying operations; recreational use; landfill operations; atmospheric deposition; and military operations.

Surface Waters: Surface water resources in the CONG baseline water quality study area include the Congaree, Wateree, and Santee Rivers; Congaree, Wateree, and other swamps and wetland areas; Weston Lake Dam at Fort Jackson and numerous other reservoirs; Cedar, Toms, Gills, Congaree, and many other tributary creeks; and numerous oxbow and other natural lakes and ponds (National Park Service 1998a).

Flooding: The Congaree River overflows its banks approximately 10 times a year. Flooding, which typically occurs in late winter and early spring, may last from a few days to a few months. As much as 90% of the park is inundated at least once a year (National Park Service 2003b). Flood frequency and magnitude at CONG have been affected by upstream impoundments, most notably the Saluda Dam. Floods with a 2-year recurrence interval before the dam had only a 4.5-year recurrence interval after the dam. Even more noticeable was that a 5-year recurrence flood before the dam was only a 25-year recurrence flood after the dam. The effect of decreased flood frequency on the aquatic communities in CONG is unknown.

Groundwater: USGS is currently monitoring groundwater, and has recently installed a network of wells to study the effects of altered hydrology on ground and surface water resulting from the upstream Saluda Dam and associated hydropower facilities. Data from this study will be important for FERC relicensing proceedings if groundwater resources are affected by upstream hydropower facility management.

Natural Hydrology: Hydrology is the single most important factor integrating the natural, physical and biological components of the Park (National Park Service 2002b). Two comprehensive studies have previously described a framework for understanding the linkages between the hydrological network and the dependent vegetation communities (Patterson et al. 1985; Rikard 1988).

Air Resources

Air Toxics: Atmospheric deposition of metals (particularly mercury) from local commercial / industrial facilities is of concern to the Park. Congaree is classified as a Class II clean air area (42 USC 7401 et seq.). The Environmental Protection Agency (EPA) has established ambient air quality standards that may not be exceeded. Under Class II, modest increases in air pollution are allowed beyond baseline levels for sulfur dioxide and particulate matter, provided the National Ambient Air Quality Standards, established by the Environmental Protection Agency, are not exceeded (National Park Service 2002b).

Surface Water Chemistry: Samples collected in lower Tom's Creek, Cedar Creek, and the Congaree River had average pH values of 5.9 to 6.5, with a minimum pH of 5.1 (National Park Service 1998a). The average ANC value on Cedar Creek was 38 µeq/l, and the minimum value was 16 µeq/l. The average ANC on the Congaree River was 160 µeq/l and the minimum value was 64 µeq/l. Weston and Wise Lakes also had low pH values, with an average pH of 5.9 and a minimum of 4.0. These data indicate surface waters in CONG are extremely acid sensitive, and it's possible that they currently experience episodic acidification (i.e., precipitation events that cause the creeks and lakes to lose all buffering capacity for a short amount of time). There is no indication that nitrogen-associated eutrophication is an issue. Surface waters in the study area contained elevated levels of a number of heavy metals, so deposition of airborne toxics might be of concern for the park.

Ozone: The risk of foliar ozone injury at Congaree National Park is low (National Park Service 2004a). While the threshold level for injury is satisfied by the Sum06 index, the N-values indicate that there are only occasional exposures to concentrations of ozone greater than 80 ppb and exposures above 100 ppb are rare. Relationships between levels of ozone and soil moisture are inconsistent, but suggest that conditions limiting the uptake of ozone occur during most years and may be most prevalent during higher ozone years. It is anticipated that the risk of injury may be greatest in years when ambient levels of ozone are high and soil moisture conditions favor uptake by plants. A program to assess the incidence of foliar ozone injury on plants at the site could use one or more of the following bioindicator species: eastern redbud, white ash, yellow-poplar, American sycamore, black cherry, American elder, and crownbeard.

Weather & Climate

Droughts: CONG climate is marked by extreme events—both flooding and droughts. During periods of prolonged drought, stressors to vegetation communities potentially have larger-than-normal affects. Wildfire and forest-pest (i.e., turpentine beetle) outbreaks have both been linked to periods of prolonged drought.

Species of Concern (Threatened, Endangered, Rare, Special)

Birds (general): More than 175 species of birds are known to inhabit Congaree National Park (Carter 1995). Water birds, songbirds, raptors [including the relatively common barred owl (*Styrax varia*)], and turkeys (*Meleagris gallopavo sylvestris*), are some of the birds found in the area. The wood duck is the most common species of waterfowl. Events such as Hurricane Hugo have created more diversity in habitat (more open areas and nesting opportunities). More bird species began frequenting the Park after Hurricane Hugo due to the increased amount of open areas caused by wind damage. The intact forest canopy blocks much of the light that would support an understory shrub layer; however Hurricane Hugo and routine storms have produced enough tree-fall to sustain shrub habitat throughout the Park (National Park Service 2002b).

RCWs: As late as 1996, the federally endangered red-cockaded woodpecker (RCW) was known to have active colonies on pine uplands within a small portion of the Park (National Park Service 2002b). In the summer of 1993, a population and habitat survey confirmed 4 birds and 9 active cavity trees. This species has received a considerable degree of management focus, as reflected in current management plans and actions. Prescribed fire was used to enhance a 300-acre plot of RCW habitat during the last three years. Currently

no RCWs are located within the park, but habitat is present and maintained for potential future adoptions of populations.

Champion Trees: CONG trees representing nineteen different species are either State or National champion specimens. Though not managed for individually, the trees are of high interest to visitors and naturalists alike.

Listed Plants: At least ten state listed plant species have been found within the Park.

Exotic / Invasive Species

Exotic Aquatic Species: The only known aquatic invasive animal at CONG is the Asiatic clam (*Corbicula corbicula*). Likely it was introduced into the system through disposal of aquarium water.

Exotic Plants: More than 25 species of non-native plants have been documented at CONG including Chinese privet (*Ligustrum sinense*), Japanese stilt grass, Jerusalem cherry (*Solanum pseudocapsicum*), and kudzu.

Feral Animals: Feral hogs and dogs are the primary concern; cats have not been known to be a problem at CONG. Feral dogs are both strays and loose hunting dogs from adjacent lands where hunting occurs. Affects on native flora and fauna are unknown. Feral hogs are present throughout the park and potentially cause much habitat degradation within the floodplains of the Congaree River and its tributaries.

Exotic Animals: Fire ants.

Forest Pest Species: Southern pine beetles and black turpentine beetles have both been recorded in the park and have caused damage to tree stands. Significant damage to pine stands was caused in 2002 by black turpentine beetles. Gypsy moths, though not yet recorded in the park, are also a management concern.

Habitats & Communities

Fish Communities: At least 59 fish species are present within or adjacent to park boundaries (Rose 2002). Of those, 56 have been documented in the park, and 3 have been documented in off-site, nearby locations.

Longleaf Pine Forests: Longleaf pine (*Pinus palustris*) stands within CONG are managed primarily for RCW habitat.

Pine Plantations: CONG has 2,000 acres of stagnant pine plantation.

Park NR Management

Exotic Plant Management: CONG is one of fourteen parks included in the Southeast Coast Network's exotic plant management module being administered by CUIS.

Fire Management: Director's Order 18 requires managers to conduct fire effects monitoring and long-term monitoring to assess the outcomes of wildland and prescribed fires relative to short-term and program goals (National Park Service 2003b). CONG will conduct its fire monitoring program in accordance with the NPS Fire Monitoring Handbook (National Park Service 2001b), which outlines standardized methods to be used for monitoring both wildland and prescribed fires. Monitoring protocols will be reviewed and approved at the Southeast Regional Office level before receiving funding.

External Stressors

Adjacent Land Use: Congaree National Park is surrounded by significant agricultural, commercial/industrial, residential, and silvicultural land uses. Nearby agricultural impacts include sedimentation and pesticide/herbicide impacts on regional groundwater supplies. Threats from nutrient inputs from high-density aquaculture are also a concern, as well as the possibility for introduction of non-native fish species

during routine flooding events. Several industrial entities are located in the area with permitted discharges. There is an EPA Superfund site within five miles of the Park. Residential land use (and conversion to residential land use) is a large source of impacts on surface waters through nutrient and sediment loading. Future impacts to drinking water supply needs have not been assessed. Adjacent silvicultural lands pose a potential source for outbreaks of forest pest species.

Hydropower Generation: The Saluda Dam is a water supply and hydropower generation facility located 38 river miles upstream of CONG that is scheduled for FERC relicensing in 2010 (extended by FERC from 2007) (National Park Service 1998a). After Saluda Dam became operational in 1930, the frequency and magnitude of floods on the Congaree River floodplain, including Congaree National Park (CONG), decreased (Patterson, Speiran, and Whetstone 1985).

Hunting: Several hunting clubs immediately adjacent to the park boundary, as well as in the surrounding area potentially add pressure to the game species found at CONG, such as white-tailed deer (*Odocoileus virginianus*) and turkey. These lands might also be a source for feral hog populations.

Superfund Sites: An Environmental Protection Agency Superfund Site is located five miles from the Park's northwest boundary and might potentially be a source for current and/or future soil, groundwater, or surface water contamination.

Other Issues

Noise Pollution: Military pilots occasionally use the river corridor for maneuvers. Park staff has observed military jets and helicopters violating the minimum 2000 feet (36CFR) airspace ceiling that is required when flying over the Park. In particular flights between 500 and 1,000 feet above the ground and along the river are the major concern because the noise disrupts the wilderness experience for visitors, and roosting and nesting of bird species might be negatively impacted (National Park Service 2002b). Key personnel at McEntire Air National Guard Base and Shaw Air Force Base have been contacted regarding this matter and have expressed an interest in cooperating.

Light Pollution: Light pollution from nearby Columbia interferes with Wilderness designation.

Disease Transmission: Monitoring for mosquito-borne diseases (such as West Nile Virus, Eastern Equine Encephalitis and St. Louis Encephalitis) has been conducted within CONG, but all cultures have been negative. Twenty-four species of mosquitoes have been identified at the park.

Visitor Use Impacts: Off-trail hiking and the creation of social trails and the subsequent effects on natural resources is a concern. The primary cause of the creation of social trails is to access the resident champion trees. Soil compaction around base of these champion trees is a long-term concern to park management.

Cumberland Island National Seashore (CUIS)

Park Description

Cumberland Island, a 26 km (17 ½ mile) long sandy barrier island, is one of the larger and more diverse islands on the Atlantic Coast. It totals 14,743 ha (36,415 acres) of which 6,821 ha (16,850 acres) are estuarine. A cordgrass (*Spartina* spp.) grass dominated salt-marsh, oyster mud flats and six tidal creeks provide the habitat for a diverse assemblage of marine-based fauna. The remaining acreage is terrestrial. A live oak/palmetto dominated forest backs an extensive dune system. As the elevation of the island rises in the northwest, a mixed pine-deciduous forest can be encountered. The island is known for nesting loggerhead sea turtles, abundant shore birds, undeveloped dune fields, maritime forest ecosystems, freshwater wetlands, and the historic structures in five historic districts on the National Register of Historic Places.

Park Mission relative to Natural Resource Management

Cumberland Island National Seashore was established in 1972, to preserve the scenic, scientific, and historical values of the largest and most southerly island off the coast of Georgia. Cumberland Island is also part of the South Atlantic-Carolinian Biosphere Reserve and will be permanently protected in a primitive state. The northern half of the island has also been 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.

Natural Resources Issues

Environmental Setting	Resources	Agents of Change
<u>Water Resources</u> <ul style="list-style-type: none"> Channelization Water Quantity Septic Tanks Water Quality Saltwater Intrusion Artesian Wells Groundwater Freshwater Sloughs, Lakes, & Streams 	<u>Species of Concern (TERS)</u> <ul style="list-style-type: none"> Sea Turtles Shore Birds Wood Stork Red Cockaded Woodpeckers Reptiles & Amphibians Manatees 	<u>Park NR Management</u> <ul style="list-style-type: none"> Exotic Animal Control Exotic Plant Management
<u>Air Resources</u> <ul style="list-style-type: none"> Air Quality Ozone 	<u>Non-Native / Invasive Species</u> <ul style="list-style-type: none"> Fire Ants Exotic Plants Armadillo Feral Hogs Feral Horses 	<u>External Stressors</u> <ul style="list-style-type: none"> Adjacent Land Use & Development Fishing Industry Naval Submarine Base Shipping & Boating Coastal Zone Management Dredging
<u>Geologic Resources</u> <ul style="list-style-type: none"> Shoreline Erosion Dune Dynamics Long Shore Sand Budget 	<u>Habitats & Communities</u> <ul style="list-style-type: none"> Salt Marshes Coastal Dunes Plant Communities 	<u>Ecosystem Functions</u> <ul style="list-style-type: none"> Fire
<u>Weather & Climate</u> <ul style="list-style-type: none"> Hurricanes Drought Sea Level Change 	<u>Unique Areas</u> <ul style="list-style-type: none"> Designated Wilderness Area 	<u>Other Issues</u> <ul style="list-style-type: none"> Visitor Use / Recreational Activity Causeways

Water Resources

Channelization: Historically channelized streams and wetlands exist on CUIS, but the effects of that legacy on natural hydrology are unknown.

Water Quantity: On CUIS, freshwater is primarily available from the surficial and Upper Floridan aquifers, which on Cumberland Island are not hydrologically connected (Frick et al. 2002). The effects of regional water withdrawals on groundwater supplies is of concern as water use on the mainland increases over time, but the degree to which resources on Cumberland Island are affected by those withdrawals remains unclear. The 2002 shutdown of the Durango Paper Mill in St. Mary's and subsequent rebounding of the cone of depression coinciding with the cessation of water withdrawals has resulted in noticeable changes in flow of abandoned artesian wells.

Septic Tanks: All facilities and residences on Cumberland Island are on septic systems. Little Cumberland Island (private community), immediately north of the Island, has approximately 80 homes, all of which are on septic systems.

Water Quality: The 1997 Baseline Water Quality Data Inventory and Analysis report suggests that some surface waters associated with the park are either saline or tidally influenced (National Park Service 1997a). If this is the case, then surface water acidification is not a concern for the park. There is no indication that nitrogen-associated eutrophication is an issue. The University of Georgia is currently conducting a total watershed assessment to determine landscape-scale drivers of water quality.

Saltwater Intrusion: Changes in shallow groundwater / surface water chemistry can potentially alter plant communities and the system's ability to carry out key ecosystem functions such as nutrient cycling and carbon sequestration. However nothing has been observed to indicate that this is a problem at this point in time.

Artesian Wells / Groundwater: Most of the groundwater supply for Cumberland Island and vicinity is obtained from two series of water-bearing aquifers. The most important of these is a deep-lying limestone aquifer, known as the Floridan aquifer (Hillestad et al. 1975). This artesian aquifer is an important source of water throughout much of the Coastal Plain. In addition to the maintained artesian wells on the island, there are at least nine artesian wells or their associated works that were improperly abandoned or have failed, resulting in uncontrolled flow.

Freshwater Sloughs & Ponds: Lake Whitney, Lake Rhetta, Sweetwater Lakes Complex, Willow Pond complex, and South End Pond.

Air Resources

Air Quality: NADP/NTN sites have been installed at Okefenokee National Wildlife Refuge, Sapelo Island, and Skidaway, GA but data are not yet available from those sites. The state of Georgia prepares annual air toxics (mercury, dioxins, benzenes etc.) monitoring reports - the nearest monitoring station to Cumberland Island is in Brunswick, GA. Cumberland Island National Seashore will be acquiring a NOAA Climate Reference Network station in September, 2004. Primary threats to air quality include nearby paper mills and power plants.

Ozone: The low levels of ozone exposure and the relatively dry soil moisture conditions at Cumberland Island National Seashore make the risk of foliar ozone injury to plants low (National Park Service 2004a). While the Sum06 exposures exceed the threshold levels for injury, the W126 do not since the N100 criterion is not satisfied. Since soil moisture conditions of mild to moderate drought reduce the effectiveness of the exposures, and hourly concentrations of ozone seldom exceeded 80 ppb, it is unlikely that foliar injury will be produced on plants. If the level of risk should increase in the future, a program to assess the incidence of foliar ozone injury on plants at the site could use one or more of the following indicator species: tree-of-heaven (*Ailanthus altissima*) (an invasive exotic), eastern redbud, white ash, American sycamore, black cherry, American elder, and crownbeard.

Geologic Resources

Shoreline Erosion: Primary effects are potentially on loss of maritime forest and potentially salt marsh on the sound side of CUIS. Although current erosion rates might be consistent with natural shoreline evolution, wake energy from boats (including Navy Trident submarines) might be an exacerbating factor.

Weather & Climate

Hurricanes:

Species of Concern (Threatened, Endangered, Rare, Special)

Horses: Horses, though exotic, are present on Cumberland Island. Horses have known or potential effects on marshlands, inland forest grasses, wetland, and coastal dune plant communities. The extent to which this occurs varies with population size, and the ecological effects overall are currently unknown. Trampling and grazing pressure on salt marshes is highly visible and is likely a problem. The target population for CUIS is 60 individuals; the population as of March 2003 was roughly 250 individuals.

Sea Turtles: All CUIS sea turtle monitoring is currently coordinated with other nesting success programs in the State by Georgia Department of Natural Resources. Depredation by hogs, raccoons, fire ants, and ghost crabs are all of concern.

Shore Birds: CUIS, similar to other national seashores is well known for its rich avifauna (Watson 2003b). Nesting American oystercatcher, Wilson's plover (*Charadrius wilsonia*), Least Tern, Black Skimmer (*Rhynchops niger*), gull-billed tern (*Sterna nilotica*), wood stork (*Mycteria americana*), bald eagle, brown-headed nuthatch (*Sitta pusilla*), dramatic shorebird and passerine migrations, and large numbers of overwintering shorebirds establish CUIS as an important avian conservation area. CUIS was recognized as a Globally Important Bird Area (IBA) by the American Bird Conservancy for its wide variety of birds and the value this barrier island park has for protection of these birds. Shorebirds of interest include piping plovers, wood storks, least terns, willets, American oystercatchers, and black skimmers. Threats to shorebirds are largely the result of human activities on the island; habitat changes; depredation from raccoons, feral hogs, and bobcats; and nest trampling from horses.

Red Cockaded Woodpeckers: Currently on the species list for the park, though none are currently known to be present. Although extirpated from CUIS, potential suitable habitat remains for possible RCW reintroductions.

Reptiles and Amphibians: Gopher tortoises are found on the Island. Gopher tortoises are also regionally affected by an upper respiratory tract disease that increases mortality rates. Incidence and transmission rates on CUIS are currently unknown.

Manatees: Present in the park.

Bobcats: Predator concerns for shorebird management.

Exotic / Invasive Species

Horses: Horses, though exotic, are present on Cumberland Island. Horses have known or potential effects on marshlands, dune systems and plant communities, inland forest grasses, wetlands, and other critical habitats. The extent to which this occurs varies with population size, and the ecological effects overall have been well studied, but not holistically synthesized. Trampling and grazing pressure on salt marshes is highly visible and is likely a problem. The population as of March 2003 was estimated at 250 individuals. Management alternatives have been established to include maintaining a small, representative herd on the south end of the Island.

Fire Ants: Predation on egg masses and hatchlings during nesting seasons potentially increases the mortality of sensitive / T&E species.

Exotic Plants: Bamboo, tung tree, and tamarisk (*Tamarix* spp.) are of primary concern, but many others exist on the island such as tree of heaven, Bermuda grass (*Cynodon dactylon*), Chinese sumac (*Rhus chinensis*), Chinese tallow (*Sapium sebiferum*), common mullein, and a host of escaped cultivars from neighboring lands as well as the cultural landscapes managed by CUIS.

Armadillo: Armadillos (*Dasyus novemcinctus*) first appeared in the park in the early 1970's. There is currently no specific data documenting the impact of the armadillo on archeological resources, insects, vegetation or other natural resources. As a newly arrived animal, whether considered exotic or naturally expanding its range, the park needs baseline data on the population size, rate of spread, reproduction, and associated impacts on park resources.

Feral Hogs: Feral hog populations are present on the Island and are currently controlled through a combination of hunting and trapping. Hogs have a potential detrimental effect on the full range of island habitats including wetland and maritime forest habitats as well as nests of both shorebirds and sea turtles. Private lands within the park boundaries provide potential sanctuaries for feral hogs; effective eradication must be done with consideration of source / sink populations both within and outside of park jurisdiction.

Habitats & Communities

Salt Marshes: CUIS has roughly 16,000-18,000 acres of marshland within its boundaries. Marsh die-off is of concern throughout coastal Georgia (and beyond), the cause of which is unknown.

Coastal Dunes: Migration rates both with and without grazing pressure from horses is an issue, as well as dune stability over time with impacts from visitor use.

Plant Communities: Within the confines of Cumberland Island, 22 plant community or vegetation types were recognized and mapped (Hillestad, Bozeman, Johnson, Berisford, and Richardson 1975). These vegetation types are not associations in the strictest sense (i.e., the conceptual "association" as used by some schools). This scheme or classification system was devised to show the diversity of habitats, the composition of the vegetation in these habitats and the spatial extent or coverage of each recognizable unit on the island. The system reflects natural units as nearly as possible, and it is extensive enough to include the principal variations in plant cover. Major communities of ecological importance include maritime forests, coastal dunes, salt marsh, wetlands, and mixed-pine forests.

Unique Areas

Designated Wilderness Area: The northern half of the island has also been 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 (National Park Service 2000a). At the same time, it has a limiting impact on park management and restoration.

Park NR Management

Exotic Animal Control: Feral hog populations are present on the Island and are currently controlled through a combination of hunting and trapping.

Exotic Plant Management: Current management activities are intended to prevent species that are allowed in the cultural landscapes from escaping and establishing populations in natural areas. Identifying and eliminating species in critical habitat is an ongoing challenge to the Park. CUIS is one of thirteen parks in the Southeast Coast Network's Exotic Plant Management Module to begin operation in FY 2005. CUIS is currently the lead park for the Module.

External Stressors

Adjacent Land Use & Development: Two river systems (St. Mary's and Satilla Rivers) drain into the sound side of Cumberland Island. These river systems drain areas primarily of urban and agricultural land use in the Jacksonville, Brunswick, and Waycross / Tifton areas of northeast Florida and Southeast Georgia. Suburban growth is increasing locally, with three major subdivisions in development or being proposed. Although these developments might not have direct impacts on the park, they are expected to result in higher (uncontrolled) visitor use through private boating access, and potential changes to regional water use and water quality.

Fishing Industry: The offshore commercial shellfishing (primarily shrimp) is the cause of sea turtle strandings / mortalities each year at CUIS. The overall impacts of commercial and recreational fishing are unknown.

Navy Submarine Base: Naval vessels pass through the Intracoastal Waterway regularly in association with the Atlantic Trident submarine fleet. Wave action from the wakes of these vessels has potentially high erosive energy on the sound side of CUIS. The Navy undertakes multiple activities with varying known and unknown effects including dredging.

Ecosystem Functions

Fire: Currently removed from the island ecology with an incomplete assessment of the full effects on island ecology.

Other Issues

Visitor Use Impacts: Visitor use is now concentrated on the south end of the island around Dungeness and Sea Camp, but this could increase over time, particularly at the Plum Orchard facility. Of specific concern are the effects of social trail creation on natural systems, particularly in coastal dune ecosystems. Visitor use is currently limited by legislation, which mandates a maximum of 300 people to be ferried to the island each day. With the new developments nearby, visitor use is expected to increase near landing access points on the southern tip of the island, as well as at Brick Hill and Cumberland Wharf / Burbank Point. Such uncontrolled visitation could have a significant impact, particularly on critical shorebird habitat.

Causeways: Causeways and associated culverts restrict and / or redirect flow.

Fort Frederica National Monument (FOFR)

Park Description

Established on St. Simon's 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, old-growth oaks, exceptionally large grapevines (*Vitis* spp.), and Spanish moss (*Tillandsia usneoides*) lend an air of antiquity unequaled on the coast.

The monument is divided by the Frederica River, one of the primary salt marsh rivers in the Brunswick area, with 99 acres of marsh lands at the Frederica site on the west side of the river and approximately 137 acres of uplands adjoining the east side of the river. The Bloody Marsh site consists of 8 acres of which approximately 5 acres are tidal marsh. Approximately 50% of park-owned lands are classified as wetlands.

Park Mission relative to Natural Resource Management

The Park's enabling legislation does not specifically mention natural resources management, however, the FOFR is responsible for managing lands in accordance with the National Park Service Organic Act (16 USC 1) and National Parks Omnibus Management Act (Pub. L. 105-392) such that the Park makes sound resource decisions based on sound scientific data in an effort to leave resources unimpaired for the enjoyment of future generations.

FOFR has been divided into four fire management units (FMUs) to facilitate the achievement of fire management objectives. The natural-resource based passive recreation zone consists of vegetated communities exhibiting natural succession. The desired resource condition would be predominately natural, and management activities designed to encourage and support that condition governs management in this zone.

Natural Resources Issues

Environmental Setting	Resources	Agents of Change
<u>Water Resources</u>	<u>Species of Concern (TERS)</u>	<u>Park NR Management</u>
<ul style="list-style-type: none">• Water Quality• Water Quantity• Rivers• Groundwater Resources	<ul style="list-style-type: none">• Deer• Wood Storks	<ul style="list-style-type: none">• Exotic Plant Management• Fire Management
<u>Air Resources</u>	<u>Exotic / Invasive Species</u>	<u>External Stressors</u>

- Air Quality
- Ozone

Geologic Resources

- Shoreline Erosion
- Soils

Weather & Climate

- Precipitation
- Temperature

- Exotic Plants
- Southern Pine Beetle
- Feral Hogs

Habitats & Communities

- Salt Marsh
- Upland Pine Forest
- Oak Scrub / Shrub Community

Unique Areas

- Adjacent Land Use

Ecosystem Functions

Other Issues

Water Resources

Water Quality: Deterioration is a concern from industrial pollutants as well as the impact of the intensive recreational use of the Frederica River by boaters and fishermen. Several of the nearby industrial plants have buried or discharged, legally and otherwise, toxic wastes in the Brunswick, Georgia, community. This dumping has, in turn, contaminated ground water. In addition, Brunswick, Georgia has four superfund sites on the National Priorities List (http://www.epa.gov/superfund/sites/npl/ga.htm#Hercules_009_Landfill). Water Quality data inventories and analyses indicate a shortage of relatively recent observations for all parameters measured in the study area and a complete lack of any data collected within the FOFR park boundary (National Park Service 1998b). Of the 1,100 observations reported for the study area, approximately 98 percent were collected before 1973 from one station in Saint Simons Sound. Without adequate data it is difficult to make definitive statements regarding recent water quality within the study area. Potential anthropogenic sources of contaminants include industrial and municipal wastewater discharges; stormwater runoff; recreational use; and atmospheric deposition.

Water Quantity: Regional waters shortages have resulted in water rationing on St. Simons Island, primarily with respect to the water usage required by nearby golf courses within the community. The long-term effects of increasing water demand associated with increasing population growth are at this point unknown.

Surface Water: Surface water resources in the FOFR study area include the Atlantic Ocean; Saint Simons Sound; the Back Hampton, Frederica, Mackay, and other rivers; Gully Hole, Dunbar, and several other smaller creeks; and numerous marshes, wetlands, and estuaries. Many of these water resources are influenced by tidal flow and contain fresh and saline waters in transition.

Groundwater Resources: Several of the nearby industrial plants have buried or discharged, legally and otherwise, toxic wastes in the Brunswick, Georgia, community. This dumping has, in turn, contaminated ground water. In addition, Brunswick, Georgia has four superfund sites on the National Priorities List (http://www.epa.gov/superfund/sites/npl/ga.htm#Hercules_009_Landfill). Three artesian wells are also located on site.

Air Resources

Air Quality: Industrial effluent from nearby Brunswick includes chemical manufacturing and pulp / paper mill facilities.

Ozone: The low levels of ozone exposure and the relatively dry soil moisture conditions at Fort Frederica National Monument make the risk of foliar ozone injury to plants low (National Park Service 2004a). While the Sum06 exposures exceed threshold levels for injury, the W126 do not since the N100 criterion is not satisfied. Since soil moisture conditions of mild to severe drought reduce the effectiveness of the higher exposures, and hourly concentrations of ozone seldom exceed 80 ppb, it is unlikely that foliar injury will be produced on plants.

Geologic Resources

Shoreline Erosion: The cultural landscape of FOFR is located along the cutbank of the Frederica River. Active erosion is occurring to the south of the property near the boat dock. Erosion control measures near the Fort ruins have stabilized the shoreline for roughly thirty years.

Soils: Sedimentary deposits composed primarily of sandstone, limestone and clay underlie Frederica. Surface deposits of sand are common to the upland area, while the marsh substrata are composed of unconsolidated clays containing high organic matter content and sand. In most areas the soils are well drained; however, poorly drained soils occur in the northeastern portion of the park.

Weather & Climate

Precipitation: The average annual mean precipitation from 1960 to 2000, as indicated in Figure 7, was 52.8 inches. The linear red trend line indicates no discernible overall increase or decrease in precipitation since 1960 (National Park Service 2003a).

Temperature: Historic weather data from Jacksonville, Florida, approximately 60 miles to the south, serve as a reasonably accurate indication of historic weather patterns of the park area.

For the 41-year time period from 1960 to 2000, the average mean temperature, as indicated in Figure 6, was 68.6 °F. Although mild warming and cooling cycles have occurred, the temperature has remained quite constant, with no discernible overall warming or cooling trend since 1960.

Species of Concern (Threatened, Endangered, Rare, Special)

Deer: Historically, both white-tailed and fallow deer (*Dama dama*) were present at FOFR. Fallow deer have not been observed at the park for at least fifteen years. As the surrounding area of St. Simons Island continues to develop, though, the park might become a habitat island for those large animals that remain.

Wood Storks: Wood storks were once common on St. Simons Island, with one of the State's largest rookeries occurring on private lands adjacent to the Park. Development pressures have extirpated the wood storks from the area, and possibly from the Island entirely. However, a wood stork was seen in the Park parking lot last year (2003).

Exotic / Invasive Species

Exotic Plants: Privet is found in abundance, primarily in the former "yacht club" portion of the property. Other escaped cultivars are likely present. Chinese tallow (*Sapium sebiferum*) is present at FOFR in small numbers along the marsh edge and within the freshwater wetland areas of the moats and to the north.

Feral Hogs: Historically, feral hogs have presented a natural resource problem for Park managers at FOFR. However, eradication efforts by the park, and its partners have eliminated all evidence of the problem.

Habitats & Communities

Salt Marsh: To the west of the Frederica River is a tract (roughly 100 acres) of salt marsh that includes both low- and high-marsh communities dominated by saltmarsh cordgrass and needle rush (*Juncus roemerianus*) respectively. Also associated with the salt marsh communities are mud flats.

Live Oak / Magnolia Forests: Live oak and laurel oak are codominant, occurring with southern magnolia (*Magnolia grandiflora*) and pignut hickory (*Carya glabra*), in the understory are scattered saw palmetto, wax-myrtle, blueberry (*Vaccinium* spp.), dogwood, redbud, persimmon and yaupon holly. A variant on this community maintained at the marsh edges includes cabbage palm and red cedar along with groundsel tree (*Baccharis halimifolia*), saltwater falsewillow (*B. angustifolia*), grasses, vines such as peppervine

(*Ampelopsis* spp.), and a variety of other woody and herbaceous perennials. On the Bloody Marsh tract, Live Oak/Magnolia (or Maritime) forest is somewhat richer with more hickory, cabbage palm, slash pine (*Pinus elliotii*) and persimmon.

Pine Successional Forests: Forest dominated by loblolly pine with an advanced understory of live oak and water oak and an understory of blueberry, wax myrtle, and an occasional saw palmetto. This community covers a large area south of the fort and to the east of the park headquarters which was formerly cleared for agriculture. A wetter variant occurs on either side of the entrance drive dominated by loblolly pine, water oak, sweet gum, yellow poplar and some water tupelo in the wettest spots with an understory of saw palmetto, gallberry (*Ilex glabra*), cinnamon fern (*Osmunda cinnamomea*) and netted chain fern (*Woodwardia areolata*).

Park NR Management

Exotic Plant Management: FOFR is one of fourteen parks within the network that will be participating in a three-year exotic plant management module that is being coordinated by CUIS.

Fire Management: FOFR is in the final stages of developing a fire management plan (National Park Service 2003a). FOFR will use prescribed fire to reduce hazard fuels accumulations, to promote ecosystem sustainability, and to restore and maintain the historic landscape. Park planning documents will guide the use of prescribed fire. All wildfires at FOFR, regardless of origin, will be suppressed.

External Stressors

Adjacent Land Use: Land use in the immediate area is primarily residential, with a large vacation rental / winter resident population. Multiple golf courses are associated with the residential community.

Other Issues

Visitor Use: Individual boats are frequently spotted within the Frederica River fishing and crabbing. Extractive uses are assumed to have a minimal impact on native communities. However, wave action from watercraft presents possible damage to park wetlands and the cultural landscape through erosion. Also, the Bloody Marsh unit is used by the local community for acquiring bait (i.e., fiddler crabs); the detrimental effects of bait harvesting (if any) are unknown

Ticks: Forested areas within FOFR have many ticks, which present both a visitor experience and public health challenge.

Fort Pulaski National Monument (FOPU)

Park Description

Fort Pulaski National Monument is located in Chatham County, Georgia along the Savannah River only a few miles from its junction with the Atlantic Ocean. The site consists of two islands that were, before human intervention, primarily salt marsh. Judging from the composition of existing vegetation, Cockspur Island probably supported some coastal hammock forest or woodland. It was selected for fortification as early as the seventeen hundreds. In the eighteen hundreds, as part of the development of the site for defense, the island was modified by the installation of drainage canals and a dike system. In latter years, the site was also impacted by the deposition of spoil material. The addition of dredge material from the Savannah River to Cockspur Island has continued until recently. During the civil war period, the vegetation was removed to enhance visibility and kept in early successional stages. Since the abandonment of the fort in the late eighteen hundreds, a large portion of central Cockspur Island has reverted to maritime forest. Currently, the upland portions of Cockspur (approximately 260

acres) support a mosaic of maritime forest, maritime shrub communities, maintained grasslands and successional spoil deposit areas. It also includes over 340 acres of tidal shrubland and tidal herbaceous marsh.

McQueens Island makes up the largest portion of land holdings for the National Monument (about 4,900 acres) and the majority of this consists of salt marsh. A railroad was constructed along the northern edge of the island in 1887 to connect the city of Savannah with Tybee Island and operated until 1933. In 1923, US Highway 80 was constructed, occupying a location across the central portion of the island and adjacent the old railroad grade along the eastern section. In 1994 Chatham County converted the abandoned railroad right-of-way to a multipurpose hiking trail. Both the highway and the converted rails-to-trails areas support ruderal habitat for a number of coastal plain herbaceous species. Other upland habitat on McQueens Island occurs in association with a public fishing and boat ramp on the eastern end of the island and an abandoned section of US 80 leading to the Bull River.

Park Mission relative to Natural Resource Management

The natural resources at FOPU face a number of threats, primarily related to its proximity to the city of Savannah. Heavy industrial development on the Savannah River, as far upstream as the Savannah River Site near Aiken, SC, have been known to impact the water quality and ecological health in and around the park. Pollutant levels in water, sediment, and invertebrate tissue will be analyzed as part of an upcoming study. Shipping traffic and associated dredging are contributing to increased shoreline erosion along the north shore of Cockspar Island. Finally, Highway 80 between Savannah and Tybee Island is slated for widening in the near future, impacting park wetlands adjacent to the existing roadway.

Natural Resources Issues

Environmental Setting	Resources	Agents of Change
<u>Water Resources</u>	<u>Species of Concern (TERS)</u>	<u>Park NR Management</u>
<ul style="list-style-type: none"> • Water Quality • Water Quantity • Natural Hydrology • Saltwater Intrusion 	<ul style="list-style-type: none"> • Birds • Mammals 	<ul style="list-style-type: none"> • Exotic Plant Management • Mosquito Control
<u>Air Resources</u>	<u>Exotic / Invasive Species</u>	<u>External Stressors</u>
<ul style="list-style-type: none"> • Air Quality • Ozone 	<ul style="list-style-type: none"> • Exotic Plants • Armadillos 	<ul style="list-style-type: none"> • Adjacent Land Use • Dredging • Shipping • Road Widening
<u>Geologic Resources</u>	<u>Habitats & Communities</u>	<u>Ecosystem Functions</u>
<ul style="list-style-type: none"> • Shoreline Erosion 	<ul style="list-style-type: none"> • Salt Marshes • Maritime Forest • Wetlands 	
<u>Weather & Climate</u>	<u>Unique Areas</u>	<u>Other Issues</u>
		<ul style="list-style-type: none"> • Pest Species

Water Resources

Water Quality: Water quality within the Savannah River, and the salt marsh of FOPU are largely driven by factors well outside the control of the park. Upstream agricultural land use and local uses by the shipping industry at the Savannah Port Authority both have large potential impacts on water quality. The degree to which Savannah affects water quality (through both point- and non-point-sources of pollution) has not yet been studied. Additionally, the effects of heavy metals contamination on higher level organisms through bioaccumulation and biomagnification are currently unknown. There have been occasional sewage spills

from the nearby Wilmington Island community and leaky pipes and other non-point source inputs of nutrients into the system. Golf courses also serve as a source of fertilizers, pesticides, and herbicides into the river system. Within the moat of the park, degraded water quality has been implicated in algal blooms and fish kills, both of which can severely impact visitor use and experience.

Water Quantity: Regional water withdrawals, from both inland agricultural use and coastal industrial and municipal uses affect the availability water resources to natural communities along the coast. Because FOPU largely consists of salt marsh communities, these resources are dependent on a natural balance between freshwater and saltwater flows.

Natural Hydrology: Concerns currently center on the potential effects of dredging on both Cockspur Island and the salt marsh tracts of the park. Specifically, the effects on the quantity of water and subsequent effects on wetland plant communities are unknown. The National Ocean Service (NOS) currently operates one continuously operating tide station in Georgia, located at Fort Pulaski, which records tide data, relative sea levels and storm surge levels.

Saltwater Intrusion: In the relatively near term, planned deepening of the dredged shipping channel within the Savannah River is hypothesized to potentially breach the confining layer of the Floridan Aquifer, potentially allowing a direct connection between ocean water and a recharge point within the aquifer. The effects of regional water withdrawals on availability and depth of freshwater resources in both the short- and long-term will continue to be of concern as population growth continues along the southeastern coast. Salinity within the moat surrounding the Fort at FOPU is also of concern as it can affect the longevity of the mortar.

Air Resources

Air Quality: The feeder canal and Savannah River had average pH values of 7.3, and the Wilmington River had a pH of 6.5 (National Park Service 2001a). The Savannah River had an average ANC of 504 $\mu\text{eq/l}$, and the Wilmington River had an ANC of 216 $\mu\text{eq/l}$. These data indicate surface waters in the park are not sensitive to acidification from atmospheric deposition. The report did not indicate that nitrogen-associated eutrophication was an issue. Surface waters in the study area contained elevated levels of a number of heavy metals, so deposition of airborne toxics may be of concern for the park. Local sources of pollution include paper plants, industrial facilities in the Savannah area, and the shipping industry.

Ozone: The low levels of ozone exposure and the relatively dry soil moisture conditions at Fort Pulaski National Monument make the risk of foliar ozone injury to plants low (National Park Service 2004a). While the Sum06 exposures exceed the threshold levels for injury, the W126 do not since the N100 criterion is not satisfied. Since soil moisture conditions of mild to severe drought reduce the effectiveness of the higher exposures, and hourly concentrations of ozone seldom exceeded 80 ppb, it is unlikely that foliar injury will be produced on plants. If the level of risk increases in the future, a program to assess the incidence of foliar ozone injury on plants at the site could use one or more of the following bioindicator species: tree-of-heaven (an invasive exotic), redbud, yellow-poplar, American sycamore, black cherry, cut-leaf coneflower, American elder, and crownbeard.

Geologic Resources

Shoreline Erosion: Shipping and dredging operations both seem to be affecting the natural shorelines of the park. Although erosion in some areas is affected by wave energy caused by shipping vessels, in other areas the shoreline is aggrading with oyster shells. This new phenomenon might or might not be related to dredging operations.

Species of Concern (Threatened, Endangered, Rare, Special)

Birds: Partners in Flight has identified the painted bunting as an indicator for other neotropical migratory bird species at the park. Cattle egrets (*Bubulcus ibis*), are also present, but the degree to which they are of concern will depend on its nativity status. FOPU is one of eighteen sites along Georgia's Colonial Coast Birding Trail, established by the Georgia Department of Natural Resources.

Mammals: White-tailed deer populations are present at FOPU, but no studies have been done to determine what the carrying capacity of the park is or whether the current population is at, above, or below that capacity. Furthermore, the effects of deer populations on plant communities (browsing) are unknown, and the effects of competition with other animals are likewise unknown.

Exotic / Invasive Species

Exotic Plants: Chinaberry (*Melia azedarach*), Chinese tallow, and privet are all present within the park. Source populations are likely upstream within the watershed and ballast heaps from the adjacent shipping channel in the vicinity of Cockspur Island (Govus 1998).

Armadillos: There is currently no specific data documenting the impact of the armadillo on archeological resources, insects, vegetation or other natural resources. As a newly arrived animal, whether considered exotic or naturally expanding its range, the park needs baseline data on the population size, rate of spread, reproduction, and associated impacts on Park resources (natural and cultural).

Birds: The European starling (*Sturnus vulgaris*) and the rock dove (*Columba livia*) are exotic birds present at FOPU that potentially negatively impact native bird communities. Further, these birds adversely affect cultural resources by nesting in and loafing on historical cannons and other resources leaving debris and droppings that degrade the site and might potentially decrease visitor enjoyment.

Habitats & Communities

Salt Marshes: Roughly 5,200 acres at FOPU are in salt marsh habitat (National Park Service 2000a). The rate of gain / loss of salt marsh acreage has not been studied, but salt marsh loss is of local and regional concern.

Maritime Forest: FOPU has one tract of relatively old forest (~80 years) that, with the exception of missing oaks, is a maritime forest in what is assumed to be in good condition.

Wetlands: Wetlands near the growing shell berm could be affected by altered flooding frequencies. In addition, it is possible that sediment could fill in the wetland over time. This might or might not be a natural process.

Park NR Management

Exotic Plant Management: Fort Pulaski National Monument is one of thirteen parks included in the Southeast Coast Network's Exotic Plant Management Module being managed by Cumberland Island National Seashore.

Mosquito Control: FOPU cooperates with Chatham County Mosquito Control Commission (CCMCC) to control mosquito populations through pesticide applications. FOPU is a training site for such applications.

Fire Management: Though planned, a fire management plan has not yet been developed for the park.

External Stressors

Adjacent Land Use: In addition to the nearby shipping industry, other adjacent and upstream land uses include chemical, industrial, paper, and nuclear facilities, all of which can have significant impacts on water quality.

Dredging: Dredging offshore occurs regularly to support shipping through the Port of Savannah. US Army Corps of Engineers is currently considering a proposal to deepen the channel to increase the size of ships that can enter the Port.

Shipping: The port of Savannah is the fastest growing port on the East Coast.

Road Design and Management: Widening of US 80 from a two-lane to a four-lane highway is currently planned to allow for increased traffic flow to and from Tybee Island. The road bisects FOPU, and might potentially have detrimental effects on natural hydrology and animal migrations. Implementation of the project has been delayed by Georgia Department of Transportation (GDOT) until 2009 (Bell 2003). The Monument is currently working with the U.S. Fish and Wildlife Service, the Federal Highways Administration, and the GDOT to develop a mitigation plan that complies with NPS Wetlands Policies.

Other Issues

Pest Species: In the cultural portions of the park, mosquitoes, house mice and black rats are present and problematic.

Fort Sumter National Monument (FOSU) Charles Pinckney National Historic Site (CHPI)

Park Description

Fort Sumter National Monument consists of 200 acres of land located at the mouth of Charleston harbor and on nearby Sullivan's Island, South Carolina. The park's three major features are Fort Sumter, site of the Civil War's first engagement, the somewhat older Fort Moultrie, which commemorates seacoast defense from 1776-1947, and Liberty Square, embarkation and visitor facility.

The 28-acre Charles Pinckney National Historic Site (CHPI) was established under Public Law 100-421 and is a relatively new addition to the National Park Service. It is a rural vernacular landscape in use from 1695 until the 1980's, and was actually a working farm until the 1960's when nearly 700 acres were sold for development. The site includes the Snee Farm House, approximately four acres of wetlands, ten acres in mixed hardwoods and pines, and fourteen acres of open grassland. The site, which fronts Long Point Road, a scenic highway, is surrounded by suburban housing developments.

Park Mission relative to Natural Resource Management

Historic Fort Sumter is influenced dramatically by the surrounding natural elements. Of the 200 acres that comprise the park, 122 acres surrounding the Fort are submerged under the waters of Charleston Harbor. The remaining acreage is located on Sullivan's Island and in Charleston. Adjacent to the park, but outside its boundaries, are shoals, islands, and marshes important to the Fort Sumter scene. Two endangered species, the manatee and the loggerhead turtle, migrate through the waters adjacent to the park, but do not live or nest within the park itself.

Natural Resources Issues

Environmental Setting	Resources	Agents of Change
<u>Water Resources</u>	<u>Species of Concern (TERS)</u>	<u>Park NR Management</u>
<ul style="list-style-type: none">• Water Quality (riverine)• Water Quality (marine)• Water Quantity		<ul style="list-style-type: none">• Exotic Plant Management

Environmental Setting	Resources	Agents of Change
<u>Air Resources</u> <ul style="list-style-type: none"> • Air Quality • Ozone 	<u>Exotic / Invasive Species</u> <ul style="list-style-type: none"> • Exotic Plants • Exotic Animals 	<u>External Stressors</u> <ul style="list-style-type: none"> • Dredging • Adjacent Land Use
<u>Geologic Resources</u> <ul style="list-style-type: none"> • Earthquakes • Barrier Island Geomorphology 	<u>Habitats & Communities</u> <ul style="list-style-type: none"> • Coastal Dunes • Riparian Wetlands • Marine Fisheries • Birds 	<u>Ecosystem Functions</u> <ul style="list-style-type: none"> • Harbor Drainage Area
<u>Weather & Climate</u> <ul style="list-style-type: none"> • Sea Level Change • Hurricanes 	<u>Unique Areas</u>	<u>Other Issues</u> <ul style="list-style-type: none"> • Oil Spills and Chemical Hazards

Water Resources

Water Quality (Riverine): A small unnamed tidal creek with associated wetlands borders the western boundary of Charles Pinckney National Historic Site. Located roughly 0.1 miles upstream is a golf course and several other sources of non-point contaminants that might influence water quality.

Water Quality (Marine): Fort Sumter National Monument includes a 122-acre plot of submerged lands within Charleston Harbor Estuary surrounding the historical Fort. The harbor receives water from the Cooper, Wando and Ashley River and is subject to both point-source and non-point-source contaminants including nutrients, and toxics mostly of human origin. Though water quality is generally considered good, some areas of the Charleston Harbor Estuary only partially support aquatic life and recreational uses (National Park Service 2003c).

Water Quantity: The degree to which surficial groundwater withdrawals affect flora and fauna is as yet unknown. The Mount Pleasant/East Cooper River Area is underlain by a series of aquifers and confining units of the Atlantic Coastal Plain sediments. The upper surficial aquifer is composed of surficial sands and clays and extends approximately 20 feet below the surface and is separated from the lower surficial aquifer by a clay and sand layer. Approximately 66 percent of drinking water distributed by the Mount Pleasant waterworks is derived from the Middendorf Aquifer which is located between 1800 and 2000 feet below the ground surface (Mount Pleasant Waterworks 2002). Groundwater generally moves from toward the east-southeast in the region. Charleston County Public Works Department has a large surface water area.

Air Resources

Air Quality: Fort Sumter NM has a PM₁₀ monitor (particulate matter) on-site. Nearby paper mills, and exhaust from shipping vessels both potentially affect overall air quality.

Ozone: Fourteen plant species at (or potentially at) FOSU and CHPI are sensitive to ozone. The low levels of ozone exposure and dry soil moisture conditions at Fort Sumter National Monument make the risk of foliar ozone injury to plants low (National Park Service 2004a). While the Sum06 index meets the criteria for injury, the W126 does not since the N100 criterion is not satisfied. Because periodic soil moisture conditions of mild to moderate drought reduce the effectiveness of the higher exposures, and hourly concentrations of ozone seldom exceed 80 ppb, it is unlikely that foliar injury will be produced on plants.

Geologic Resources

Earthquakes: The seismic history of the southeastern United States is dominated by the 1886 earthquake that occurred in the Coastal Plain near Charleston, South Carolina. It was one of the largest historic earthquakes in eastern North America, and by far the largest earthquake in the southeastern United States. The historic

record suggests the Charleston-Summerville area had a continuum of low level seismic activity prior to 1886, and low-level activity continues in the same area today (South Carolina Seismic Network 2003).

Shoreline Erosion: Rip-rap currently stabilizes the shoreline surrounding the Fort Moultrie portion of FOSU and protects the shoreline from erosion, and provides enough stability for a small coastal dune plant community to exist. Management of the rip-rap is conducted by the State of South Carolina, Office of Coastal and Resource Management.

Barrier Island Geomorphology: Adjacent natural lands are accreting on the eastern end of Sullivan's Island. Interest exists in the community for developing lands into housing lots East of Battery Logan. Sullivan's Island has a conservation easement along the oceanfront on the Federal property at the Charleston Light.

Weather & Climate

Sea Level Change: At present, sea level rise is approximately 1.3 millimeters per year, but many experts believe this rate may accelerate in coming decades. An annual increase in sea level, no matter how small, over a long period of time would upset coastal dynamics in the Charleston area and could eventually pose a direct threat to Fort Sumter and Fort Moultrie.

Hurricanes: Hurricane season is June 1 through November 30 each year. The potential for another category 4 storm like Hugo in 1989 is a potential threat to the park.

Exotic / Invasive Species

Exotic Plants: . Sources of exotic plants likely come from a combination of adjacent lands and escaped cultivars (particularly at CHPI), and ballast heaps associated with dredging activities.

Exotic Animals: Exotic insects include fire ants, which are of concern for both ecological and visitor experience reasons. Also found at the park are large populations of rock doves.

Habitats & Communities

Coastal Dunes: A small coastal dune plant community exists along the border of the Fort Moultrie portion of Fort Sumter National Monument. The degree to which plants in this community are representative of other regional examples is currently unknown.

Riparian Wetlands: Charles Pinckney National Historic Site includes a small tributary to the Wando River, which includes a plant community primarily made up of salt marsh grasses.

Marine Fisheries: Status is currently unknown.

Birds: Of local interest, but the diversity of birds at FOSU is currently undocumented.

Park NR Management

Exotic Plant Management: Fort Sumter National Monument (and CHPI) is one of fourteen park units included in the Southeast Coast Network's Exotic Plant Management module currently being managed by Cumberland Island National Seashore.

External Stressors

Dredging: The lower surficial aquifer is directly connected to the Cooper River. The river bottom and shipping channel is kept open by periodic dredging by the United States Army Corps of Engineers(National Park Service 1997b). Dredging is necessary in order to maintain Charleston as a viable seaport; however, it might negatively impact Fort Sumter's marine ecosystems as well as disturbing the historic viewshed by

creating spoil banks on nearby barrier islands. The park staff continues to monitor dredging activities within the harbor, working with the Army Corps of Engineers and local authorities to mitigate the impact of dredging on park resources whenever possible (National Park Service 2000a).

Adjacent Land Use: Both CHPI and FOSU are affected by a variety of land uses in the metropolitan Charleston area. The effects on NPS property, however, primarily manifest themselves in air quality and water quality. Industrial facilities and ships on the Cooper River are potential sources for contaminants or catastrophic damage. FOSU is affected by commercial ship traffic in the Charleston harbor.

Other Issues

Oil Spills and Chemical Hazards:

Horseshoe Bend National Military Park (HOBE)

Park Description

Horseshoe Bend National Military Park is comprised of 2,040 acres. The park is located along the southern boundary of the Northern Piedmont Upland physiographic region ¹ and consists of metamorphic and igneous rocks of Paleozoic to Precambian age. The granite, gneiss, and schist bedrock weather to produce well-drained reddish loamy or clayey soils ². The elevations range from 535 feet along the river to 680 feet at the higher ridgelines. The topography is relatively flat along the river floodplain, with low rolling hills throughout much of the park. Slopes may reach 30 percent in some areas, but are more commonly 10 to 14 percent.

The park contains many plant species endemic to the Piedmont region, and also species associated with the Southeastern and Southern Coastal Plains. River bottomland borders each side of the Tallapoosa River. This land, which was extensively cultivated from 1832 until the establishment of the park in 1959, is in various stages of ecological succession.

The land has undergone significant changes in the 190 years since the battle. In many places shortleaf pine (*Pinus echinata*) and loblolly pine have displaced the mixed longleaf pine / hardwood forest that existed in 1814. Southern pine beetle infestations exist in numerous pockets of the park. In some cases, infestations are near park boundaries and endanger adjacent commercial forests. A heavy accumulation of slash and downed trees due to beetle kills and the aftermath of hurricanes and winter storms have resulted in potentially dangerous fire situations.

Park Mission relative to Natural Resource Management

The Creek Indian War consisted of 17 battles or skirmishes, with the final and most significant battle fought at Horseshoe Bend on March 27, 1814. In this battle, 3,300 frontier troops and Indian allies under the command of Andrew Jackson defeated 1,000 Creek warriors who had fortified themselves behind a seemingly impregnable log barricade. More than 800 Creek Indians were killed, ending for all time the power of the Creek Nation.

As a result of this battle, the Creek lands were subsequently added to the United States and opened for settlement. This cession of considerable magnitude, three-fifths of Alabama and one-fifth of Georgia, paved the way for Alabama's statehood five years later.

In August, 1959, President Dwight D. Eisenhower signed the Proclamation establishing Horseshoe Bend National Military Park, enacting the park's enabling legislation, passed in July, 1956. The 2,040 acre park was established to memorialize the final and most critical battle of the Creek Indian War. Although the Park's enabling legislation does not explicitly mention natural resources, those resources are paramount to the history and the story of HOBE .

Natural Resources Issues

Environmental Setting	Resources	Agents of Change
<u>Water Resources</u>	<u>Species of Concern (TERS)</u>	<u>Park NR Management</u>
<ul style="list-style-type: none"> Streams & Rivers Water Quality Water Quantity River Regulation 	<ul style="list-style-type: none"> Freshwater Mussels 	<ul style="list-style-type: none"> Fire Management Fisheries Management
<u>Air Resources</u>	<u>Exotic / Invasive Species</u>	<u>External Stressors</u>
<ul style="list-style-type: none"> Ozone 	<ul style="list-style-type: none"> Southern Pine Beetle Exotic Aquatic Species Exotic Plants Exotic Animals 	<ul style="list-style-type: none"> Adjacent Land Use Hydropower Generation Drinking Water Storage & Withdrawal
<u>Geologic Resources</u>	<u>Habitats & Communities</u>	<u>Ecosystem Functions</u>
<ul style="list-style-type: none"> Shoreline Erosion 	<ul style="list-style-type: none"> Aquatic Communities 	<ul style="list-style-type: none"> Fire Flooding
<u>Weather & Climate</u>	<u>Unique Areas</u>	<u>Other Issues</u>

Water Resources

Streams & Rivers: The Tallapoosa River bisects HOBE. The historical battlefield site is located within a single meander / bend of the River. At this point along the river drainage, the Tallapoosa River is a historically deep channel marked by several shoals.

Water Quality: The park is concerned about the impacts of livestock and chicken ranches upstream as well as agricultural runoff. The park is seeking funding to partner with USGS in a two-year water quality assessment of the Tallapoosa River.

Water Quantity: The impacts of artificial flow regimens determined by releases from hydropower facilities upstream are not completely understood. The river system has been targeted as a potential source of drinking water for the metropolitan Atlanta area through interbasin transfer of water resources.

River Regulation: Harris Dam, located roughly twenty miles upstream of HOBE near Lineville, AL, is one of two hydropower generation facilities along the Tallapoosa River. Another structure is located roughly 25 miles downstream of HOBE. Peak power generation activities at Harris Dam result in two high-water events per day; consequently river levels fluctuate 5-6 feet during these events. Impoundments and their associated lakes are likely restricting natural migration and breeding patterns of fish and mussel species within the drainage. The management of Harris Dam and the continuing tri-state negotiations over water allocation prompted American Rivers to list the Tallapoosa River as #9 on the 2003 list of America's Most Endangered Rivers (American Rivers 2003).

Air Resources

Ozone: The risk of foliar ozone injury to plants at Horseshoe Bend National Military Park is high (National Park Service 2004a). Although the levels of ozone exposure generally create the potential for injury, low soil moisture may reduce the likelihood of injury developing in the higher ozone years. Because the site is subject to potentially harmful levels of ozone in most years, the probability of foliar injury developing may be greatest during years in which ozone levels are somewhat reduced but still exceed the thresholds, and soil moisture levels are normal or under mild drought and do not significantly constrain the uptake of ozone. A program to assess the incidence of foliar ozone injury on plants at the site could use one or more

of the following bioindicator species: tree-of-heaven (an invasive exotic), redbud, white ash, yellow-poplar, American sycamore, black cherry, cut-leaf coneflower, American elder, and crownbeard.

Geologic Resources

Shoreline Erosion: Not currently a problem, but it could be long-term given the daily fluctuations and associated erosion potential resulting from hydropower generation upstream.

Species of Concern (Threatened, Endangered, Rare, Special)

Freshwater Mussels: Two endangered mussel species have been reported near the Park; both are assumed to be extirpated from the Park's boundaries. Both species are likely still in tributaries of the Tallapoosa River within Georgia. Impoundments along the mainstem river will likely be a major impediment for those species to re-colonize the Tallapoosa within HOBE boundaries.

Armadillo: The status of this species at HOBE is still unknown. Questions as to whether increasing populations represent an exotic species invasion or a natural range extension are unclear, and the impacts, if any, have not been studied.

Deer: Overpopulation on the north side of the river; possibly over-hunted on the south side of the river due to illegal poaching and dog hunting along the borders.

Turkeys: Overpopulation on the north side of the river; possibly over-hunted on the south side of the river due to illegal poaching and dog hunting along the borders.

Exotic / Invasive Species

Southern Pine Beetle: Occurs within the park and is a potential threat to other internal stands as well as those on neighboring lands. Standard BMPs call for cutting all pines within 100 ft (?) of infested trees when they are identified. Reintroduction of fire into the forest ecosystem should help to control or reduce outbreaks in the future. However, neighboring lands that are currently *unmanaged* (i.e., Alabama Power lands) might serve as source populations in the future.

Exotic Aquatic Species: Unknown at this time. Asiatic clam (*Corbicula corbicula*) assumed to be present in the system and potentially competing with native mussels.

Exotic Plants: During the last 190 years, the vegetation has been altered by human settlement, logging, and the introduction of invasive-exotic species. Exotic species have impacted many areas within the park and all occurrences were mapped in 2002. Invading exotic plants such as tree of heaven, mimosa (*Albizia julibrissin*), Chinaberry, Japanese honeysuckle, kudzu, and sandburs (*Cenchrus longispinus*) continue to expand and invade new areas. Some of these invasive plants, such as kudzu and honeysuckle, can serve as ladder fuels and increase fire danger (National Park Service 2003d).

Exotic Animals: Feral dogs are found within the border; some hunting dogs as well. Presence of hunting dogs should decrease or disappear during the next 4-5 years as dog hunting becomes limited by the State.

Habitats & Communities

Longleaf Pine / Mixed Hardwood Forest: HOBE is near the northern boundary of longleaf pine, but it is present within the boundary. Based on conversations with several botanists and ecologists, the best estimation is that the floodplains and drainages consisted of mixed hardwoods and the ridge tops were crested with patches of longleaf pine. The hillsides and some of the ridgelines likely consisted of hardwoods such as hickory (*Carya* spp.), oak, ash (*Fraxinus* spp.), walnut (*Juglans* spp.), and chestnut (*Castanea* spp.). Current management plans call for restoring the community to that found circa 1814 to better simulate the cultural landscape of the battlefield. To date, a desired future condition for this is undefined.

Park NR Management

Fire Management: Upon approval, the Fire Management Plan will permit fire management in the park to expand operations beyond immediate and total suppression to include prescribed fire. The restoration of fire as a natural force will have manifold ecological benefits, and at the same time will increase safety to the visitor, firefighter, and infrastructure alike. Both hardwood and longleaf pine ecosystems will benefit significantly from their current status, and the dangers of uncontrollable wildland fire associated with fuel build-up will be significantly reduced (National Park Service 2003d). Implementation of the plan is currently scheduled to begin in January 2004.

Fisheries Management: The Park does not currently have a fisheries management plan. As part of the annual creel census Alabama Department of Conservation and Natural Resources conducts annual creel surveys at the boat ramp in the park.

External Stressors

Adjacent Land Use: Primary land uses surrounding HOBE are silviculture and agriculture. Agricultural operations are typically cattle or chicken farming; primarily of medium-low density. Much of the surrounding land to the northwest (?) is owned by Georgia Power, which leases hunting. No active land management occurs on the Georgia Power lands. Hay farming occurs to the east of HOBE.

Hydropower Generation: Harris Dam, located roughly twenty miles upstream of HOBE near Lineville, AL, is one of two hydropower generation facilities along the Tallapoosa River. Peak power generation activities at Harris Dam result in two high-water events per day; consequently, river levels fluctuate 5-6 feet during these events. Another structure is located roughly 25 miles downstream of HOBE.

Drinking Water Storage & Withdrawal: Lake Martin, five miles downstream of HOBE serves as a drinking water supply for the cities of Alexander City, Dadeville, and Tallassee. However, because of the rapid growth of metropolitan Atlanta, the Tallapoosa River will likely be looked at as an additional water supply source for Atlanta in the future.

Ecosystem Functions

Fire: Before the large-scale impacts of white settlers in what is now eastern Alabama, fire played a significant role in shaping the vegetative conditions. Although direct evidence is difficult to find due to over 300 years of Euro-American occupation, numerous historians, ethnographers, and geographers believe the evidence of American Indian use of fire as a landscape tool is beyond doubt (Denevan 1992; National Park Service 2003d).

Flooding: According to local residents and park employees, prior to the construction of Harris Dam, natural flooding events occurred once every two years.

Kennesaw Mountain National Battlefield Park (KEMO)

Park Description

Kennesaw Mountain National Battlefield Park was created to commemorate the 1864 Atlanta Campaign of the Civil War. In particular it preserves the battle lines where from mid-June to early July the Confederate forces under Joseph E. Johnson delayed the progress of William T. Sherman's Union forces in their advance from Chattanooga to Atlanta. Enabling Legislation included in Appendix 1.

The natural resources of the 2,884-acre park include the 1,808-foot peak of Kennesaw Mountain, Little Kennesaw Mountain and hundreds of acres of mixed hardwood/pine forests intermixed with a number of grassy fields.

Included are over 16 miles of designated hiking trails that attract hundreds of recreational visitors daily. The Park's location in the Atlanta metropolitan 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 twenty-five most threatened parks.

Park Mission relative to Natural Resource Management

Largely because of its proximity to Atlanta, major natural resource threats exist at KEMO. The development of Cobb County and greater metro Atlanta makes the lands within Kennesaw Mountain relatively valuable for natural habitats of 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. In addition, there are minor threats from encroachment of adjacent landowners, exotic plant species, and industrial air and water pollution.

Natural Resources Issues

Environmental Setting	Resources	Agents of Change
<u>Water Resources</u>	<u>Species of Concern (TERS)</u>	<u>Park NR Management</u>
<ul style="list-style-type: none"> Streams Water Quality 	<ul style="list-style-type: none"> Beavers Deer 	<ul style="list-style-type: none"> Fire Management
<u>Air Resources</u>	<u>Exotic / Invasive Species</u>	<u>External Stressors</u>
<ul style="list-style-type: none"> Air Quality Ozone 	<ul style="list-style-type: none"> Southern Pine Beetle Exotic Plants Exotic Animals 	<ul style="list-style-type: none"> Adjacent Land Use In flight path for Dobbins AFB
<u>Geologic Resources</u>	<u>Habitats & Communities</u>	<u>Ecosystem Functions</u>
<ul style="list-style-type: none"> Granite Outcroppings 	<ul style="list-style-type: none"> Birds 	
<u>Weather & Climate</u>	<u>Unique Areas</u>	<u>Other Issues</u>
	<ul style="list-style-type: none"> Granite Outcroppings 	<ul style="list-style-type: none"> Encroachment Dumping Visitor Use

Water Resources

Streams: Noses Creek and John Ward Creek both flow through the park boundaries. Both creeks have upstream portions outside the boundaries of the park, so KEMO has no direct control over factors that influence the quality of water resources. Both streams ultimately drain into the Chattahoochee River.

Water Quality: Development pressure in and around KEMO has a major impact on surface water quality of both Noses Creek and John Ward Creek. Sedimentation from construction-related land disturbances upstream has altered stream habitat quality and bed sediment grain size distribution; effects on turbidity during rain events are pronounced. The degree to which these systems are impacted by non-point sources of nutrients, metals, and pesticides is as yet unknown although they are presumed to be above target concentrations. Volunteer water quality monitoring is being conducted by North Cobb High School; data indicates an extremely high fecal coliform level.

Air Resources

Air Quality: KEMO is currently designated a Class II air quality park, but the effects of metropolitan Atlanta on air resources is increasing. The effects of smog, ozone, particulates, and other atmospheric contaminants on natural resources are largely unknown. Because the population of Atlanta is expected to continue growing over the next several decades (Atlanta Regional Commission 1993), air quality is likely to be an ongoing and worsening issue. Vehicular travel through the park exceeds 15 million cars per year.

Ozone: The risk of foliar ozone injury to plants at Kennesaw Mountain National Battlefield Park is high (National Park Service 2004a). While the levels of ozone exposure consistently create the potential for injury, low soil moisture may reduce the likelihood of injury developing in any particular year. Since the site is subject to potentially harmful levels of ozone annually, the probability of foliar injury developing may be greatest during years in which ozone exposures exceed the thresholds, and soil moisture levels are normal or under mild drought and do not significantly constrain the uptake of ozone. A program to assess the incidence of foliar ozone injury on plants at the site could use one or more of the following bioindicator species: tree-of-heaven (an invasive exotic), spreading dogbane, common milkweed (*Asclepias syriaca*), redbud, white ash, yellow-poplar, American sycamore, black cherry, cut-leaf coneflower, American elder, and northern fox grape.

Geologic Resources

Granite Outcroppings: Granite outcroppings exist on Kennesaw and Little Kennesaw Mountain. These areas provide habitat that supports a variety of Georgia state-protected plant species and species of special concern: openground draba (*Draba aprica*), green rockcress (*Arabis missouriensis*), and Stone Mountain Mint (*Pycnanthemum curvipes*) (Chris Hughes, personal communication, 2003).

Species of Concern (Threatened, Endangered, Rare, Special)

Beavers: There appears to be an increase in the beaver population. As the beavers create their dams, distribution and water quality is altered. Beavers, though native to the region, are considered a nuisance species at KEMO (Willie – I made this up... is it true, and if so is it written down anywhere that I can cite it?).

Deer: I wrote down deer but have no additional data here... Excessively high deer populations reduce forest under story species due to grazing and ultimately lead to low or no forest regeneration.

Exotic / Invasive Species

Southern Pine Beetle: Occurs within the park and is a potential threat to other internal stands as well as those on neighboring lands. Standard BMPs call for cutting all pines within 150 m of infested trees when they are identified. Reintroduction of fire, which is a potential control for southern pine beetles, is not a management option at KEMO due to WUI and smoke concerns. Pine beetles were first identified within the park in 1993 and have since killed off thousands of pine trees throughout the park. The resulting increase in fuels lying on the forest floor pose an increased fire risk.

Exotic Plants: Common species include mimosa, garlic mustard, privet, tree of heaven, Japanese honeysuckle, and kudzu. Escaped cultivars from nearby private lands are also a concern. KEMO is one of fourteen parks covered in the exotic plant management module currently being managed by CUIS.

Exotic Animals: Fire ants.

Habitats & Communities

Birds: KEMO was the first designated Globally Important Bird Area in Georgia. The park's location at the southern terminus of the Appalachian Mountains provides a unique vantage point for viewing birds year-round, but particularly during spring and fall migrations. Bird watchers make up a significant portion of the visitors who come to KEMO.

Park NR Management

Fire Management: Much effort is being concentrated on fuels reduction on 105 acres within the park. Mechanical removal of fuels is the only viable means by which to reduce fire threat, but the degree to which these efforts mimic natural processes is unknown.

External Stressors

Adjacent Land Use: Surrounding land use was historically rural. However, because of KEMO's location in northwest Atlanta, the natural resources are under constant pressure from nearby suburban land use, and development of new lands into such uses. Inholdings within the park include significant developments (subdivisions). Other pressures originating from adjacent lands include sources of exotic plants and animals, automobile traffic, and traffic related to the nearby Cobb County landfill (located ~1 mile to the south of the park). Development pressure in and around the park is also a root cause of sedimentation into both John Ward Creek and Noses Creek, both of which flow through the park's boundaries. The Anderson Farm development to the ENE of the park is large new development currently underway.

Dobbins Air Force Base: KEMO is located on the flight path for Dobbins Air Force Base. Increased air traffic over the park causes increased noise and air pollution.

Other Issues

Encroachment: High degree of shared boundaries with private landowners has resulted in the creation of multiple social trails, particularly along the southwest boundary of the park.

Visitor Use: KEMO constitutes an important outdoor recreation resource to over 3.7 million people located in the metropolitan Atlanta. The primary use is recreation – jogging and walking. KEMO, along with CHAT, constitute 60-70% of the green space available to Atlanta residents. The park's green space significantly improves the quality of life by serving as a sanctuary as well as providing a variety of outdoor recreation opportunities such as hiking, birding, and nature viewing.

Dumping: The dumping of trash and other refuse by adjacent land owners and developers is an all too common occurrence at KEMO.

Moore's Creek National Battlefield

Park Description

This 87-acre park preserves the site of the Revolutionary War battle of Moore's Creek Bridge, fought February 27, 1776, between loyalists supporting the British Crown and patriots of North Carolina. The battlefield is located 20 miles northwest of Wilmington, NC, within the inland Carolina coastal plain.

Park Mission relative to Natural Resource Management

In recent years, natural resources management at MOCR has focused on restoring natural fire regimes, restoring longleaf pine and savannah communities, and removal of exotic invasive plants.

Natural Resources Issues

Environmental Setting	Resources	Agents of Change
<u>Water Resources</u>	<u>Species of Concern</u>	<u>Park NR Management</u>
<ul style="list-style-type: none">Moore's Creek	<ul style="list-style-type: none">State Listed / T&E Plants	<ul style="list-style-type: none">Fire Management

<ul style="list-style-type: none"> • Water Quality • Natural Hydrology • Artesian Springs 	<ul style="list-style-type: none"> • Native Grasses 	<ul style="list-style-type: none"> • Exotic Plant Removal • Longleaf Pine Restoration • Longleaf Pine - Savannah Wetland Restoration
<u>Air Resources</u>	<u>Exotic / Invasive Species</u>	<u>External Stressors</u>
<ul style="list-style-type: none"> • Air Quality 	<ul style="list-style-type: none"> • Privet, Wisteria, and others. • Fire Ants 	<ul style="list-style-type: none"> • Adjacent Land Use
<u>Geologic Resources</u>	<u>Habitats & Communities</u>	<u>Ecosystem Functions</u>
<ul style="list-style-type: none"> • Stream Channel Geomorphology • Springs and Seeps 	<ul style="list-style-type: none"> • Riparian Forests • Longleaf Pine (Sandhill) Communities 	
<u>Weather & Climate</u>	<u>Unique Areas</u>	<u>Other Issues</u>
<ul style="list-style-type: none"> • Hurricanes 	<ul style="list-style-type: none"> • Savanna / Wetland 	<ul style="list-style-type: none"> • Rare plant poaching

Water Resources

Moores Creek: This black water stream, averaging 30 feet in width, forms the western boundary of the park, and represents a resource of both natural and cultural significance. Flow within Moores Creek is tidally influenced. Moores Creek is a freshwater system, but during high tide water “backs up” causing a reversal of flow within the boundaries of MOCR. During extremely wet years or during large rain events, the storage capacity of the watershed can cause floodwaters to cover portions of the causeway, boardwalk, and the lowest decking portions of the bridge.

Water Quality: Affects of adjacent land uses and other agents of change on water quality are unknown, but are assumed to have minimal effect on Moores Creek at this time.

Natural Hydrology: The savannah tract of MOCR was historically ditched to provide areas suitable for recreation, as well as to provide drainage from the visitor center parking lot. As a part of restoration efforts in the longleaf pine-savannah wetland beginning in 1996, hydrologic restoration began to better mimic natural hydrologic conditions. Fourteen shallow groundwater wells are located within the wetland to monitor groundwater levels in response to the restoration efforts.

Artesian Springs: Three artesian springs have pipes inserted and one was used as a drinking fountain in the 1940s – 1950s. None are currently used as public drinking water sources today, but all still have above ground pipes / valves in place.

Air Resources

Air Quality: MOCR is designated a class II air shed under the Clean Air Act. Under class II, modest increases in air pollution are allowed beyond baseline levels for particulate matter, sulfur dioxide, nitrogen and nitrogen dioxide, provided that the national ambient air quality standards, established by the Environmental Protection Agency (EPA), are not exceeded. Principal sources of air pollutants in the park vicinity are industry emissions from nearby Wilmington (National Park Service 2004a).

Ozone: The risk of foliar ozone injury at Moore’s Creek National Battlefield is moderate (National Park Service 2004a). The Sum06 threshold is satisfied annually while the W126 threshold is satisfied only in the highest exposure years. The N-values indicate that exposures to 80 to 100 ppb vary considerably among years. Months of low soil moisture occur independent of the level of ozone and can significantly constrain the uptake of ozone. It is anticipated that the risk of injury would be greatest in years when high levels of ozone happened to occur when soil moisture conditions favor its uptake by plants. A program to assess the incidence of foliar ozone injury on plants at the site could use one or more of the following bioindicator species: redbud, yellow-poplar, American sycamore, black cherry, and American elder.

Geologic Resources

Stream Channel Geomorphology: Natural cut banks within Moores Creek potentially threaten the stability of developed features on the cultural landscape – the causeway and reconstructed historical Moores Creek Bridge site (historic bridge abutments are buried on each side of the creek bank at the bridge crossing site). Geomorphic studies conducted by U.S. Geological survey indicated that the current vegetation communities within the swamp woodlands and pools within the river should serve to dissipate erosional forces that might threaten the bridge site or the existing stream channel, but soil loss and cutbank migration might prove to be of long-term concern for the causeway, which is considered an historic structure.

Soils: Soil series represented within the region include Grifton (67%), Meggett (17%), Invershiel (8%), and other soils of minor extent (8%). Park soils are generally coarse-loamy, poorly drained and nutrient-poor (National Park Service 2003e).

Weather & Climate

Hurricanes: High winds and flood waters from hurricanes have caused repeated damage to natural (and cultural) resources at MOCR. The combined effects of Hurricanes Bertha and Fran (1996) resulted in the park closing for more than 40 days (Capps and Davis 1999).

Species of Concern (Threatened, Endangered, Rare, Special)

State Listed / Rare Plants: Two state listed plant species: the threatened Carolina bogmint (*Macbridea caroliniana*) and the endangered Carolina grass-of-parnassus (*Parnassia caroliniana*). Both are known to exist within the park within the longleaf pine-savanna wetland within the park. Other rare species known to exist at the park include springflowering goldenrod (*Solidago verna*), which inhabits mesic to moist pinelands and pocosin ecotones, sarvis holly (*Ilex amelanchar*), which inhabits blackwater swamps and riverbanks and clay-based Carolina bays, and Venus flytrap (*Dionaea muscipula*) (Sieren 1982).

Native Grasses: Several native grass species are found within the park: wiregrass (*Aristida stricta*), cutover muhly grass (*Muhlenbergia expansa*), Carolina dropseed (*Sporobolus pinetorum*), and toothachegrass (*Ctenium aromaticum*). Park management efforts include reintroduction of these species from locally available seed sources from partnering lands managed by the State and The Nature Conservancy. Reintroduction efforts are currently focused within areas to be managed by prescribed burning as most of these species are fire dependent.

Exotic / Invasive Species

Exotic Plants: Historic home sites in the northeast corner of MOCR have served as sources for populations of privet, wisteria, mimosa, and Japanese honeysuckle. Populations of these species can potentially spread to other areas within the Park if left unchecked. Current eradication efforts have relied on manual removal by volunteer inmate crews.

Fire Ants: Fire ants are pervasive pests throughout the park, particularly within the cultural landscapes.

Habitats & Communities

Longleaf Pine (Sandhill) Communities: Ranges in elevation from 3 to 5 feet; contains longleaf and loblolly pine, oak, hickory, Georgia beargrass (*Nolina georgiana*), and prickly pear cactus, with thick hardwood brush.

Swamp Woodlands: Located adjacent to Moores Creek at an elevation of 3 to 4 feet above sea level; cypress, willow (*Salix* spp.), and water ash (*Fraxinus carolineana*) predominate.

Unique Areas

Longleaf Pine – Savannah Wetland: Largely created from drained swamp; contains grasses, vascular plants and scattered longleaf pine, with invasive hardwood brush and exotic vegetation.

Park NR Management

Fire Management: The current fire management plan calls for prescribed burning in several portions of the park to maintain ecosystem function and plant community diversity (National Park Service 2003e). Of primary concern is the use of fire to encourage recruitment and growth of many fire dependent grasses whose distribution is currently limited within the region such as wiregrass, cutover muhly grass, Carolina dropseed, and toothachegrass. Secondly, fire will be used to suppress growth of fire intolerant species such as loblolly pine and boxelder (*Acer negundo*). Initial plans for burning call for fall burns once every 1-3 years evolving to a schedule of once every 5-7 years after the first few burn cycles.

Exotic Plant Removal: Moores Creek National Battlefield is one of thirteen parks included in the Southeast Coast Network's Exotic Plant Management Module being managed by Cumberland Island National Seashore.

Longleaf Pine Restoration: It is the Park's goal to convert stands of loblolly pine to longleaf pine upon completion of the Cultural Landscape Report and its associated management recommendations. In the early 90s, Moores Creek National Battlefield planted roughly 1000 longleaf pines, primarily in stands near the entrance and within the historical HWY 210 road bed, which cuts across the northern portion of the Park. MOCR hopes to plant 500 longleaf pines per year beginning in FY04 in combination with mechanical thinning and reintroduction of fire. The TarHeel trail area is targeted for reintroduction efforts in FY05.

Longleaf Pine-Savannah Wetland Restoration: Restoration of the longleaf pine-savannah wetland area consists of restoration of natural hydrology, reintroduction of fire, and reintroduction of native grass species following prescribed burns (Crighton and Sutter 2000).

External Stressors

Adjacent Land Use: International Paper owns significant holdings on the south side dominated by loblolly pine plantations. In the short term, this represents an ongoing source population for loblolly pines that could affect efforts to restore longleaf pine communities. In the long term, the parcel of land might be subject to development pressures that could affect park resources.

Other Issues

Rare Plant Collecting: Collection activities from the scientific community and those (illegal) activities from rare plant enthusiasts threaten the extant populations of rare plants still found within the unique habitats of MOCR.

Ocmulgee National Monument (OCMU)

Park Description

OCMU is located in central Georgia, in Bibb County. The main park unit, consisting of approximately 690 acres, is bordered on three sides by the city of Macon. It is accessed by heavily-traveled U.S. Highway 80. The Ocmulgee River runs along the southwestern boundary of the unit. Walnut Creek flows through the northeastern portion of the unit and then along its southeastern boundary, emptying into the Ocmulgee River at the southernmost point of the unit. The Ocmulgee River Bottoms, comprising the southern portion of the unit, constitute a low-lying

floodplain with an average elevation of about 290 feet above sea level, which is inundated for several months each year.

The detached Lamar unit, consisting of approximately 45 acres, is located approximately two and one-half miles to the southeast of the main park unit. It is accessed by an unnumbered county road (Confederate Way). It is also classified as low-lying floodplain, with an average elevation of about 280 feet above sea level.

Park Mission relative to Natural Resource Management

Ocmulgee National Monument sits on the “Fall line,” the transition between the rolling piedmont and the flat coastal plain. A portion of the monument is within the city limits of Macon, GA. The Ocmulgee River comprises the boundary on one side of the monument. Ocmulgee National Monument preserves the history of the people of the Southeast; artifacts have been found dating back 10,000 years. The visible features are mounds, built by the Mississippians who lived here from approximately 900-1100 AD.

The natural resources of the park have been heavily impacted by human activities, including I-16 and its associated berm, which has essentially cut off the river from its floodplain and disrupted the natural flow of the area. Despite this, and its proximity to Macon, Ocmulgee has a surprising amount of wildlife present. This is probably a result of a corridor, or what is known locally as the “Greenway,” connecting the monument to other natural areas south of the monument. Numerous bird species are present in the monument, either feeding or nesting or both. Migratory birds utilize the area as a stopover during spring and fall migrations. The endangered wood stork feeds here during summer months. Numerous other wildlife live here, including white-tailed deer, American beaver (*Myocastor canadensis*), bobcat, alligators (*Alligator mississippiensis*), and various reptiles and amphibians. Recreational fishing is allowed, with largemouth bass and bream being two common catches. Within the last eight years, coyotes (*Canis latrans*) have entered the monument. What effect this will have is unknown. Exotic species include nutria, fire ants, feral pigs, as well as domestic dogs and cats. Vegetative exotics include privet, Japanese honeysuckle, and kudzu.

Natural Resources Issues

Environmental Setting	Resources	Agents of Change
<u>Water Resources</u>	<u>Species of Concern (TERS)</u>	<u>Park NR Management</u>
<ul style="list-style-type: none"> • Water Quality • Streams • Water Quantity • Natural Hydrology 	<ul style="list-style-type: none"> • Reptiles & Amphibians 	<ul style="list-style-type: none"> • Fire Management • Exotic Species Management
<u>Air Resources</u>	<u>Exotic / Invasive Species</u>	<u>External Stressors</u>
<ul style="list-style-type: none"> • Air Quality • Ozone 	<ul style="list-style-type: none"> • Feral Hogs • Exotic Plants • Other Feral Animals • Exotic Animals • Southern Pine Beetle 	<ul style="list-style-type: none"> • Adjacent Land Use • Road Construction • Sewer Lines • Railroad Maintenance
<u>Geologic Resources</u>	<u>Habitats & Communities</u>	<u>Ecosystem Functions</u>
<ul style="list-style-type: none"> • Stream Geomorphology 	<ul style="list-style-type: none"> • Wetlands 	<ul style="list-style-type: none"> • Fire
<u>Weather & Climate</u>	<u>Unique Areas</u>	<u>Other Issues</u>
<ul style="list-style-type: none"> • Flooding 		<ul style="list-style-type: none"> • Visitor Use Impacts

Water Resources

Streams: Two major streams flow through OCMU – the Ocmulgee River and Walnut Creek. Ocmulgee National Monument has jurisdiction over half of the Ocmulgee River along its border.

Water Quality: Degradation of water quality is a major concern at OCMU. Walnut Creek is currently on EPA's 303d list for non-attainment of designated uses, and frequently appears to be carrying heavy silt loads. Fecal coliform counts have been recorded in excess of 50,000 ppm, and is likely the result of non-point-source inputs of nutrients. Historical sewage lines and disposal sites might also contribute to nutrient loading, however. Litter from upstream and from the highways that run through the Park is also a source of degradation to riverine and riparian habitats. A sewage lift station and its associate pipes are located within the park. In the past these pipes have had major sewer leaks; pipe restoration is now near completion.

Water Quantity: The headwaters of the Ocmulgee River system originate in the Metropolitan Atlanta area. With the increasing growth in Atlanta, the demands for freshwater supplies are expected to continue. Pressure to impound headwater streams to create water supply reservoirs has the potential to reduce the amount of water that ultimately makes it to Ocmulgee National Monument.

Natural Hydrology: The berm surrounding I-16 potentially diverts stream flows to a point that influences natural wetland communities. Water that at one time flowed via sheet-flow through wetlands is now diverted through four culverts. The natural hydrology at OCMU is poorly understood at this point, including the natural flood frequency.

Air Resources

Air Quality: OCMU is designated a class II air shed under the Clean Air Act. Under class II, modest increases in air pollution are allowed beyond baseline levels for particulate matter, sulfur dioxide, nitrogen and nitrogen dioxide, provided that the national ambient air quality standards, established by the Environmental Protection Agency (EPA), are not exceeded. Vegetation at OCMU is at risk of ozone injury, where interpolated values are 21-39 ppm-hrs. Principal sources of air pollutants in the park vicinity include industrial emissions from Macon and Atlanta, and motor vehicle emissions. Also, surface water quality monitoring has revealed elevated levels of a number of heavy metals, so deposition of airborne toxics might be of concern for the Park (National Park Service 2002c).

Ozone: The risk of foliar ozone injury to plants at Ocmulgee National Monument is high (National Park Service 2004a). The levels of ozone exposure consistently create the potential for injury, however dry soil conditions may reduce the likelihood of injury in a high exposure year. Levels of exposure capable of producing foliar injury also occur under conditions of minor drought and normal soil moisture. The probability of foliar injury developing may be greatest during years in which ozone levels are somewhat reduced but still exceed the thresholds, and soil moisture levels are normal or under mild drought and do not significantly constrain the uptake of ozone. A program to assess the incidence of foliar ozone injury on plants at the site could use one or more of the following bioindicator species: redbud, yellow-poplar, American sycamore, black cherry, American elder, crownbeard, and northern fox grape.

Geologic Resources

Stream Geomorphology: Tropical Storm Alberto, which deposited many inches of rain in 1994, caused significant flooding in the Macon area and as a result, portions of Walnut Creek “jumped channel” and the previous channel is now backwater. Although now in naturalized conditions, the degree to which the geomorphic changes were driven by road placement and design is unknown, as well as what might be expected during future flooding events.

Species of Concern (Threatened, Endangered, Rare, Special)

Reptiles and Amphibians: Recent inventories conducted by University of Georgia Savanna River Ecology Lab have indicated that the reptile and amphibian communities are much more diverse than previously known, likely due the park's location on the fall line.

Birds: Ocmulgee National Monument is frequently visited by the Macon Audubon Society and other avid birders.

Exotic / Invasive Species

Feral Hogs: Feral hogs present a threat to both natural and cultural resources through their rooting activities. OCMU has an active trapping and eradication program that has removed more than 150 individuals to date. However, the Park is likely to continue receiving individuals from source populations outside its boundaries (the wetlands and Bond Swamp NWR to the Southeast).

Exotic Plants: Several exotic plant species are found at OCMU, with many seed sources present off-site. Specific species of known management importance include privet, which is located primarily within the wetlands, kudzu, which is not thought to be currently advancing, and Chinaberry, which has been controlled where it is affecting cultural resources. Tree of heaven populations have been expanding this past year possibly due to heavier precipitation than seen during the last several years. Most species have been introduced to adjacent lands as a result of landscaping or ornamental efforts.

Other Feral Animals: Feral dogs and cats are both present at OCMU. Feral dogs are assumed to most frequently be stray or abandoned pets. Feral cats are reproducing and pose a potential threat to migratory songbirds and reptile & amphibian populations.

Exotic Animals: Fire ants are present in the park and pose a threat to native ant species as well as potentially degrade cultural resources [I have no idea if this is true... Thoughts?] and visitor experience.

Southern Pine Beetle: A southern pine beetle occurs within the park and have historically caused heavy damage to the Park's loblolly pine stands. Standard BMPs call for cutting all pines within 150 m (?) of infested trees when they are identified. The effectiveness of mechanical fuel removal at reducing future outbreaks of pine beetle are unknown.

Habitats & Communities

Wetlands: Much of the existing acreage of OCMU is wetlands. To the southeast is a large tract of undeveloped wetlands considered to be one of the largest peat bogs in the Southeast. The parcel of lands that contain those wetlands is under consideration for future acquisition by the park and if acquired will be a significant natural resource.

Park NR Management

Fire Management: Currently the park is reducing fuel loads through mechanical removal and grinding efforts. The Park has recently completed its fire management plan (draft), which calls for the use of prescribed fire or non-fire applications to protect and maintain the prehistoric landscape, reduce hazard fuels accumulations, control exotic plant species, protect soil resources, and maintain safety relative to adjacent lands (National Park Service 2003f).

Exotic Plant Management: Ocmulgee National Monument is one of fourteen park units included in the Southeast Coast Network's Exotic Plant Management module currently being managed by Cumberland Island National Seashore.

External Stressors

Adjacent Land Use: The city of Macon, GA is located adjacent to the park to the Northwest, and is a major source of point- and non-point-source contaminants into both the Ocmulgee River and Walnut Creek.

Development pressures associated with Macon are thought to be the largest threat to environmental quality at OCMU. Robbins AFB is also located nearby. Immediately to the southeast is a large tract of undeveloped wetlands that contains one of the largest remaining peat bogs in the region. A bit further to the southeast is Bond Swamp NWR. The lands to the southeast are likely a major refuge for feral hog populations.

Road Construction: Design options for the Fall Line Bypass are currently underway and most options call for major portions of the road to pass through or adjacent to the Park. Increased traffic in the area likely will increase non-point contaminant pressures as well as affect air quality.

Trail Management: The riverfront along the Ocmulgee River is currently scheduled to be developed into a greenway trail that will connect with other portions of the trail system in Macon.

Railroad Maintenance: A CSX railroad line passes through OCMU, and routinely sprays herbicides to control plant growth on and adjacent to the railroad bed. Effects on native flora and fauna are unknown.

Ecosystem Functions

Fire: Ecological and meteorological evidence indicates that lightning-caused fires were a major environmental force shaping the vegetation of North America for millions of years prior to human habitation (van Lear and Waldrop 1989). Fire-adapted ecosystems developed, as did individual plant species dependent upon or adapted to wildland fire. Frost (1998) maintains "...fire once played a role in shaping all but the wettest, the most arid, or the most fire-sheltered plant communities of the United States."

Although it is difficult to substantiate purposeful landscape burning by American Indians from the archeological record, diaries, letters, reports, and books by eyewitnesses of Indian fire use from the 1600s to the 1900s have yielded considerable evidence that American Indians did use fire to modify ecosystems, with profound cumulative effects on the landscape(Barrett 1980;Barrett 1981;Russell 1983;McClain and Elzinga 1994;Whitney 1994). At the time of European contact, many eastern deciduous forests were open and park-like, with little undergrowth, the result of regular burning by Native Americans (Day 1953;Olson 1996;Kay 2000;Bonnicksen 2000).

Other Issues

Visitor Use Impacts: With the creation of the greenway trail through the park, visitor use might to increase. The impacts (if any) of increased traffic are unknown.

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

Park Description

Timucuan and Fort Caroline National Memorial are administered as one park. Fort Caroline NM includes approximately 138 acres located along the St. Johns River within the city of Jacksonville and Duval County, Florida. Located primarily on a bluff overlooking the river that rises to a height of nearly 90 feet, the park consists

of mixed species forest with fresh water wetlands, preserving an enclave of representative species native to the North Florida-South Georgia community.

Timucuan Ecological and Historical Preserve covers approximately 46,000 acres between the St. Johns and Nassau rivers and is situated entirely within Duval County and the city limits of Jacksonville, FL. The southern third of the Preserve lies at the mouth of the extensive St. Johns River watershed, which encompasses parts of Duval and several other counties for approximately 300 miles to the south. The St. Johns River is heavily impacted by agricultural, industrial and urban pollution; however, marine tidal waters near its mouth serve to ameliorate pollution through dilution and flushing. Water quality is considered relatively good in the Preserve due to this flushing action. The northern two thirds of the Preserve lies within the Nassau River drainage basin, a small watershed that covers parts of Duval and Nassau counties. The Nassau River watershed has not yet experienced the concentrated urban and industrial growth found along the St. Johns River; still, portions of the watershed exhibit poor water quality. The area surrounding the Preserve to the west and north is predominantly marsh and low uplands utilized for timbering, residential and agricultural uses.

Park Mission relative to Natural Resource Management

To preserve and interpret the wetlands and historic and prehistoric resources in the St. Johns Valley, Florida including the historic la Caroline settlement at Fort Caroline and to permit and manage cooperatively with other agencies the resource-based recreation that does not impair resource values (National Park Service 2000b).

The Preserve:

- Protects one of the largest, relatively healthy and undeveloped biologically diverse areas representing the coastal marshes of the Southeast U.S.
- Provides habitat for diverse species of animal life including rare or threatened and endangered species.
- Includes prehistoric archeological sites containing some of the oldest evidence of human habitation found to date in Florida.
- Initiates cultural interactions and exchanges influencing the beliefs, economies, and social communication between many cultures spanning 400 years.
- Protects natural areas that provide opportunities for solitude, recreation and expansive relatively unspoiled vistas.
- Contains one of the earliest, long term European settlements in what became the United States.

Natural Resources Issues

Environmental Setting	Resources	Agents of Change
<u>Water Resources</u>	<u>Species of Concern (TERS)</u>	<u>Park NR Management</u>
<ul style="list-style-type: none"> • Water Quality • Water Quantity • Rivers 	<ul style="list-style-type: none"> • Wood Stork • Gopher Tortoise • Manatees 	<ul style="list-style-type: none"> • Exotic Plant Management
<u>Air Resources</u>	<u>Exotic / Invasive Species</u>	<u>External Stressors</u>
<ul style="list-style-type: none"> • Air Quality • Ozone 	<ul style="list-style-type: none"> • Exotic Plants • Feral Animals • Exotic Animals 	<ul style="list-style-type: none"> • Jetties • Dredging • Adjacent land use
<u>Geologic Resources</u>	<u>Habitats & Communities</u>	<u>Ecosystem Functions</u>
<ul style="list-style-type: none"> • Sand Transport • Shoreline Erosion 	<ul style="list-style-type: none"> • Salt Marshes • Maritime Forests 	

Environmental Setting	Resources	Agents of Change
<u>Weather & Climate</u>	<u>Unique Areas</u>	<u>Other Issues</u>
<ul style="list-style-type: none"> Hurricanes 	<ul style="list-style-type: none"> Oak/Scrubs Spanish Pond 	<ul style="list-style-type: none"> Visitor Use Impacts

Water Resources

Water Quality: Water quality impacts include increased nutrients, metals, and sediment from upstream sources (and in the case of metals, potentially from atmospheric sources). Most inputs are the result of non-point-sources from the Jacksonville, FL area. Salinity concentrations in the estuary are also important as they are dependent on a balance between freshwater inputs, which are affected by precipitation, groundwater withdrawals, and upstream water uses.

Surface water resources in the TIMU and FOCA study area include the Atlantic Ocean; portions of the Intracoastal Waterway; St. Johns, Fort George, Nassau, South Amelia, and other rivers; Dunn, Clapboard, Browns, Cedar Point, Edwards, and many other creeks; Sample, Clapboard, and numerous other swamps and marshes; many interconnected lakes and lagoons; and some small impoundments. Many of these water resources are influenced by tidal flow and contain fresh and saline waters in transition. Based on the data inventories and analyses contained in this report, surface water quality within the study area appears to have been impacted by human activities. Potential anthropogenic sources of contaminants include municipal and industrial wastewater discharges; commercial and residential development; agricultural operations; marine traffic; storm water runoff; recreational activities; and atmospheric deposition (National Park Service 2002a).

Water Quantity: Regional shallow groundwater withdrawals and deep-water withdrawals from the Floridan Aquifer are potentially major drivers of wetland and salt marsh ecosystems in both the short and long terms. As regional population growth continues, consumptive uses of fresh water from surficial and below-ground sources are likely to increase, and might potentially affect multiple Park resources.

Rivers: Most streams within the park are tidal creeks that flow through the salt marsh. However, both the St. Johns and Nassau River systems drain into the park providing the majority of freshwater inputs into the intertidal salt marsh ecosystem. Also through the park is the Intracoastal Waterway.

Air Resources

Air Quality: TIMU is a class II park, with minimal air-quality related issues due to prevailing air currents. Two very large coal and petroleum coke fire power plants are located on the park boundary. These two plants produce over 83,700 tons per year of emissions and an unknown amount of gaseous mercury. Besides ozone, these plants produce particulate, NO_x and SO₂ emissions. No monitoring is conducted in the vicinity of the Preserve and prevailing winds do move these plumes toward the preserve a substantial amount of time. The impacts to preserve resource are not evaluated due to the lack of monitoring devices in the preserve.

Ozone: The low levels of ozone exposure and the periodically dry soil moisture conditions at Timucuan Ecological and Historic Preserve make the risk of foliar ozone injury to plants low (National Park Service 2004a). Although the Sum06 exposures exceed the threshold level for injury, the W126 do not since the N100 criteria are not satisfied. High ozone exposures occur during periods of several continuous months of mild to severe drought significantly reduce their effectiveness. Hourly concentrations of ozone exceed 80 ppb for a few hours each year and are unlikely to produce foliar injury to plants. If the level of risk increases in the future, a program to assess the incidence of foliar ozone injury on plants at the site could use one or more of the following bioindicator species: redbud, white ash, yellow-poplar, black cherry, and American elder.

Geologic Resources

Sand Transport: Sand aggradation has restricted historic flows within the Fort George River system. Increased aggradation rates is likely a combination changes in upstream flows that historically flushed the system and jetties that have been constructed to maintain shipping channels along the Intracoastal Waterway.

Shoreline Erosion: Coastal shorelines at FOCA are at risk of erosion due to wave action associated with storm events, shipping and ongoing dredging of the St. Johns River. Along the Intracoastal Waterway (ICW), dredging and boating traffic (both commercial and pleasure), have an unknown impact to nearby marsh areas. A recent study comparing 1943 and 2000 aerial photographs indicate a significant loss (up to 19%?) of emergent vegetation along the ICW. Whether this loss is the result of rising ocean levels or sediment loss is unknown.

Weather & Climate

Hurricanes: [to be filled in later]

Species of Concern (Threatened, Endangered, Rare, Special)

Wood Storks: Currently no monitoring of wood stork rookeries is conducted by the preserve staff. Several colonies on neighboring lands are active and the preserve provides foraging areas. Population trends are unknown.

Gopher Tortoise: The gopher tortoise is a species of special concern present in the park. The impacts of urban development within and adjacent to the park reduces the availability of habitat for this species and isolates populations. Additional threats to the gopher tortoise result from declining habitat quality and fragmentation. Succession of sandhill habitat from past and current management practices reduces the availability of herbaceous food species needed by the tortoise.

Manatees: Present at the park, and are particularly at risk of harm due to interactions with watercraft.

Exotic / Invasive Species

Exotic Plants: Chinese tallow, kudzu, cogon grass (*Imperata cylindrica*), Bermuda grass, and air-potato (*Dioscorea bulbifera*) are all present on the park. Water hyacinth (*Eichhornia crassipes*) is also abundant in Spanish Pond at FOCA.

Feral Animals: Feral hogs, cats, and dogs are all present in the park. The impacts of feral cats on bird communities are unknown, but feral cats in natural areas typically result in *some* impact to birds (Watson 2003a). Unleashed dogs have been also observed to disturb feeding and resting shorebirds. Monitoring for gypsy moth and Asian moth is ongoing, though to date no observations have been recorded.

Exotic Animals: Hogs are problematic in some portions of the preserve and soil surface damage has been observed to increase exotic plant expansion. Impacts of hogs on other species are not monitored. Armadillos are also present, but their status as “exotic” is not known—there recent appearance in the Park might be the result of a natural range expansion eastward. Fire ants are also present in the park.

Habitats & Communities

Salt Marshes: Timucuan Ecological and Historic Preserve is one of eight network parks with significant salt marsh communities that have experienced varying levels of retraction in recent years due to potential stressors such as decreased water quality and saltwater intrusion. The salt marsh communities of TIMU represent one of the remaining “type” communities along the southeastern seaboard. Determining baseline conditions of salt marsh vegetation communities is both a high-priority for Park managers, and will serve as a potential comparison for future monitoring efforts within the Southeast Coast Network. Both cordgrass and rush species are present within the park, denoting community shifts along natural salinity gradients.

Maritime Forests: Also referred to as coastal hammocks; dominated by live oak, scrub oak, and cabbage palm. Found primarily on barrier islands, Big Talbot Island in particular. Fort Caroline also has a relatively undisturbed tract.

Oak/Scrubs: Similar to maritime forest community, but located further inland. Contains species that are less salt tolerant and more drought tolerant than the coastal hammocks.

Shell Midden Communities: Dominated by red cedar, located on historic shell middens and islands where soils are more calcareous than upland and barrier island soils.

Unique Areas

Spanish Pond: Spanish pond is a natural freshwater pond and associated wetland, primarily fed by sheet flow.

Park NR Management

Exotic Plant Management: TIMU is included in the Florida EPMT unit, managed out of Miami. The park has had a program of plant control that has varied in intensity based on funding of seasonal botanist and EPMT funding. Targeted species include mimosa (*Albizia julibrissin*), Chinese tallow (*Sapium sebiferum*), Chinese wisteria (*Wisteria sinensis*), air potato (*Dioscorea bulbifera*), chinaberry (*Melia azedarach*), winged yam (*Dioscorea atropurpurea*), kudzu (*Pueraria montana*), water hyacinth (*Eichhornia crassipes*), cogon grass (*Imperata cylindrical*), old world climbing fern (*Lygodium scandens*), and coral ardisia (*Ardisia crenata*).

External Stressors

Jetties: Jetties to the north and south of the St. Johns River Inlet modify flows of both sediment and water. As a result of modified flows, natural “flushing” of the salt marsh has decreased resulting in increased sedimentation, particularly in the Fort George River inlet. Also, reduced flows of saline water have the potential to shift the salinity gradient and subsequently affect distributions of salt marsh plant species (*Juncus* and *Spartina* spp.).

Dredging: The boundaries of TIMU include portions of the Intracoastal Waterway, which is routinely dredged as a part of channel maintenance. The effects of dredging on natural hydrology, fate of contaminants within dredge spoil, and impacts on native vegetation communities as a result of dredging activities are unknown. Contaminated sediments are known to occur in some areas of the Preserve, but the extent of contamination and the effects of sediments resuspension are not known. This is of particular concern as several major dredging projects are proposed in the near future.

Adjacent Land Use: Duval is one of the fastest growing counties in Florida. The Preserve is located in an area that has historically experienced limited development and growth due to lack of easy and quick access. Development and recreational use pressures have increased, however, with the opening of a six-lane bridge in 1989 and ongoing construction of a major highway linking the bridge to the interstate highway system.

Other Issues

Visitor Use Impacts: Personal watercraft use within the park poses a potential threat to natural resources.

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