



AFFECTED ENVIRONMENT

INTRODUCTION

This chapter describes the resources that could be affected in the nine national parks participating in this draft *Exotic Plant Management Plan and Environmental Impact Statement* (v). These parks include five in south Florida—Big Cypress National Preserve, Biscayne National Park, Canaveral National Seashore, Dry Tortugas National Park, and Everglades National Park, and four in the Caribbean—Buck Island Reef National Monument, Christiansted National Historic Site, Salt River Bay National Historic Park and Ecological Preserve, and Virgin Islands National Park.

The discussion of each resource begins with an overview of information and issues relevant to all nine parks. The discussion then narrows in focus: to minimize repetition, parks with similar characteristics for a given resource are discussed together. If a park faces unique conditions for a particular resource, a separate discussion is provided. As a result, the logical organization varies from one resource to the next.



NATIVE PLANTS / VEGETATION CATEGORIES

BIODIVERSITY

Biodiversity—The sum of all living organisms and the habitats in which they live.

Biodiversity, or biological diversity, is the sum of all living organisms and the habitats in which they live. Each of the more than 10 million species on earth is adapted to its unique niche in the environment. This niche, together with the physical factors that affect it, is called an *ecosystem*. Functioning ecosystems are vital to life: they regulate many of the chemical and physical systems that make clean air and water available, and they provide the oxygen that we breathe. The continued function of ecosystems depends on the continued health and vitality of the organisms that compose the ecosystem.

Exotic plants are a major threat to ecosystems, because they can change an entire habitat by crowding out native species and placing entire ecosystems at risk. Exotic plants rank second only to outright habitat destruction as a threat to biodiversity. Of the 1,880 imperiled species in the United States, almost 50% are endangered because of the effects of introduced species alone, or combined with other forces (Simberloff 2000).

Monotypic—Consisting of a single species; having only one representative.

In south Florida, exotic plants have dramatically altered some of the greatest ecosystems in the country. In Everglades National Park, for example, sawgrass has long dominated large regions, providing habitat for unique wildlife. Now, however, the exotic tree melaleuca often towers over the sawgrass and out-competes it for sunlight. As the melaleuca forms dense monotypic stands, soil elevations rise because of accumulating leaf litter. This litter inhibits the normal water flow and can cause ponding and water quality degradation. Melaleuca also changes the natural fire regime. Seasonal fires that previously swept through the marshlands doing little damage now burn hotter and longer because of the increased fuel source provided by the melaleuca (Gordon and Thomas 1997).

Approximately 40 distinctly different vegetation communities occur in the nine parks discussed in this draft EPMP/EIS. These communities have been classified under nine vegetation categories based on basic vegetative structure and functional similarities, such as wetland habitat versus upland habitat, or a dominance of forested species versus herbaceous species. The combinations of vegetation communities that form the nine vegetation categories are further described in this section. Table 25 shows the vegetation categories and the parks in which they occur. The vegetation category maps in appendixes A – I illustrate distribution of vegetation categories within each park.



TABLE 25: VEGETATION CATEGORIES IN THE SOUTH FLORIDA AND CARIBBEAN NATIONAL PARKS

Vegetation Category	Big Cypress National Preserve (acres)	Biscayne National Park (acres)	Canaveral National Seashore (acres)	Dry Tortugas National Park (acres)	Everglades National Park (acres)	Buck Island Reef National Monument (acres)	Christiansted National Historic Site (acres)	Salt River Bay National Historic Park and Ecological Preserve (acres)	Virgin Islands National Park (acres)	Total Acres
Agriculture / Disturbed Land / Developed Area (including roads)	4,797	174	527	1	7,852	0	7	46	373	13,777
Beach / Dune	0	58	199	58	2	11	0	3	58	389
Coastal Marsh	7,166	419	3,131	0	115,142	0	0	17	73	125,948
Grassland / Coastal Strand	943	less than 1	1,040	0	694	0	0	53	16	2,746
Mangrove	8,038	5,519	1,153	55	361,478	less than 1	0	48	73	376,364
Sawgrass Marsh / Wet Prairie / Freshwater Marsh	249,844	32	378	0	431,389	0	0	0	0	681,643
Shrubland	390	0	312	0	0	75	0	136	1,924	2,837
Upland Dry / Mesic Forest	61,563	1,615	7,231	0	10,852	103	0	134	5,460	86,958
Wetland Forest	393,867	22	646	0	20,112	0	0	3	1,178	415,828
Totals	726,608	7,839	14,617	114	947,521	190	7	440	9,155	1,706,490

Source: Vegetative coverage in Florida parks was based on Florida fish and Wildlife Commission data. Buck Island Reef National Monument coverage was based on NPS monitoring data. Salt River Bay National Historic Park and Ecological Preserve and Virgin Islands National Park coverage was based on National Oceanic and Atmospheric Administration (NOAA) biogeographic data.



Shrubland

Big Cypress National Preserve, Canaveral National Seashore, Buck Island Reef National Monument, Salt River Bay National Historic Park and Ecological Preserve, and Virgin Islands National Park

*Sclerophyllous—
Leathery type
leaves with a thick
waxy cuticle that
reduces water
loss in plants.*

This vegetation category includes sclerophyllous evergreen shrublands, mixed dry shrublands, gallery shrublands, thicket scrub, coastal scrub, thorn scrub, and coastal hedge. In the Virgin Islands, the “shrublands” category describes areas in dry locations at low elevations. Vegetation is usually 3 to 15 feet tall, multi-stemmed, and bushy. Many shrublands include thorny shrubs, cacti, and succulents that can tolerate thin, rocky soils; strong winds; and dry substrate. Conditions such as aspect, elevation, and past land use also determine the vegetative cover.

Gallery shrublands are found in small guts (gullies) and ravines and, because of the additional moisture, are often transitional areas that become gallery woodlands or forests. The mixed, dry shrublands are common on the islands and are characterized by a diverse mixture of tropical species and interspersed with cacti and agave, depending on the soil moisture. Coastal hedge in the Virgin Islands is similar to the coastal scrub on the east coast of Florida, as in the Canaveral National Seashore. These communities have adapted to the wind, salt air, and poor soil, and often support examples of species that would normally be much larger in more hospitable environments. In addition to being smaller, some species in coastal scrub and coastal hedge also develop small, highly cutinized leaves and twisted shapes that lean in the direction of the prevailing winds.

*Heavily cutinized
leaves minimize
evaporation from
the inner, juicy
tissue that can
retain and store
water over long
periods.*

Beach / Dune

Big Cypress National Preserve, Biscayne National Park, Canaveral National Seashore, Everglades National Park, Buck Island Reef National Monument, Salt River Bay National Historic Park and Ecological Preserve, and Virgin Islands National Park

Beaches, dunes, and coastal uplands are characterized as unconsolidated substrate comprised of sand and coarse calcareous detritus (remains of various organisms) that has been deposited by currents, waves, and wind. The vegetation categories start with the tidally influenced halophytic, xerophytic, pioneering species such as grasses such as sea oats with other grasses including cordgrass and beach grass. Forbs including morning glory, sea purselane, and sea rocket occur with small shrubs such as beach berry, beach elder, and verbena. In addition, herbs including dune sunflower and railroad vine are found in this habitat. Dunes are relatively undisturbed but high seas and overwash affect the distribution and relative succession of the species found here.

Grassland / Coastal Strand

Big Cypress National Preserve, Canaveral National Seashore, Everglades National Park, Salt River Bay National Historic Park and Ecological Preserve, and Virgin Islands National Park

This category includes dry prairies, coastal strands, coastal grasslands, and coastal uplands. Dry prairies of Big Cypress National Preserve and Everglades National Park are native grasslands occurring on very flat terrain and interspersed



with scattered cypress domes and strands, bayheads, isolated freshwater marshes, and hardwood hammocks. Dry prairies are characterized by many species of grasses, sedges, herbs, and shrubs, including saw palmetto, fetterbush, staggerbush, tar flower, gallberry blueberry, wiregrass, carpet grasses, and various bluestems. In south Florida, palmetto prairies, which consist of former pine flatwoods where the overstory trees have been thinned or removed, are also included in this category.

Coastal strand, coastal upland, or coastal grasslands occur on well-drained, sandy soils and include the typically zoned vegetation of the upper beach, nearby dunes, or coastal rock formations. Coastal strands are an early-succession community that occurs on the seaward or windward side of a dune between bare sand and the more stable hammock community. Coastal strand, coastal upland, or coastal grasslands generally occur in long, narrow bands parallel to the open waters of the Atlantic Ocean, such as on the barrier island, on recent dunes inland from coastal dunes in the Canaveral National Seashore or Gulf of Mexico, and along the shores of some saline bays or sounds in south Florida and the Virgin Islands. They are non-wetland communities on the coast, on land with enough elevation to be out of the influence of normal tidal inundations. These plants occupy areas formed along high-energy shorelines and are strongly affected by wind, waves, and salt spray. Vegetation typically consists of low growing vines, grasses, and herbaceous plants, with very few small trees or large shrubs.

Early successional herbaceous vegetation characterizes the foredune and upper beach, while a gradual change to woody plant species occurs in more protected areas toward land. Typical plant species include beach morning glory, railroad vine, saw palmetto, Spanish bayonet, sea grape, wax myrtle, cocoplum, and other tropical plants in southern Florida. Coastal strands only include the zone of early successional vegetation that lies between the upper beach, and more highly developed communities landward (FFWCC 2003).

Foredune—A dune ridge built up behind a coastline. Generally higher and more extensive than a beachridge.

Upland Dry / Mesic Forest

Big Cypress National Preserve, Biscayne National Park, Canaveral National Seashore, Everglades National Park, Buck Island Reef National Monument, Salt River Bay National Historic Park and Ecological Preserve, and Virgin Islands National Park

This category includes tropical hardwood hammocks, pine flatwoods, south Florida rocklands, mixed hardwood/pine forests, coastal hammock, xeric oak scrub, oak-saw palmetto scrub, drought-deciduous forests, semi-deciduous forests, gallery semi-deciduous forests, semi-evergreen forests, evergreen woodlands, gallery semi-deciduous woodlands, semi-deciduous woodlands, drought-deciduous woodlands, upland moist forests, and gallery moist forests.

Deciduous—Having leaves that fall off or are shed seasonally to avoid adverse weather conditions such as cold or drought.

Tropical hardwood hammock forests occur in south Florida and are characterized by tree and shrub species on the northern edge of a range that extends southward into the Caribbean. These forests are sparsely distributed along coastal uplands south of a line from about Vero Beach on the Atlantic coast to Sarasota on the Gulf coast. They occur on many tree islands in Big Cypress National Preserve, Biscayne National Park, Everglades National Park, and on uplands throughout the Florida Keys. These cold-intolerant tropical forests have very high plant



species diversity, sometimes containing over 35 species of trees and about 65 species of shrubs. Characteristic tropical plants include strangler fig, gumbo-limbo, mastic, bustic, lancewood, ironwoods, poisonwood, pigeon plum, Jamaica dogwood, and Bahama lysiloma. Live oak and cabbage palm are sometimes found within these forests. Tropical hammocks in the Florida keys may also contain lignum vitae, mahogany, thatch palms, and manchineel, which are extremely rare within the United States.

Coastal hammock occurs on barrier islands in Canaveral National Seashore inland from the coastal scrub zone where salt spray pruning is reduced and the stature of the vegetation increases. Live oak is the canopy dominant with red bay and cabbage palm often occurring. Shrubs of tropical affinity including nakedwood, lancewood, myrsine, and wild coffee may dominate the understory.

An additional pine flatwoods forest type occurs on exposed limestone formations in extreme south Florida where the south Florida variety of slash pine comprises the overstory and herbs, grasses, and tropical hardwood species make up the understory. These pine rocklands support a number of special status species.

Pinelands in south Florida include pine flatwoods and south Florida pine rocklands. Pine flatwoods are found in Big Cypress National Preserve and Canaveral National Seashore. The understory and groundcover within pine flatwoods and pine rocklands are somewhat similar and include several common species such as saw palmetto, gallberry, wax myrtle, and a wide variety of grasses and herbs. Cypress domes, bayheads, and freshwater marshes are commonly interspersed in isolated depressions throughout this community type, and fire is a major disturbance factor.

Scrubby flatwoods, another pineland type, occur on drier ridges and on or near old coastal dunes. Sand pine or slash pine dominate the overstory, while the groundcover is similar to the xeric oak scrub community.

Mixed hardwood/pine forests contain longleaf pine and slash pine in mixed association with live oak, laurel oak, and water oak, together with other hardwood species characteristic of upland hardwood hammocks and forests. These are often transitional areas that have occurred because of fire suppression or historic logging operations.

Xeric oak scrub is a xeric hardwood typically consisting of clumped patches of low growing oaks interspersed with bare areas of white sand, occurring on areas of deep, well-washed, sterile sands. Xeric oak scrub is dominated by myrtle oak, Chapman's oak, sand-live oak, and saw palmetto. Fire is important in setting back plant succession and maintaining viable oak scrubs.

Oak-saw palmetto scrub is a shrubland dominated by scrub oaks (*Quercus myrtifolia*, *Q. geminate*; *Q. chapmanii*), saw palmetto, and ericaceous shrubs including *Lyonia ferruginea*, *L. fruticosa*, *L. lucida*, and *Bejaria racemosa*. Shiny blueberry is a common small shrub, and Wiregrass a frequent herb. Soils are typically moderately well-drained Pomello or Orsino sands.



Dry/mesic forests and woodlands are the predominant land cover of the Caribbean parks. Woodlands are distinguished from forests by having a more open canopy of fewer trees. Many of the forests and woodlands grow on similar soils, but the vegetation composition is influenced by wind patterns, topography, aspect, rainfall, and length of dry season. Gallery forests and woodlands are found along streams and gullies (gullies) and have a somewhat different composition than the surrounding forests because of the additional moisture. The semi-deciduous forests generally occur in areas that receive more rainfall than those vegetated with the semi-evergreen forests and woodlands.

Agriculture / Disturbed Land / Developed Area

Big Cypress National Preserve, Biscayne National Park, Canaveral National Seashore, Dry Tortugas National Park, Everglades National Park, Buck Island Reef National Monument, Christiansted National Historic Site, Salt River Bay National Historic Park and Ecological Preserve, and Virgin Islands National Park

All agriculture areas, barren lands, mixed grasslands, drought-deciduous shrublands, shrub and brush lands, and exotic plants are included in this category.

In Florida, shrub and brush lands include many instances where natural uplands have been recently disturbed through clear-cutting commercial pinelands, land clearing, or fire, and are recovering through natural successional processes. Natural uplands could be characterized as an early condition of old field succession if the community is dominated by various shrubs, tree saplings, and lesser amounts of grasses and herbs. However, the community is likely dominated by Brazilian pepper, melaleuca, or other exotic plants. In Canaveral National Seashore earthen dikes which surround mosquito control impoundments are dominated by Brazilian pepper.

Drought-deciduous shrublands of the Virgin Islands are typically areas that have been disturbed through land use changes and have subsequently been overgrown predominantly by exotic plants, specifically, tan tan, or genip.

Mangrove

Big Cypress National Preserve, Biscayne National Park, Canaveral National Seashore, Dry Tortugas National Park, Everglades National Park, Buck Island Reef National Monument, Salt River Bay National Historic Park and Ecological Preserve, and Virgin Islands National Park

Mangrove forests develop in coastal areas subject to regular (or sometimes only occasional) tidal flushing, which produces elevated soil salinity. Each mangrove species has a different level of salt tolerance, which in part determines its location within the tidal zone. Mangroves grow best where wave energy is low and freshwater runoff contributes nutrients and helps maintain optimum salinity levels. As a transition zone from land to sea, they serve important ecosystem functions in shore stabilization and nutrient cycling. Mangrove forests also provide foraging and nesting sites for wading birds and are considered to be essential fish habitat for numerous fish and invertebrate species (Odum and McIvor 1990).



Mangrove communities are highly variable, but three species are common to all communities in the general project setting. These are red mangrove (*Rhizophora mangle*), white mangrove (*Laguncularia racemosa*), and black mangrove (*Avicennia germinans*). Buttonwood (*Conocarpus erectus*) is another species usually found in the landward fringe behind mangroves. The different types of mangrove ecosystems included in this category are mangrove fringe, mangrove forest and woodland, and mangrove shrubland. Mangrove fringe is a narrow line of mangroves along a shoreline, salt pond, waterway, or embayment. These areas are continually flushed of nutrients by the tides and do not receive the terrestrial nutrients that enrich the mangrove forests. Mangrove fringe communities are common in the Virgin Islands and south Florida parks.

Mangrove woodlands and forests are found at the shoreward extremes of tidally flooded areas, and the dominant species are usually black-and-white mangroves, but the woodlands have a less dense canopy. The forests and woodlands are continually enriched with terrestrial nutrients, and the trees can reach 30 feet.

Mangrove shrublands are found in areas where the vegetation is stressed by high-energy wave action or extremes in the environment. The dominant species in these areas is usually the red mangrove, and individual trees are usually less than 15 feet tall.

Coastal Marsh

Big Cypress National Preserve, Biscayne National Park, Canaveral National Seashore, Dry Tortugas National Park, Everglades National Park, Buck Island Reef National Monument, Salt River Bay National Historic Park and Ecological Preserve, and Virgin Islands National Park

*Halophyte—A
plant that is
adapted to grow in
salty soil.*

This category includes the salt marshes, salt flats, and salt ponds typically found around coastal areas, either in transitional areas between the land and sea, or in the more shallow areas around the coast. Seagrasses that are found in waters adjacent to these communities have also been included in this category as they may be indirectly affected by exotic plant management activities occurring in adjacent terrestrial areas.

*Hypersaline—Very
saline brines. Salt
concentration
greater than
sea water.*

Salt marshes are usually less diverse than freshwater marshes, and often support dense stands of only one or two species. The species composition is determined by site conditions such as water elevations, wave energy, salinity levels, and substrate. These factors vary significantly throughout south Florida and the Virgin Islands. Salt flat communities are usually characterized by a very sparse cover of herbaceous halophytes, most likely because of the high salinity levels. The hypersaline conditions in these areas usually prohibit exotic plant invasion.

Seagrasses are submerged aquatic vegetation found in some shallow waters of gulfs, bays, estuaries, and lagoons. Seagrass meadows are among the most productive ecosystems on earth. These plants usually occur as monocultures or as a mixture of the species, appearing as vast meadows on the shallow bottom.



Sawgrass Marsh / Wet Prairie / Freshwater Marsh
Big Cypress National Preserve, Biscayne National Park,
Canaveral National Seashore, and Everglades National Park

In freshwater marshes, wet prairies, and marl prairies the dominant species are herbaceous and the soils are usually saturated or inundated for at least one or two months during the growing season. These marshes and prairies comprise 33% of all Florida wetlands and 13% of all natural vegetation types in Florida, but are rare in the Virgin Islands, and do not exist in the Caribbean parks addressed by this draft EPMP/EIS.

The main species in this category include graminoids such as sawgrass, muhly grass, Florida bluestem, Elliot's love grass, and maidencane, as well as beak rush and spike rush. Although these wetlands are usually nutrient poor, they provide essential habitat and foraging areas for numerous invertebrates, birds, fish, reptiles, amphibians, and mammals (USGS 2004a).

*Graminoids—
Grasses and
grasslike plants.*

Wetland Forest

Big Cypress National Preserve, Everglades National Park, Biscayne National Park, Canaveral National Seashore, Salt River Bay National Historic Park and Ecological Preserve, and Virgin Islands National Park

This vegetation category includes mixed cypress strands, cypress sloughs, cypress domes, bay swamps, hardwood swamp forests, basin moist forests, mixed swamps, and shrub swamps.

Cypress swamps, strands, and sloughs are regularly inundated wetlands that form a forested border along large rivers, creeks, and lakes, or that occur in depressions as circular domes or linear strands. These areas are strongly dominated by either bald cypress or pond cypress, with scattered temperate and/or tropical hardwood species. Understory and ground cover are usually sparse because of frequent flooding, but they sometimes include such species as buttonbush, lizard's-tail, and various ferns. Cypress wetlands are the predominant wetland forest in this vegetation category and are extensive in the Big Cypress National Preserve and Everglades National Park.

Bay swamps contain broadleaf evergreen trees that occur in shallow, stagnant drainages or depressions often found within pine flatwoods, or at the base of sandy ridges where seepage maintains constantly wet soils. The soils, which are usually covered by an abundant layer of leaf litter, are mostly acidic peat or muck that remain saturated for long periods, but over which little water level fluctuation occurs. Overstory trees within bay swamps are dominated by sweet bay, swamp bay, and loblolly bay. Other species may include pond pine, slash pine, black gum, and cypress as scattered individuals, but bay trees dominate the canopy and characterize the area. Understory and groundcover species may include dahoon holly, wax myrtle, fetterbush, greenbriar, royal fern, cinnamon fern, and sphagnum moss.

Mixed hardwood swamp forests are composed of either pure stands of hardwoods, or occur as a mixture of hardwoods and cypress. This association of wetland-adapted trees occurs throughout the state on organic soils and forms the forested floodplains of nonalluvial rivers, creeks, and broad lake basins. Tree



species include a mixed overstory containing black gum, water tupelo, bald cypress, dahoon holly, red maple, swamp ash, cabbage palm, and sweet bay.

Shrub swamps are dominated by dense, low-growing, woody shrubs or small trees. Shrub swamps are usually characteristic of wetland areas that are experiencing environmental change and are early to mid-successional in species complement and structure. These changes result from natural or human-induced disturbances due to increased or decreased wet period, fire, clear cutting or land clearing, and siltation. Shrub swamps may be dominated by one species, such as willow, or an array of opportunistic plants may form a dense, low canopy. Common species include willow, wax myrtle, primrose willow, buttonbush, and saplings of red maple, sweet bay, black gum, and other hydric tree species.



SOILS

BIG CYPRESS NATIONAL PRESERVE AND EVERGLADES NATIONAL PARK

Most soils in Big Cypress National Preserve and Everglades National Park are geological and biological products that have not had sufficient time to develop into true soils. Marl (calclitic mud), organic matter (peat), sand, and rock outcroppings are the four common substrate types in these parks (Duever et al. 1986; NPS 1997d).

Marls are the most widespread soil type in these parks. Marls are mixtures of calcium-bearing fine sediments with calcite particles, sand, and/or shell fragments, and may have periphyton precipitates at the surface. These soils were formed in shallow waters with a relatively short period of flooding, and therefore have high rates of microbial activity and decomposition of organic matter. These soils cover the extensive peat deposits of the central reaches of both parks (Bacher 1997; NPS 1997e).

Organic matter, or *peat*, is formed under anaerobic conditions during long periods of flooding, where the volume of decaying plant material exceeds the ability of microbes to decompose it. Once exposed to air, microbe populations increase and decomposition accelerates, leading to soil loss. Peat deposits lie beneath the surface soils across the low-lying reaches of Everglades National Park and Big Cypress National Preserve (Duever et al. 1986; NPS 1997e). Peat soils are identified by major vegetation categories of sawgrass and mangroves.

A hard limestone substrate, commonly called cap rock, is typically located 10 to 40 inches below the soil surface. The limestone also outcrops at the land surface, particularly within hardwood hammocks. The shallow limestone rock is typically pitted with solution holes of all sizes, a karst topography (Bacher 1997).

The eastern boundaries of the parks have intermittent, thin, sandy deposits that are likely derived from ancient shorelines. These types of soil are highly permeable and moderately to well-drained. As these soils transition to peat and marl, the presence of fine sand and loam (moistened fine sediments) increases, which results in poor drainage and allows the buildup of organic matter. The low-relief marshes, from Florida Bay to Whitewater Bay, generally exhibit increasing depths of sand and mangrove peat. Along the west coast, the Ten Thousand Islands have shallow sandy soils typical of barrier islands (Bacher 1997; SFWMD 2000).

In both of these parks, large monotypic stands of melaleuca, Brazilian pepper, and Australian pine have altered local soil conditions. Melaleuca modifies the soils and topography of the shallow wetlands it invades, and Brazilian pepper accelerates soil development and raises elevations beneath its canopy (Gordon 1998). The primary cause of these changes is the high litter-deposition rates common to both species. Leaf litter beneath these stands can be many inches deep, changing the chemistry and nutrient balance of the soil by reducing oxygen concentration and altering the nitrogen-to-phosphorus ratio. Melaleuca litter, in particular, is high in carbon and has relatively slow decomposition rates (Gordon

*Periphyton—
Microscopic
underwater plants
and animals that
are firmly attached
to solid surfaces
such as rocks.*

*Karst topography—
A landscape
characterized by
sinks, solution
valleys, and other
features produced by
groundwater
activity; it commonly
develops in
limestone.*



1998). This leads to reduced productivity and contributes to the low biodiversity found in melaleuca forests.

Phenol—A caustic, poisonous acidic compound.

Lignin—Fairly common in plant materials especially those that are stiff or woody in nature. It is difficult for bacteria to decompose lignin. Only fungi can decompose it easily.

Along the coastline of Everglades National Park, stands of Australian pine may accelerate shoreline erosion by excluding growth of native soil-stabilizing grasses. In addition, microbial root symbionts of this tree fix nitrogen, enrich the soil, and alter the soil's chemistry. Australian pines also deposit deep layers of litter in the form of shed needles and small branches. Again, this disrupts normal soil function by adding decay resistant phenols and lignins to the soil surface. These factors all contribute to the barren, desert-like conditions that occur on the floor of the Australian pine forest.

BISCAYNE NATIONAL PARK, CANAVERAL NATIONAL SEASHORE, AND DRY TORTUGAS NATIONAL PARK

The terrestrial resources of these parks include beaches, intertidal habitats, and off-shore barrier island environments (NPS 2000e). Barrier islands are low-lying and composed primarily of gently sloping, well-drained, sandy soils consisting of disintegrated rock mixed with decayed organic matter, shell fragments, and sand. These soils are classified as well-drained or excessively well-drained (NPS 2001e).

The inland soils of Canaveral National Seashore and Biscayne National Park vary from poorly drained to excessively drained. The mainland soil types include sands, loams, and marsh soils that are organic throughout (NPS 2001e).

The amount of human disturbance of soils on the shores and islands ranges from a largely natural state on the small, remote keys, to the nearly full development of Fort Jefferson on Garden Key in Dry Tortugas and the lighthouse and visitor area on Boca Chita in Biscayne National Park.

In Biscayne National Park and Canaveral National Seashore, as in Everglades National Park and Big Cypress National Preserve, persistent stands of Brazilian pepper and Australian pine can affect local soil qualities. Beneath the Brazilian pepper canopy, deep litter accelerates soil development and increases elevation. Australian pines increase coastal erosion and stand above a barren forest floor that is covered with litter that resists decay.

BUCK ISLAND REEF NATIONAL MONUMENT, CHRISTIANSTED NATIONAL HISTORIC SITE, SALT RIVER BAY NATIONAL HISTORIC PARK AND ECOLOGICAL PRESERVE, AND VIRGIN ISLANDS NATIONAL PARK

With the exception of Buck Island Reef National Monument, the islands that comprise Caribbean parks have experienced large-scale disturbance and intensive agriculture. In the 1700s, large portions of St. Thomas, St. John, and St. Croix were cleared for sugar cane production. After a short time, the volcanic islands of St. John and St. Thomas proved to be too labor intensive, and the majority of



production was moved to St. Croix. The tilled hillsides and plantations on St. John and St. Thomas were left to natural processes (NPS n.d.e).

The upland soils of the Caribbean parks could best be described as shallow, gravelly and clayey-loams. St. Croix (Christiansted National Historic Site, Salt River Bay National Historic Park and Ecological Preserve, and Buck Island Reef National Monument) and the southern portion of St. John (Virgin Islands National Park) are dominated by shallow, well-drained, stony soils that cover the slopes and summits. The soils are generally 10 inches deep or less, with weathered bedrock found at depths from 10 to 30 inches. The soils are often very stony, and, therefore, have serious limitations for development (USDA 2002b).

The coastal areas of the islands have a variety of soil types. The islands are ringed by sandy beaches, saline marshes, and outcroppings of exposed bedrock. Beach sand depth above the igneous bedrock varies, depending on the wave action and current. The islands' saline marshes have very deep, very poorly drained soils that have been formed by alluvial and marine sediments and the remains of hydrophytic plants. These soils are high in organic matter and would commonly be called muck. The dramatic beach views, for which the islands are known, are enhanced by outcroppings of basalt, volcanic sandstone, and other water island formations (USDA 2002).

Tan tan is one species of exotic plant in the Virgin Islands that forms single-species stands. No adverse effects to soils associated with groves of tan tan have yet been identified.

Alluvia—Soil that contains clay, silt, sand, or gravel deposited by running water.

Hydrophytic—'before the first water-adapted' or 'water-loving.' hydrophytic plants have an ability to thrive in waterlogged conditions.



WATER QUALITY AND HYDROLOGY

BIG CYPRESS NATIONAL PRESERVE AND EVERGLADES NATIONAL PARK

FRESHWATER RESOURCES

Sheet flow—A condition of flooding that occurs overland in places where there are no defined channels.

These parks protect a portion of the historic Everglades ecosystem and lie within a large interconnected freshwater system called the Kissimmee-Lake Okeechobee-Everglades Watershed. This watershed covers almost 11,000 square miles in south-central Florida and is the dominant freshwater supply for the region's population centers (NPS 1997d). Historically, the Everglades system was fed by sheet flow from lakes and wetlands in the north. This surface flow of clean, clear water moved slowly through the extensive wetlands that define the Everglades and on to Florida Bay or the Ten Thousand Islands (SFWMD 2000). This flow was up to 50 miles wide, 6 inches to 3 feet deep, and moved about 100 feet per day from May to October. During the wet season, the landscape was nearly covered with water and featured deep freshwater pools. As winter approached, the river slowed and then ceased for the annual 6-month dry season. By December, the land was dotted with shallow pools where wildlife would retreat to await the rains (Bacher 1997).

Today, much of this watershed is characterized by urban centers and highly productive agricultural areas, which have been made possible by dramatically altering the natural hydrology of the area. Since the 1880s, development was assisted by large-scale drainage of wetlands, construction of channels to carry water to the population centers of the east, and flood control structures. Today, many portions of this watershed are drier or wetter for longer periods than prior to such development, and have poorer water quality related to agricultural and urban runoff (SFWMD 2000).

The fresh surface waters of Big Cypress National Preserve and Everglades National Park are currently designated as Outstanding Florida Waters. This is a state designation, delegated by the U.S. Environmental Protection Agency (EPA) under the *Clean Water Act*, and is intended to protect existing, high-quality waters.

The low-nutrient, high-quality water in these parks is vulnerable to degradation from contaminants. Because the water is of such high quality, even small amounts of contaminants can result in relatively large adverse effects. External sources of pollution primarily include nutrient-enriched runoff from upstream agricultural and urban activities, especially in the north. Internal contaminant sources include park development, operation of boats and vehicles within the park, and oil and gas leakage in Big Cypress National Preserve. Today, water quality in some locations is dramatically different than before 1900. Surface water entering Big Cypress National Preserve is nearly completely controlled, and having drained from agricultural and developed areas is laden with nutrients, dissolved solids, and trace amounts of pesticides and herbicides (SFWMD 1992, 2000).



As the primary steward for South Florida's urban and agricultural water resources, the South Florida Water Management District (SFWMD) maintains an ongoing water quality monitoring program. Water quality samples currently are collected monthly throughout the parks, and analyzed for a suite of water quality parameters. This water monitoring program provides a long-term record for assessing ambient water quality conditions and identification of contamination threats.

Pesticide assays have been included in the water quality monitoring program since 1984. However, the assay does not currently test for the presence of herbicides used in exotic plant control in the national parks. The detection efforts focus on agricultural insecticides and herbicides and their breakdown products, including atrazine, 2,4-D, DDT, and diuron (Pfeuffer and Matson 2003). Findings of this monitoring include the presence of atrazine at approximately 90% of testing sites at levels below the parts per billion range. In contrast, the SFWMD did include testing for glyphosate for several years, but abandoned the practice because this chemical was not detected at any site through several test periods (Pfeuffer 2004).

GROUNDWATER RESOURCES

Big Cypress National Preserve and Everglades National Park are underlain by the Biscayne aquifer and a series of shallow, unnamed surficial aquifers. These waters are used as a freshwater supply for approximately three million south Florida residents (USGS 2001, EPA 2003c). Deep below these surface aquifers lies the lower unit of the Floridan aquifer system, protected by 1,000 feet of low-permeability clay deposits. This aquifer is not accessed for municipal or agricultural supply in south Florida (EPA 2003c). The region's municipal wastewater is disposed of by a combination of ocean outfall and deep well injection into the Lower Floridan aquifer (EPA 2003c).

The aquifers that underlie south Florida are made mostly of limestone and other carbonate rocks. These formations tend to dissolve in water over time, making them porous. Groundwater travels relatively quickly through these formations. These open aquifers are said to be "unconfined" and are recharged quickly by fresh surface water flows. Where limestone or other porous aquifers are near the coast, salty seawater can begin to move inward, and infiltrate freshwater aquifers. This is particularly problematic where fresh groundwater is pumped to provide urban water supplies. Rapid development in south Florida has resulted in saline marine groundwater moving inward more than 15 miles in some places (USGS 2001).

The seasonality of water availability in Everglades National Park has created an interplay of surface water and groundwater. During the summer rainy season, increased overland flow and stream flows recharge aquifers near the surface. During the dry winter, these superficial aquifers supply groundwater to support stream flows and provide vital moisture for wetlands and marshes.



MARINE WATERS

The marine habitats of Everglades National Park are not open sea, but shallow waters under the influence of freshwater inflows and generally have soft sediment bottoms. This combination of climate and physical conditions occurs nowhere else. These marine habitats include all of Florida Bay and the coastline of the Ten Thousand Islands region (Livingston 1990). This environment is critical to the park's marine-based recreation and sport fishery.

Florida Bay has long been known for its clear water, lush seagrass beds, and good fishing. During the 1980s and 1990s, the bay showed dramatic changes as the water became clouded with algae, seagrasses died off, and the fishery showed signs of decline (Fourqurean and Robblee 1999). The *Comprehensive Everglades Restoration Plan* has prompted investigation of the complex history of the bay, with the goal of determining appropriate restoration efforts (Florida Bay Science Program 2003).

BISCAYNE NATIONAL PARK AND CANAVERAL NATIONAL SEASHORE

FRESHWATER RESOURCES

Freshwater resources in these coastal parks are sparse. Estuaries receive freshwater inputs from rainfall, sheet flow, and minor natural and human-created drainages that carry water from the mainland. The inflows from these engineered structures are of concern because they carry stormwater, which is often laden with contaminants. However, the effects of these transient inputs are difficult to assess (NPS 2000e).

GROUNDWATER RESOURCES

Biscayne National Park is underlain by the Biscayne aquifer, a shallow surficial aquifer that is used as a water supply for Miami and other urban centers. In the 1990s, over 800 million gallons of freshwater were withdrawn from this source daily. Because the Biscayne aquifer is shallow and very permeable, it is subject to contamination. Water from this source is sometimes colored by the presence of organic acids from plant material, but this does not represent a threat to human health (EPA 2003c).

Canaveral National Seashore is underlain by a series of shallow, unconfined, and unnamed aquifers. Just to the west of the park lies the upper unit of the vast Floridan aquifer system. The Upper Floridan and the unnamed aquifers supply local drinking water. Being permeable and relatively near the surface, they are prone to contamination from agricultural activities, urban runoff and waste disposal, and saltwater intrusion. Since the late 1980s, approximately 320 million gallons per day of treated wastewater have been injected into the Lower Floridan system, at depths as great as 3,000 feet below the surface (EPA 2003c).



MARINE WATERS

These coastal parks are a combination of sandy shores, large lagoons or estuaries, and open sea. Biscayne National Park's acreage is approximately 95% water, mostly contained within Biscayne Bay, and is the largest marine park in the national park system. Canaveral National Seashore is dominated by Mosquito Lagoon, which comprises 38,000 of the park's total 58,000 acres.

The bays are broad, shallow estuaries where freshwater from the land mixes with saltwater from the sea. These bays serve as nurseries for juvenile marine life and support important commercial and sport fisheries. Within their clear waters, dense beds of turtle grass and patches of algae, sponges, and soft coral nurture a diverse collection of other marine and estuarine life. The primary driving force of water movement into and out of these bays is the rise and fall of the diurnal (twice daily) ocean tide (NPS 2000e).

Bay water is relatively clean in spite of the constant threat of pollution from mainland industrial, agricultural, and urban sources. In Biscayne Bay, shipping lines cut through along the Intracoastal Waterway that also extends along a portion of Canaveral National Seashore's western boundary. At Canaveral National Seashore, the National Aeronautics and Space Administration (NASA) station receives traffic related to its launch facility.

Biscayne Bay. Water quality in Biscayne Bay ranges from poor to nearly pristine (NPS n.d.e). Most threats to water quality are associated with the city of Miami, and include stormwater inflows, nutrient loading from sewage, and contamination from landfill leachate. Miami-Dade County has conducted water quality monitoring at about 100 stations in Biscayne Bay since 1979. Monitoring includes analysis for 22 water quality parameters. Water quality monitoring results are available on the EPA's STORET website at <http://oaspub.epa.gov/storpubl/station> selection.

*Leachate—
Contaminated water
that leaks from a
disposal site such as
a landfill or dump.*

Outside Biscayne Bay, the waters of the shallow sea beyond the barrier system foster living coral and many other forms of colorful life that find shelter and food among the coral communities. Biscayne National Park includes the northernmost living patch reefs of the United States, as well as shoal reefs that parallel the park's eastern boundary (NPS n.d.e).

Mosquito Lagoon. Most of Mosquito Lagoon is considered near-pristine habitat. Occasionally, storms and high winds cause high turbidity by mixing bottom sediment. Since 1995, overall turbidity in the lagoon has increased to approximately three times historic levels. In addition, there has been an increase in the total nitrogen concentration of lagoon waters over the last 20 years. Algal blooms, reported in 1990 and 1996, likely resulted from a combination of water temperatures, low salinity, and high phosphorus loadings resulting from abnormally high rainfall (NPS 2001h).

*Turbidity—A
measure of water
cloudiness caused by
the amount of
suspended matter in
the water.*

Water quality in the lagoon is routinely monitored for a suite of parameters, including physical characteristics (such as temperature, pH, turbidity, or salinity), chemical components (such as nitrogen, or phosphorus), and metal content (such as lead, iron, or potassium) (NPS 2001h).



DRY TORTUGAS NATIONAL PARK

Dry Tortugas National Park is a remote barrier island chain that lacks freshwater resources. The marine waters in the area are generally pollution free due to dynamic ocean currents and the absence of urban runoff and wastewater effluent. A long-term monitoring program conducted by Florida International University shows that water quality in the western reaches of Florida Bay directly influences water quality at the park. Salinity and turbidity vary locally, mostly in response to changes in rainfall and varying bottom coverage by seagrasses (NPS 2000e).

BUCK ISLAND REEF NATIONAL MONUMENT, CHRISTIANSTED NATIONAL HISTORIC SITE, SALT RIVER BAY NATIONAL HISTORIC PARK AND ECOLOGICAL PRESERVE, AND VIRGIN ISLANDS NATIONAL PARK

FRESHWATER RESOURCES

Freshwater is scarce on the Virgin Islands, which lack perennial streams. Gullies or “guts,” as they are called locally, flow in response to rain and storm events. Watersheds have a high percentage of steep slopes and rocky, well-drained soils. This results in runoff rushing from the mountains to valley bottoms and the sea. Short-duration, localized flooding is a concern on the islands, especially in the event of a tropical storm or hurricane (USDA 2002).

Drought is also a concern on the islands, affecting some part of the islands each year. Because of the shallow, rocky soils and lack of freshwater supplies, these dry periods can adversely affect vegetation categories, agriculture, and human water supplies (USDA 2002).

GROUNDWATER RESOURCES

Groundwater is scarce on the Virgin Islands. The island of St. Croix (Christiansted National Historic Site and Salt River Bay National Historic Park and Ecological Preserve) has a major aquifer, but most groundwater is limited to coastal embayments and volcanic rock aquifers deep underground. Most of the water supply for the islands comes from stored rainwater or from desalination plants for the larger communities. Because groundwater is scarce and subject to saltwater intrusion and pollution by wastewater and petroleum products, only about 20% of island usage comes from aquifers (USDA 2002).

The quality and quantity of surface water and groundwater on the islands are monitored by the U.S. Geological Survey (USGS). The Water Resources Data for 2000 reports that surface water quality is most affected by turbidity during runoff events and that groundwater resources are subject to over-withdrawal, which can bring about salt water intrusion, resulting in decreased water quality for human use (USGS 2000).

At the mouth of guts, saltwater ponds may develop where corals grow across the mouth near the shoreline. As materials are deposited on these corals, they build up a ridge that traps the salt water. In high tides or storms, there may be water



exchange between the pond and the sea. These ponds support mangrove stands and also serve as important habitats for birds such as plovers, the Bahama white cheek pintail, and herons (NPS n.d.f).

MARINE WATERS

The marine waters that encircle the Virgin Islands are generally of good quality and support a variety of sensitive habitats, from mangroves to seagrasses to coral reefs. However, periodic reductions in local water quality result from sediment and releases of untreated or partially treated sewage (USGS 2004b; U of VI 2004). Ongoing erosion from rapid development, agricultural practices, and continued use of unpaved roads releases sediment during rain events. Discharge of sewage can occur as chronic, low-level contamination from individual septic systems, recreational boaters, or municipal systems that are improperly maintained or inundated during tropical storm events. In addition, water quality in high boat traffic areas such as harbors and marinas can be degraded by petroleum products and industrial wastes (U of VI n.d.)



SPECIAL STATUS SPECIES

Exotic plant infestation can affect rare, threatened, and endangered species in several ways. The aggressive exotic plants intercept light, moisture, and nutrients, directly out-competing some endangered plant species. Exotic plants can indirectly cause the decline or extirpation of rare plants by altering their habitat to a degree that affects the interactions of predators, pollinators, and other elements required for the continued functioning of an ecosystem (Gordon 1998). This section summarizes federal threatened and endangered species, as well as state and territory species of concern known to occur within the parks.

FEDERALLY LISTED SPECIES

Table 26 presents the federally listed threatened, endangered, and candidate plant and animal species that may be affected by exotic plants or their treatments, and the parks where these special-status species occur. This list is not inclusive of all federally listed species that occur within the parks but is focused on those species that have the potential to be affected or whose habitat may be affected, either directly or indirectly, by management actions.

Table 27 identifies potentially threatened and endangered species habitats within parks, and the amount that may be potentially infested with exotic plants. The federally listed species included in the table are only those species with available distribution information.

PLANTS

Blodgett's Silverbush **Everglades National Park**

Blodgett's silverbush (*Argythamnia blodgettii*) is a small, semiwoody perennial plant known to occur at the edges of pine rocklands, in tropical hardwood hammocks, and along coastal berms. It requires sunny sites and periodic low-intensity fires to reduce competition from larger woody species. Fewer than 10,000 individuals are known to exist, with 90% of these restricted to 11 protected areas, including the eastern portions of Everglades National Park. This species is currently a candidate species for listing by the USFWS. The USFWS has an ecosystem-based, multiple species recovery plan for the threatened and endangered species of south Florida, which emphasizes conservation of habitats where this species occurs (USFWS 1999b).



TABLE 26: POTENTIALLY AFFECTED FEDERALLY LISTED SPECIES IN SOUTH FLORIDA AND CARIBBEAN NATIONAL PARKS

Common Name	Scientific Name	Federal Status	BICY	BISC	CANA	DRTO	EVER	BUIS	CHRI	SARI	VIIS
Plants											
Blodgett's silverbush	<i>Argythamnia blodgettii</i>	Candidate					X				
Cape Sable thoroughwort	<i>Chromolaena frustrata</i>	Candidate					X				
Crenulated lead plant	<i>Amorpha crenulata</i>	Endangered					X				
Everglades bully	<i>Sideroxylon reclinatum ssp. Austrofloridense</i>	Candidate	X				X				
Florida pineland crabgrass	<i>Digitaria pauciflora</i>	Candidate	X				X				
Florida prairieclover	<i>Dalea carthagenensis var. floridana</i>	Candidate	X				X				
Florida semaphore cactus	<i>Consolea corallicola</i>	Candidate		X							
Garber's spurge	<i>Chamaesyce garberi</i>	Threatened		X			X				
Pineland sandmat	<i>Chamaesyce deltoidea pinetorum</i>	Candidate					X				
Small's milkpea	<i>Galactia smallii</i>	Endangered		X			X				
St. Thomas prickly ash	<i>Zanthoxylum thomasianum</i>	Endangered									X
St. Thomas lidflower	<i>Calyptanthus thomasiana</i>	Endangered									X
Animals											
Mammals											
Florida panther	<i>Felis concolor coryi</i>	Endangered	X				X				
Southeastern beach mouse	<i>Peromyscus polionotus niveiventris</i>	Endangered			X						
West Indian manatee	<i>Trichechus manatus</i>	Endangered		X	X	X	X				
Reptiles											
American crocodile	<i>Crocodylus acutus</i>	Endangered		X			X				
Atlantic salt marsh snake	<i>Nerodia clarkii taeniata</i>	Threatened			X						
Eastern indigo snake	<i>Drymarchon corais couperi</i>	Threatened	X	X	X		X				
Green sea turtle	<i>Chelonia mydas</i>	Endangered		X	X	X	X	X		X	X
Hawksbill sea turtle	<i>Eretmochelys imbricata</i>	Endangered		X	X	X	X	X		X	X
Kemp's Ridley sea turtle	<i>Lepidochelys kempii</i>	Endangered		X	X	X	X				
Leatherback sea turtle	<i>Dermochelys coriacea</i>	Endangered		X	X	X	X	X		X	X
Loggerhead sea turtle	<i>Caretta caretta</i>	Threatened		X	X	X	X				

Special Status Species





TABLE 26: POTENTIALLY AFFECTED FEDERALLY LISTED SPECIES IN SOUTH FLORIDA AND CARIBBEAN NATIONAL PARKS (CONTINUED)

Common Name	Scientific Name	Federal Status	BICY	BISC	CANA	DRTO	EVER	BUIS	CHRI	SARI	VIIS
Birds											
Audubon's crested caracara	<i>Polyborus plancus audubonii</i>	Threatened					X				
Bald eagle	<i>Haliaeetus leucocephalus</i>	Threatened	X	X	X	X	X				
Brown pelican	<i>Pelecanus occidentalis</i>	Endangered in U.S. Virgin Islands	X	X	X	X	X	X		X	X
Cape Sable seaside sparrow	<i>Ammodramus maritime mirabilis</i>	Endangered	X				X				
Everglade snail kite	<i>Rostrhamus sociabilis plumbeus</i>	Endangered	X				X				
Florida scrub jay	<i>Aphelocoma coerulescens</i>	Threatened			X						
Piping plover	<i>Charadrius melodus</i>	Threatened		X			X				X
Red cockaded woodpecker	<i>Picoides borealis</i>	Endangered	X								
Roseate tern	<i>Sterna dougallii dougallii</i>	Threatened				X	X				X
Wood stork	<i>Mycteria americana</i>	Endangered	X	X	X		X				
Invertebrates											
Miami Blue butterfly	<i>Cyclargus bethunebakeri thomasi</i>	Candidate		X			X				
Schaus swallowtail butterfly	<i>Papilio aristodemus ponceanus</i>	Endangered		X							
Stock Island tree snail	<i>Orithalicus reses reses</i>	Threatened	X				X				

- a. BICY—Big Cypress National Preserve
 b. BISC—Biscayne National Park
 c. CANA—Canaveral National Seashore
 d. DRTO—Dry Tortugas National Park
 e. EVER—Everglades National Park

- f. BUIS—Buck Island Reef National Monument
 g. CHRI—Christiansted National Historic Site
 h. SARI—Salt River Bay National Historic Park and Ecological Preserve
 i. VIIS—Virgin Islands National Park

TABLE 27: ACRES OF POTENTIALLY THREATENED AND ENDANGERED SPECIES HABITATS THAT ARE POTENTIALLY INFESTED

Species	Potential Habitat within Park (acres)	Potential Habitat Potentially Infested (acres)
Big Cypress National Preserve		
Florida panther	430,855	103,634
Bald eagle	7,242	598
Eastern indigo snake	384,716	95,361
Wood stork	477,486	88,786
Everglade snail kite	13,334	3,708
Red-cockaded woodpecker	2,029	441
Biscayne National Park		
American crocodile	370	6
Eastern indigo snake	3,070	91
Buck Island Reef National Monument		
Brown pelican	9	3
Hawksbill sea turtle, leatherback sea turtle, green sea turtle	11	less than 1
Canaveral National Seashore		
Southeastern beach mouse	242	94
Florida scrub-jay	1,744	303
Eastern indigo snake	11,867	2,294
Wood stork	4,220	1,048
Bald eagle	2,736	526
Everglades National Park		
Cape Sable seaside sparrow	102,326	10,359
Florida panther	25,145	3,789
Everglade snail kite	26,472	7,859
Wood stork	585,502	93,431
Eastern indigo snake	95,036	26,924
American crocodile	44,356	1,242
Bald eagle	4,177	144
Salt River Bay National Historic Park and Ecological Preserve		
Sensitive natural area	87	45
Virgin Islands National Park		
Brown pelican	154	0
St. Thomas lidflower	92	0
St. Thomas prickly ash	83	0
Roseate tern	1	0
Hawksbill sea turtle, leatherback sea turtle, green sea turtle	29	0

Note: Acreage and distribution of potential sensitive species habitat within Florida parks was obtained from the Florida Natural Areas Inventory. Acreage and distribution of exotic plants within Florida parks was obtained from NPS staff and aerial reconnaissance data. Acreage of potential sensitive species habitat and distribution of exotic plants in the Caribbean parks was determined based on information obtained from D. Clark, NPS, and R. Boulon, NPS.



Cape Sable Thoroughwort **Everglades National Park**

Cape Sable thoroughwort (*Chromolaena frustrata*) is a perennial herb endemic to south Florida and the Florida Keys and is threatened by loss of habitat and invasion by exotic plants. In Everglades National Park, this species is extant in the Cape Sable region along the Coastal Prairie Trail where it occurs in buttonwood hammock. This plant is known to occur in open sun to partial shade at the edges of rockland hammock and in coastal barrens. This species is currently a candidate species for listing by the USFWS (USFWS 2005a).

Crenulated Lead Plant **Everglades National Park**

*Crenulated—
Small, rounded
projections
forming a
distinct edge.*

The crenulated lead plant (*Amorpha crenulata*) is a federally endangered shrub occurring in pine rocklands in south Florida. Loss of habitat from development has been the most important factor in the decline of this shrub. Fire suppression and the invasion of Brazilian pepper and a giant reed, *Neyraudia* sp. threaten the remaining population (USFWS 1996b). Crenulated lead plant is extant at a single location in Everglades National Park; however, this occurrence is the result of a past introduction and is not considered to be native to the park (Sadle 2005).

Everglades Bully **Big Cypress National Preserve and Everglades National Park**

Everglades bully (*Sideroxylon reclinatum* ssp. *austrofloridense*) is a shrub endemic to south Florida. It occurs in pine rockland, marl prairie, and the ecotone between those two habitats. In Everglades National Park, it is relatively common throughout the Long Pine Key region. In Big Cypress National Preserve, a single specimen was found in the southern portion of the preserve while a floristic inventory was being conducted by the Institute for Regional Conservation. The complete distribution and population size of this species in Big Cypress National Preserve is currently not known. However, it is anticipated that more plants would be located with systematic surveys of the area in which it was collected. This species is threatened by invasion of Brazilian pepper and other exotic plants, but the extent of the threat is not known (Sadle 2005). This species is currently a candidate species for listing by the USFWS.

Florida Pineland Grass **Big Cypress National Preserve and Everglades National Park**

Florida pineland grass (*Digitaria pauciflora*) is a perennial grass species endemic to south Florida. The vast majority of the range of this species is within Everglades National Park and Big Cypress National Preserve. It occurs in marl prairie, pine rocklands, and the ecotone between these two communities. In Everglades National Park, this species occurs throughout Long Pine Key and sporadically in the Pine Island area. In Big Cypress National Preserve, a single population is known from marl prairies in the Gum Slough area. The exact extent and population size of this species in both parks is not completely known (Sadle 2005). This species is currently a candidate for listing by the USFWS, which has included it in the multiple species recovery plan for south Florida, with the



primary recommendation being land conservation where the remaining Florida pineland grass occurs (USFWS 1999b).

Florida Prairieclover

Big Cypress National Preserve and Everglades National Park

Florida prairieclover (*Dalea carthagenensis* var. *floridana*) is a perennial shrub endemic to south Florida and is currently a candidate for listing by the USFWS. It was collected in Everglades National Park along the eastern boundary and along Old Ingram Highway, presumably in pine rockland or disturbed roadside edges. Recent surveys to relocate this species in Everglades National Park were unsuccessful, and it is considered to be extirpated from the park. In Big Cypress National Preserve, Florida prairieclover occurs in pine rockland, roadside edges, and pineland-hammock ecotones. Two populations are known, one in the Pinecrest area and one in the Raccoon Point area. In the Pinecrest area, plants are known from roadside edges and in pine rockland, typical of that region. Plants are most abundant in disturbed soil and are found growing with low density Brazilian pepper. In the Raccoon Point area, plants are known from pineland-hammock ecotone growing in apparently undisturbed soil, with Brazilian pepper also occurring in the vicinity of this population (Sadle 2005).

Florida Semaphore Cactus

Biscayne National Park

Florida semaphore cactus (*Consolea corallicola*) is a large cactus endemic to the Florida Keys and is currently a candidate for listing by the USFWS. This cactus grows in hammocks on bare rocks, with a minimum amount of organic soil cover (USFWS 2004b). It is known to exist at Swan Key in Biscayne National Park, where the largest remaining population in the world occurs (Sadle 2005). Current threats to this plant species include an exotic *Cactoblastis moth* and habitat destruction (USFWS 2004b).

Garber's Spurge

Biscayne National Park and Everglades National Park

Garber's spurge (*Chamaesyce garberi*) is a prostrate herb that occurs in the transitional area between hardwood hammocks and pine rocklands, and on beach ridges in coastal areas. It is known to occur in pine rocklands in the Long Pine Key area of Everglades National Park (Sadle 2005) and has the potential to occur in Biscayne National Park. Low density invasions of Brazilian pepper and other exotic plants may be present where this plant occurs. This plant is listed as federally threatened by the USFWS predominantly due to loss of habitat from development (USFWS 2005b).

Pineland Sandmat

Everglades National Park

Pineland sandmat (*Chamaesyce deltoidea pinetorum*) is a small, perennial, herbaceous plant known to occur only in pine rocklands along the Miami Rock Ridge in southern Miami-Dade County. Loss of pine rockland habitat, fire



suppression, and exotic plant invasion have reduced the population of this species to around 10,000 individuals. This species is currently a candidate species for listing by the USFWS. Approximately 90% of the individual plants occur in seven protected areas, including Everglades National Park. Low density invasions of Brazilian pepper and other exotic plants may be present where this plant occurs. Pineland sandmat is covered under the USFWS multiple-species recovery plan for south Florida, which emphasizes conservation of the remaining pine rockland communities (USFWS 1999b).

Small's Milkpea

Biscayne National Park and Everglades National Park

Small's milkpea (*Galactia smallii*) is a perennial twining vine endemic to the Miami rock ridge in south Florida. It is found in pine rocklands in the Long Pine Key area of Everglades National Park and has the potential to occur in Biscayne National Park. Low density invasions of Brazilian pepper and other exotic plants may be present where this plant occurs (Sadle 2005). Small's milkpea is federally endangered because of loss of habitat from development. Fire suppression and invasion from exotic plants, particularly Brazilian pepper and Burma reed, threaten remaining populations (USFWS 2005c).

St. Thomas Prickly Ash

Virgin Islands National Park

The St. Thomas prickly ash (*Zanthoxylum thomasianum*) is an evergreen shrub or small tree that has become endangered because of the loss of habitat. The only known occurrence is within Virgin Islands National Park on Gift Hill, near Salt Pond, and Lameshur (USFWS 1992). This species would likely benefit from the control of exotic plants, but there is no information specifically regarding the effects of exotic plants on its habitat.

St. Thomas Lidflower

Virgin Islands National Park

St. Thomas lidflower (*Calypttranthes thomasiana*) is an evergreen shrub found on Bordeaux Mountain in Virgin Islands National Park. The population of this federally endangered plant is in peril because of feral pigs and donkeys (USFWS 1995) and the influx of exotic plants, such as tan tan and genip, both of which are out-competing the native species in the subtropical moist forest.



ANIMALS

MAMMALS

Florida Panther

Big Cypress National Park and Everglades National Park

In south Florida, the Florida panther (*Felis concolor coryi*), whose preferred prey is white-tailed deer (*Odocoileus virginianus*), is found in Big Cypress National Preserve and Everglades National Park. In general, panther population centers appear to indicate a preference toward large, remote tracts with adequate prey, cover, and reduced levels of disturbance. Only preliminary data are available on Florida panther reproduction. Existing data indicate that breeding may occur throughout the year, with a peak during the period of winter and spring, a gestation period of around 90 to 95 days, litter sizes of 1 to 4 kittens, and a breeding cycle of 2 years for females successfully raising young to dispersal, which occurs around 18 to 24 months (USFWS 2005d). The white-tailed deer's food preference is the swamp lily (*Crinum americanum*), a monocot that grows in cypress and hardwood swamps (Labisky 2003). The decline of the swamp lily, as swamps are overrun with melaleuca, would likely affect the panther population. Reports show that while subadults and nonbreeding female panthers feed almost exclusively on small prey, such as raccoon, marsh rabbit, and alligator, breeding females prey primarily on white-tailed deer. If deer populations decline, the panther population declines.



Florida panther

Southeastern Beach Mouse

Canaveral National Seashore

The Southeastern beach mouse (*Peromyscus polionotus niveiventris*) is listed as federally endangered by the USFWS. It is found on sand dunes vegetated with sea oats and panic grass, and with adjacent scrub dominated by oaks and palmetto. Preferred food is the seeds of sea oats and panic grass. The decline of these plant populations would lead to the decline of the mouse (USFWS 1996b). The mice thrive in this transitional zone, which is vulnerable to the invasion of Brazilian pepper because of the open ground areas. Little specific information exists about these species' burrowing habits, although they are presumed to be similar to those of beach mice on the Gulf Coast. Sometimes beach mice use the former burrows of ghost crabs, but usually they dig their own. Burrow entrances are generally found on the sloping side of a dune at the base of a clump of grass. The burrows are used for nesting and food storage as well as a refuge (USFWS 2005k).

West Indian Manatee

**Biscayne National Park, Canaveral National Seashore,
Dry Tortugas National Park, and Everglades National Park**

The West Indian manatee (*Trichechus manatus*), a federally endangered species, is a fully aquatic herbivorous mammal. The manatee occupies a prominent position in the parks' marine and estuarine systems as a prodigious grazer of submerged aquatic vegetation. It spends about five hours a day feeding, and in that time, it consumes about 4 to 9 percent of its body weight (20 to 45 kg/day) (Bengston 1983). Submerged aquatic vegetation, such as seagrasses, is a major component of the diet of manatees, and although manatees appear to tolerate marine and hyper saline conditions, they are most frequently found in fresh or brackish waters. Manatees inhabit both salt and fresh water of sufficient depth (1.5 meters to usually less than 6 meters) and may be encountered in canals, rivers, estuarine habitats, saltwater bays, and, on occasion, have been observed as much as 3.7 miles off the Florida gulf coast (USFWS 2005e).

REPTILES

American Crocodile

Biscayne National Park and Everglades National Park



*Crocodile eggs in an
Australian pine stand*

American crocodiles (*Crocodylus acutus*) are the most widely distributed New World crocodiles, ranging from southern Florida to northern South America. Their habitat consists of freshwater or brackish water coastal inlets, lagoons, and mangrove swamps. This species was listed as endangered in 1975 largely because of hunting and a loss of habitat (destruction of coastal mangroves and beach development). The American crocodile is a large species, with males reaching lengths of 15 to 18 feet (Ross n.d.). American crocodiles feed at night, primarily eating fish and other aquatic species, including turtles and crabs. They also eat birds (Britton 2002). American crocodiles utilize holes or mounds for nesting and can use a variety of environments to construct their nests. They are found in the marine and brackish waterways of Biscayne National Park and Everglades National Park. Soil disturbance tends to attract American crocodiles seeking nesting sites (NPS 2002b). They nest during the dry season (November through April) to avoid exposing their eggs to the high water table associated with rainy weather (Britton 2002).

Atlantic Salt Marsh Snake Canaveral National Seashore

The Atlantic salt marsh snake (*Nerodia clarkia taeniata*) is a small, slender, nonvenomous snake that inhabits coastal salt marshes and mangrove swamps, which vary in salinity from brackish to full strength seawater. This snake was listed as a threatened species because of habitat loss and alteration, as well as potential hybridization with adjacent freshwater species. The Atlantic salt marsh snake use of marsh habitats may be limited by water level, with extreme fluctuations making the marsh too hydric or xeric. Although the Atlantic salt

marsh snake is most easily observed at night, it may be active any time of the day (USFWS 1999b). Its activity is influenced by tidal cycles, which strongly influence the availability of food. It feeds on small fishes, crabs, shrimp, and other invertebrates trapped in isolated pools of water by the falling tide (Florida Museum of Natural History 2005).

Eastern Indigo Snake

Big Cypress National Preserve, Biscayne National Park, Canaveral National Seashore, and Everglades National Park

The Eastern indigo snake (*Drymarchon corais couperi*) is a large, docile, nonvenomous snake that has declined in numbers over the last 100 years because of the loss of habitat, pesticide use, and collection for the pet trade. The snake uses the burrows of other animals for denning, or to lay eggs. The preferred diet of these snakes is frogs, other snakes, toads, salamanders, small mammals, and birds. The presence of exotic plants would not directly affect the Eastern indigo, but if the habitat becomes a monoculture of Brazilian pepper or melaleuca, the prey species and the burrowing animals it depends on to provide denning sites would decline. This would indirectly contribute to the decline of this species (USFWS 1996b).

Green Sea Turtle

Biscayne National Park, Canaveral National Seashore, Dry Tortugas National Park, Everglades National Park, Buck Island Reef National Monument, Salt River Bay National Historic Park and Ecological Preserve, and Virgin Islands National Park

The green sea turtle (*Chelonia mydas*) was listed as endangered/threatened in 1978, with the greatest cause of population decline being commercial harvest for eggs, food, skin, and shells for jewelry curios. The breeding populations off Florida and the Pacific coast of Mexico are listed as endangered, while all others, including those found in the Caribbean parks, are threatened (NMFS 2005a). During the day, green sea turtles feed in the seagrass beds that grow in shallow waters. At night, they sleep on the shallow bottom and sometimes out of the water on rocky ledges. Present estimates range from 200 to 1,100 females nesting on U.S. beaches (NMFS 2005a), and almost all U.S. nesting occurs on eastern Florida beaches between May and September (Ehrhart 1992). Although green sea turtles feed in seagrass beds in park waters off St. John, they are infrequent nesters on Virgin Islands National Park's beaches. Green sea turtles are, however, known to nest on Buck Island (NPS 2004c). Invasion of exotic plants into dune areas, which are often less stabilizing than native plants, is attributed to increased erosion and degradation of suitable nesting habitat. In south Florida, Australian pine is the most detrimental threat (USFWS 1999b).



Hawksbill Sea Turtle

Biscayne National Park, Canaveral National Seashore, Dry Tortugas National Park, Everglades National Park, Buck Island Reef National Monument, Salt River Bay National Historic Park and Ecological Preserve, and Virgin Islands National Park

The federally endangered Hawksbill sea turtle (*Eretmochelys imbricata*) is a small to medium-sized sea turtle, ranging worldwide throughout the tropics. In the Caribbean, nesting females average about 24 to 37 inches in straight carapace length (Meylan 1992). Weight is typically to 176 pounds in the wider Caribbean. Post-hatchling Hawksbills occupy the pelagic environment, but juveniles through adults utilize coral reefs as foraging habitat and prey on sponges. Hawksbills are also known to inhabit mangrove-fringed bays and estuaries, particularly along the eastern shore of continents where coral reefs are absent. Both insular and mainland nesting sites are known. Hawksbills will nest on small pocket beaches and exhibit a wide tolerance for nesting substrate type. Nests are typically placed under vegetation (NMFS 2005b). In Florida, only a few hawksbill nests are documented each year (Meylan 1992).

Kemp's Ridley Sea Turtle

Biscayne National Park, Canaveral National Seashore, Dry Tortugas National Park, and Everglades National Park

Kemp's ridley sea turtles (*Lepidochelys kempii*) are the smallest of all extant sea turtles, with the weight of an adult generally being less than 100 pounds. Hatchling Kemp's ridleys feed on the available sargassum and associated fauna found in the Gulf of Mexico. Juvenile and adult Kemp's ridleys are largely crab-eaters, with a preference for portunid crabs, and they live in a wide variety of coastal benthic habitats, usually sand or mud bottoms. The major nesting beach for Kemp's ridleys is on the northeastern coast of Mexico. The species occurs mainly in coastal areas of the Gulf of Mexico and the northwestern Atlantic Ocean. The Kemp's ridley was listed as endangered throughout its range in 1970, and its status remains the same. The decline of this species was primarily because of human activities, including collection of eggs, fishing for juveniles and adults, killing adults for meat and other products, and incidental taking by shrimp trawlers. Nesting in Florida is incidental, but adult Kemp's ridleys can be found in Florida's coastal waters (Meylan 1992).

Leatherback Sea Turtle

Biscayne National Park, Canaveral National Seashore, Dry Tortugas National Park, Everglades National Park, Buck Island Reef National Monument, Salt River Bay National Historic Park and Ecological Preserve, and Virgin Islands National Park

The federally endangered Leatherback sea turtle (*Dermochelys coriacea*) is the largest living turtle. It is so distinctive that it is placed in a separate taxonomic family (NMFS 2005c). The bulk of the Leatherback diet consists of jellyfish (Pritchard 1992). The Leatherback sea turtle is an extremely wide-ranging species. Nonbreeding ones in the Atlantic have been found from Canada to Argentina, while breeding adults nest on tropical, usually mainland, shores in the Atlantic, Indian, and Pacific Oceans (Pritchard 1992). Critical habitat for the



Leatherback includes the waters adjacent to Sandy Point, St. Croix, U.S. Virgin Islands. In the U.S., nesting occurs from February to July, with sites located from Georgia to the U.S. Virgin Islands. During the summer, leatherbacks tend to be found along the east coast of the U.S., from the Gulf of Maine south to the middle of Florida. The population faces significant threats from the incidental taking of commercial fisheries, marine pollution, the harvest of eggs and flesh, and habitat destruction (NMFS 2005c).

Loggerhead Sea Turtle

**Biscayne National Park, Canaveral National Seashore,
Dry Tortugas National Park, and Everglades National Park**

The federally threatened Loggerhead sea turtles (*Caretta caretta*) are throughout the world, inhabiting continental shelves, bays, estuaries, and lagoons in temperate, subtropical, and tropical waters. Loggerhead turtles have a varied diet but feed mainly on mollusks, crustaceans, and horseshoe crabs (Dodd 1992). In the Atlantic, the Loggerhead turtle's range extends from Newfoundland to as far south as Argentina. During the summer, nesting occurs in the lower latitudes. Mating takes place in late March to early June, and eggs are laid throughout the summer. The primary Atlantic nesting sites are along the east coast of Florida, with additional sites in Georgia, the Carolinas, and the Gulf Coast of Florida. Genetic research has identified a distinct south Florida subpopulation, found from northeast Florida and extending up to Naples on Florida's west coast. The Loggerhead turtle was listed as threatened throughout its range in 1978, with the most significant threats to the Loggerhead turtle populations being coastal development, commercial fisheries, and pollution. Loggerhead turtles are the most abundant species in U.S. coastal waters, and are often captured incidentally by shrimp trawling (NMFS 2005d).

BIRDS

Audubon's Crested Caracara Everglades National Park

The federally threatened Audubon's crested caracara (*Polyborus plancus audubonii*) is a hawk about the size of an osprey, but with shorter wings. The crested caracara occupies open country, predominantly dry prairie with wetter areas and scattered cabbage palm (*Sabal palmetto*). They also occur in some improved pasture lands and even in lightly wooded areas with a more limited stretch of open grassland. The crested caracara is an opportunistic feeder whose diet includes both carrion and living prey. The living prey are usually small turtles and turtle eggs, as well as insects, fish, frogs, lizards, snakes, birds, and small mammals. The crested caracara's breeding season lasts from January to March, with the usual clutch being two or three eggs. Threats to remaining populations include habitat loss and susceptibility to natural disturbances, such as hurricanes, and human-caused disturbances, such as poisoning (pesticides, herbicides, etc.) (USFWS 2005f).

Clutch—A nest of eggs or the number of eggs produced or incubated at one time.

Bald Eagle

Big Cypress National Preserve, Biscayne National Park, Canaveral National Seashore, Dry Tortugas National Park, and Everglades National Park

With its white head and tail and dark body, the federally threatened bald eagle (*Haliaeetus leucocephalus*) is one of the most recognizable of American birds. These large predators may weigh as much as 14 pounds, with a wingspan of 8 feet. Bald eagles feed largely on fish and, occasionally, on reptiles and amphibians, and tend to be found near the seacoast and along the banks of rivers and lakes. Nesting habitat includes a nest tree, perch, and roost sites, and adjacent high-use areas. Generally, bald eagle nesting habitat is adjacent to, or near, large bodies of water that are used for foraging. In south Florida, nesting activities generally begin in early September, with egg-laying occurring as early as late October, and peaking in the latter part of December. Depending on latitude, incubation may be initiated from as early as October to as late as March. Clutches usually consist of one or two eggs, but occasionally three or four are laid. Loss of habitat and loss of food resources through pollution, overfishing, and habitat modification contributed to the decline of the bald eagle. As top-level consumers in the food chain, bald eagles are also vulnerable to bioaccumulation of toxins such as pesticides such as DDT and heavy metals such as mercury (USFWS 1999b).

Brown Pelican

Buck Island Reef National Monument and Virgin Islands National Park

The brown pelican (*Pelecanus occidentalis*) is currently designated by the USFWS as endangered in the entire US, with the exception of the U.S. Atlantic Coast, Florida, and Alabama, where the population recovered and was delisted in 1985. The brown pelican is known to occur in Buck Island Reef National Monument and Virgin Islands National Park, where it is federally endangered, and also occurs in all of the Florida parks. The brown pelican is a large, brown, water bird, with a white head and neck. Young brown pelicans have a gray head and neck and a white underbelly. Brown pelicans nest in colonies on coastal islands. Nests are generally built in mangrove trees, but ground nests are also used. Nest types vary from practically nothing to well-built structures of sticks, reeds, palmetto leaves, and grass. The eastern subspecies, *Pelecanus occidentalis carolinensi*, nests in early spring or summer, although fall and winter nesting have been recorded in some localities. The Caribbean subspecies, *Pelecanus occidentalis occidentalis*, begins nesting between May and August, but the season is at its peak during September through November. Normal clutch size for the brown pelican is three eggs (USFWS 2005g). The diet of the brown pelican consists of fish and sometimes crustaceans.

Cape Sable Seaside Sparrow

Big Cypress National Preserve and Everglades National Park

The Cape Sable seaside sparrow (*Ammodramus maritimus mirabilis*) is an endangered, ecologically isolated subspecies of the seaside sparrow. Recent surveys estimate the population at approximately 3,000 individuals, all of which are restricted to the marl prairies of Big Cypress National Preserve and Everglades National Park (USGS 2003). The Cape Sable seaside sparrow has



specific habitat preferences: dense stands of graminoid species less than 1 meter in height and naturally inundated by freshwater during part of the year. The sparrow has a generalist diet; it commonly feeds on soft-bodied insects such as grasshoppers, spiders, moths, caterpillars, beetles, dragonflies, wasps, marine worms, shrimp, grass and sedge seeds, and tends to shift the importance of prey items in response to their availability (USFWS 1999b). The Cape Sable seaside sparrow's breeding season typically extends over nearly half of the year. Nesting may begin as early as late February and may persist into early August. The amount of summer nesting, which essentially means the number of third broods attempted, may depend on the characteristics of individual rainy seasons. Nesting activity decreases abruptly when the marsh they depend on becomes flooded (USFWS 2005h). Pimm and others (2004) attributes to high water elevations the recent decline in the species from 6,000 in 1992, but stated that the exotic plants encroaching into its habitat are also threatening the population. Woody species, such as melaleuca and Brazilian pepper, have a more permanent impact on the habitat of the Cape Sable seaside sparrow than the water elevation fluctuations, by altering the marsh character of the marl prairies.

Everglade Snail Kite

Big Cypress National Preserve and Everglades National Park

The Everglade snail kite (*Rostrhamus sociabilis plumbeus*) is an endangered raptor that inhabits the freshwater marshes and marl prairies of the Florida peninsula. The species' breeding season varies within a period extending from February into July. The exact dates are influenced by prevailing weather conditions. The Everglade snail kite feeds almost exclusively on the apple snail (*Pomacea paludosa*), so the continued existence of this snail decides the fate of the snail kite. The apple snail lives in freshwater wetlands with sparsely distributed emergent vegetation consisting predominantly of grass and sedge species. While managing the hydrology of these marshes is important to the survival of the snails, maintaining the vegetative composition is also important. Infestation of woody species, such as Brazilian pepper and melaleuca, would probably cause a decline in the apple snail and snail kite populations (USFWS 1996b).

Florida Scrub Jay

Canaveral National Seashore

The Florida scrub jay (*Aphelocoma coerulescens coerulescens*) is federally listed as threatened because of its decline and the loss and degradation of its habitat. This relative of the common blue jay has very specific habitat requirements, preferring brushy oak scrub, 5 to 15 years old, with large patches of open, sandy spaces. The majority of scrub oak habitat that has not been cleared for development has grown too high for the Florida scrub jay because of the suppression of the natural fire cycle. Brazilian pepper infestations also degrade the habitat for Florida scrub jays, and the manual removal of these species is recommended prior to burning. Insects comprise the majority of the scrub



Florida scrub jay

jay diet, while they also commonly consume scrub oak acorns. Nesting normally occurs from March through June, with an average clutch size of three or four eggs (USFWS 1999b).

Piping Plover

Biscayne National Park, Everglades National Park, and Virgin Islands National Park

The piping plover (*Charadrius melodus*) is designated as threatened by the USFWS in the entire U.S., except in the Great Lakes watershed, where it is listed as endangered. The piping plover is a small, stocky, sand-colored bird resembling a sandpiper. Atlantic Coast piping plovers use open, sandy beaches that are close to the primary dune of the barrier islands and coastlines of the Atlantic for breeding. They prefer sparsely vegetated open sand, gravel, or cobble for a nest site, and forage along the rack line, where the tide washes up onto the beach. The piping plover feeds primarily on marine, freshwater, and terrestrial invertebrates. The breeding season for piping plovers can begin in late March or early April and extend through August, usually occurring along beaches in the northeastern U.S. and Canada. Piping plovers winter primarily on the Gulf Coast, in Florida, Texas, Louisiana, and Alabama, as well as the southern Atlantic Coast (USFWS 2005i). Piping plovers are considered rare summer migrants to Virgin Islands National Park (NPS 2004e).

Red-cockaded Woodpecker

Big Cypress National Preserve

The red-cockaded woodpecker (*Picoides borealis*) is a federally endangered species that has declined from widespread populations throughout the southeast to 30 disjunct populations totaling about 11,000 birds. Much of the red-cockaded woodpecker's life is centered around large, open stands of mature pine (75 to 100 years old) that are maintained naturally by lightning-started fires that occur about every 1 to 5 years. The red-cockaded woodpecker requires mature pine trees to provide ample foraging surface area and to hold nest and roost cavities, which are typically located close together in areas called clusters. Red-cockaded woodpeckers forage in a wide variety of pine species and especially favor areas that contain large trees, which have a large surface area and loose bark. They feed on adults, larvae, and eggs of arthropods, especially ants and termites that they find by flaking bark from the tree (USFWS 1996b). This species can be affected by exotic plants in several ways. Brazilian pepper in the understory can provide fuel for catastrophic fires that can destroy the pines in which the woodpeckers nest. In addition, Old World climbing fern can create "fire ladders" into the pine canopies, allowing normal seasonal fires to destroy trees rather than sweep through harmlessly in the understory.

*Arthropods—
Invertebrate
animals with
jointed legs,
including insects,
crustaceans, and
spiders.*

Roseate Tern

Dry Tortugas National Park, Everglades National Park, and Virgin Islands National Park

The Roseate tern (*Sterna dougallii dougallii*), a medium-sized, slender, marine coast sea bird, feeds on small fish by plunging into the water. There are two



populations of the roseate tern in the Western Hemisphere, the northeastern population (New York through Canada) and the Caribbean population (Florida Keys through the West Indies to islands off Central America and northern South America). Although the northeastern population is federally listed as endangered, the Caribbean population, including Florida and the Virgin Islands, is listed as threatened by the USFWS. Roseate terns breed primarily on small offshore islands, rocks, cays, and islets, on a variety of bare substrates. The Caribbean birds nest in relatively open areas, often with no cover nearby. Hunting, eggging, and habitat loss threaten roseate tern populations. Predators (gulls and domestic animals) and human disturbance also threaten them. Roseate terns usually arrive in late April and initiate nesting in late May. The roseate terns usually lay one or two eggs, and chicks fledge after 22 to 29 days of age (Smith 1996).

Wood Stork

Big Cypress National Preserve, Biscayne

National Park, Canaveral National Seashore, and Everglades National Park

Wood storks (*Mycteria americana*) are birds of freshwater and brackish wetlands, primarily nesting in cypress or mangrove swamps. They feed in freshwater marshes, narrow tidal creeks, or flooded tidal pools, primarily on fish between 2 and 25 centimeters in length (USFWS 1999b). Particularly attractive feeding sites are depressions in marshes or swamps where fish become concentrated during periods of falling water levels. The United States breeding population of the wood stork declined from an estimated 20,000 pairs in the 1930s to about 10,000 pairs by 1960. Since 1978, fewer than 5,000 pairs have bred each year. The decline is believed to be due primarily to the loss of suitable feeding habitat, especially in south Florida rookeries, where repeated nesting failures have occurred despite protection of the rookeries. Feeding areas in south Florida have decreased by about 35% since 1900 because of human alteration of wetlands. Additionally, human-made levees, canals, and floodgates have greatly changed natural water regimes in south Florida. These human-made alterations have resulted in the influx of exotic plants in south Florida, which also affects the freshwater wetlands, exacerbating the hydrological effects (USFWS 1996b). *Melaleuca* and Brazilian pepper change the character of the marshes to shrub swamps unsuitable for the foraging tactics used by the wood storks. Old World climbing fern can destroy a cypress swamp that may provide habitat for a rookery. The Old World climbing ferns climb into the canopies of the cypress trees, weaken the trees, and eventually pull them down. The nesting season of wood storks vary geographically, but in Florida the nesting season can extend from early October to late June (USFWS 1999b).



*Wood stork at
Everglades
National Park*

INVERTEBRATES

Miami Blue Butterfly

Biscayne National Park, and Everglades National Park

The Miami blue butterfly (*Cyclargus thomasi bethunebakeri*) is a small, brightly colored butterfly whose population is threatened by habitat loss and

fragmentation. This species is known to inhabit tropical coastal hammocks, pinelands, pine rocklands, and open coastal areas. This species is currently a candidate species for listing by the USFWS. Reintroduction efforts have been underway since May 2004, when six rounds of releases occurred at eight locations within Everglades National Park and one location within Biscayne National Park. Adults of the Miami blue butterfly have been found to nectar at a wide variety of flowers, both native and exotic, some of which are Spanish needles (*Bidens alba*), Leavenworth's tickseed (*Coreopsis leavensorthi*), buttonsage (*Lantana involucrata*), and the exotic Brazilian pepper. Suitably open habitat and nectar sources in close proximity are critical to the survival of this species because of the Miami blue butterfly's observed colonial habit and sedentary behavior (USFWS 2005j).

Schaus Swallowtail Butterfly **Biscayne National Park**

Schaus swallowtail butterfly (*Papilio aristodemus ponceanus*) is a resident of the Florida Keys and the larger keys of Biscayne National Park. The federally endangered Schaus swallowtail butterfly frequents hardwood hammocks throughout its life cycle, primarily using citrus, torchwood, and wild lime (*Zanthoxylum fagara*) as host plants in their larval form, and nectar from blossoms of cheese shrub (*Morinda royoc*), blue porterweed (*Stachytarpheta jamaicensis*), sea grape (*Coccoloba uvifera*), wild sage (*Lantana involucrata*), wild coffee (*Psychotria nervosa*), or guava (*Psidium guajava*) along the margins of the hardwood hammocks. Up to 30 different wild plant species may be exploited. The major reasons for the decline of this species are the loss of the hardwood hammock habitat to development and the use of pesticides. However, the infestation of lather leaf in the tropical hardwood hammock could result in the decline of the trees and shrubs necessary to the survival of the Schaus swallowtail butterfly (USFWS 1999b).

Stock Island Tree Snail **Big Cypress National Preserve and Everglades National Park**

The Stock Island tree snail (*Orthalicus reses reses*) is a large conical snail with a white and purple-brown striped shell. The Stock Island tree snail grazes on lichens and fungi growing on trees and stems of the native vegetation in tropical hardwood hammocks in the Florida Keys. The Stock Island tree snail is listed as threatened by the USFWS, and, historically, was found only on Stock Island and Key West in the Florida Keys. The Stock Island tree snail was introduced to Everglades National Park and Big Cypress National Preserve by collectors in the late 1980s. Between 1987 and 1994, the presence of the Stock Island tree snails at Everglades National Park was reported, but by 1995, surveys revealed the Stock Island tree snails were no longer present. The disappearance of the Stock Island tree snails from Everglades National Park may be because of over-collecting, hurricanes, exotic plant infestation in their habit, competition from other native snails, or the inability to adapt to their relocation surroundings. The status of the populations in Everglades National Park and Big Cypress National Preserve is considered to be declining or extirpated (USFWS 1999b). The Stock Island tree snail feeds on epiphytic growth on hardwood tree trunks, branches,

*Epiphytic—One
organism living
within or upon
another without
causing harm.*



and leaves. Little is known about the feeding habits or food preferences of this snail, but probable food items include a variety of fungi, algae, and lichens found on many of the native hammock trees (USFWS 1999b).

STATE AND TERRITORY LISTED SPECIES

State and territory listed species of concern may occur within the 9 parks. Appendix O contains the list of state or territory species of special concern known to occur or have habitat within each park. For the Florida parks, the lists also provide the current species status as endangered, threatened, or a species of special concern. These lists are subject to change as species are added, removed, or recategorized. For the Caribbean parks, these species are known to occur or have habitat on the individual islands on which the parks occur. Not all of these species are known to occur within the parks.



WILDLIFE AND WILDLIFE HABITATS

SAWGRASS MARSH / WET PRAIRIE / FRESHWATER MARSH

**Big Cypress National Preserve,
Everglades National Park, and Canaveral National Seashore**

These important ecosystems are quickly being overtaken by exotic woody species such as melaleuca and Brazilian pepper, which are altering the structure and hydrology of the ecosystem and reducing the quality of the habitat for wildlife (Gordon 1998). The exotic shrubs and trees shade out the important graminoid species on which numerous wildlife species rely. They also can change the surface water flow and increase evapotranspiration rates so that the available water decreases or the seasonal water fluctuations are disrupted. Melaleuca has the ability to build soil elevations and completely change the character of the freshwater marsh. There are extensive freshwater herbaceous wetlands within Big Cypress National Preserve and Everglades National Park and a limited amount at Canaveral National Seashore.

MAMMALS

The south Florida marshlands are habitat for at least 10 mammal species, including the largest and most endangered mammal in the state, the Florida panther (*Felis concolor coryi*). Probably the most common mammal species include raccoons (*Procyon lotor*) and marsh rabbits (*Sylvilagus palustris*). Otters are more at home in water than on land but are usually seen only in the dry season. Cotton mice (*Peromyscus gossypinus*) or cotton rats are seldom found in the melaleuca strands, but they do occur in the freshwater marshes and wet prairies, especially in the ecotonal areas. Rice rats (*Oryzomys* spp.) move between hammock islands, indicating that they would also occur in the freshwater marshes, even if only in transit. Other rodents include the exotic house mouse (*Mus musculus*) and the muskrat or Florida water rat (*Neofiber alleni*). Everglades mink (*Mustela vison*) are rare, but they can be found in the true Everglades region of south Florida. Most mink are generally found in sawgrass habitat but retreat from marshland as it dries. Mink and other mammals are likely to be indirectly impacted by exotic plants encroaching on their foraging habitat (U of M 2003).

*Ecotonal—A zone
of transition between
two different
ecosystems, for
example, where the
sea meets the land.*

AMPHIBIANS AND REPTILES

Some of the turtle species that inhabit freshwater include the mud turtle (*Kinosternon Obauri* and *K. subrubrum*), musk turtle (*Sternotherus odoratus*), Florida cooter (*Chrysemys floridana*), and red-bellied turtle (*C. nelsoni*). Many species found in freshwater marshes also use prairies. During wet periods, marsh species move into the wet prairie, and upland species use the wet prairie when it is dry. Some common species to these areas include the American alligator (*Alligator mississippiensis*) leopard frog (*Rana sphenoccephala*), pig frog (*R. grylio*), bullfrog (*R. catesbeiana*), green tree frog (*Hyla cinerea*), fire-bellied newt (*Cynops orientalis*), dwarf siren (*Pseudobranchius striatus*), green water snake (*Nerodia cyclopion*), swamp snake (*Seminatrix pygaea*), and cottonmouth



(*Agkistrodon piscivorus*). The rare black swamp snake was recently found in a freshwater swale on the mainland section of Canaveral National Seashore.

The survival of these species is directly affected by exotic plant infestation. The hydrological and structural changes that occur in the freshwater marshes and wet prairies when they have become overrun by melaleuca and Brazilian pepper create an environment that is hostile to these species.

BIRDS

Birds that breed or forage in the freshwater marshes of Canaveral National Seashore, Everglades National Park, and Big Cypress National Preserve parks, include raptors, wading birds, song birds, corvids, ducks, and numerous other birds. These birds are directly and indirectly affected by the influx of exotic plants. Some birds, such as robins, eat Brazilian pepper seeds and are largely responsible for dispersing the seeds during their migration. Other birds, such as those that depend on the grassy marshes for foraging and breeding, are declining in number, because their habitat is lost to the encroachment of Brazilian pepper and melaleuca.

FISH

At least 30 fish species are present in freshwater marsh or wet prairie habitat. Of these 30 species, only 16 are found in the sawgrass marshes. Small species of killifish (*Cyprinodontidae*), live-bearers (*Poeciliidae*), and juvenile sunfish (*Centrarchidae*) are the common inhabitants of spikerush and sawgrass. The killifish and live-bearers are short-lived, rapidly growing species that respond to favorable conditions with rapid increases in population. The deeper, open-water alligator holes are used by larger fish, such as Florida gar, yellow bullhead, and adult sunfish, although smaller species including mosquito fish and sailfin molly are also common. The majority of common species in the marsh are omnivorous, while a smaller number are mainly herbivorous, detritivorous, or predators of fish and decapods (U of M 2003).

Freshwater fish are a mainstay of the Everglades food chains. They provide the diet for alligators, otters, wading birds, and other predators. Herbivorous species include the golden shiner, sailfin molly, least killifish, and flagfish. Other fish (such as golden topminnows, marsh killifish, mosquito fish, bullheads, red ear sunfish, and bluegills), feed on invertebrates, many of which graze on plants. Adult Florida gar, warmouth, and largemouth bass feed principally on other fish, and are in turn the vital food supply for other predators.

Studies have shown that some exotic plant species, such as melaleuca, have the ability to modify rainfall interception, surface water flow, evapotranspiration rates, and, possibly, ground and surface water table levels (Gordon 1998). The impacts on the freshwater supply have long-range effects on the freshwater habitat and on all trophic levels throughout Everglades National Park.



INVERTEBRATES

Amphipod,
chydorid
cladocerans,
odonates, and
dipterans—
Types of
crustaceans,
insects, and
water fleas.

Aquatic invertebrates include two mayflies, a few snails, and one amphipod, while chydorid cladocerans, odonates, and dipterans are diverse. The Florida apple snail is an important freshwater mollusk because of its predation by a variety of wildlife, including young alligators and numerous birds. The most publicized example is the snail kite, a hawk-like bird that feeds exclusively on the apple snail and, thus, completely depends on water levels and open freshwater wetlands to maintain the snail's habitat. The limpkin, a wading bird related to cranes, also depends heavily on the apple snail (U of M 2003).

The crayfish (*Procambarus alleni*) is prevalent in the Florida peninsula and is the only species of crayfish adapted to the motionless waters of marshes and the alternating wet and dry seasons of the region. Crayfish are important prey for largemouth bass, pig frogs, young alligators, and wading birds, particularly the white ibis, especially during the early portion of the nesting season. The freshwater prawn (*Palaemonetes paludosus*) of south Florida, is much smaller than the crayfish. These shrimps can reach very high densities during the wet season, and are prey items of larger fish and many birds (U of M 2003).

Aquatic insects are important in the food chain of the Everglades, as they are in all freshwater habitats. Numerous insects (for example, water scavenger beetles, water boatmen, and giant water bugs) are totally aquatic but have retained the ability to fly and would attempt to relocate if their environments dry up. Most species that inhabit aquatic habitats, however, live in the water only as larvae and emerge to live in the air as adults. Prominent examples are mosquitoes, mayflies, damselflies, and dragonflies. Their dual lifestyles represent a significant transfer of energy from aquatic to terrestrial environments, where flying insects are important in the diets of many birds.

All of these important prey species depend on a herbaceous freshwater habitat that is declining because of exotic-plant infestation.

COASTAL MARSH

**Big Cypress National Preserve, Biscayne National Park,
Canaveral National Seashore, Everglades National Park, Salt River Bay
National Historic Park and Ecological Preserve, and Virgin Islands National Park**

Salt marshes are found at the unshaded interface of land and sea and support salt-tolerant plants that are occasionally inundated. This environment is dynamic and very stressful for the animal life within because of the dramatic, irregular, sudden fluctuations in salinity and water level. It is difficult for most species to adapt to these extremes, but hardy terrestrial mammals and other vertebrates use the salt marshes for transient daily activities. These few species that can adapt are often abundant since production is high and diversity is low (Montague and Weigert 1990). Only five or six fish, reptile, bird, or mammal species are considered residents of salt marshes. The few successful salt-marsh species are widely distributed throughout Florida and southeastern U.S. The distribution and diversity of species are remarkably similar from marsh to marsh.



MAMMALS

The most common terrestrial mammal to use the salt marsh consistently for both feeding and nesting is the rice rat (*Oryzomys palustris*). Along with raccoons, they are effective egg predators and feed on a variety of bird and reptile eggs in and around the salt marshes. The roundtailed muskrat (*Neofiber alleni*) is also a frequent visitor to the marsh.

AMPHIBIANS AND REPTILES

Salt-tolerant amphibians and reptiles, such as the southern leopard frog (*Rana sphenocephala*) and the American alligator, use the salt marshes, as do the diamondback terrapin (*Malaclemys terrapin*) and salt marsh snake (*Nerodia fasciata clarkii*). These species cannot tolerate full-strength seawater and prefer these marshes to the nearby lagoons (Montague and Wiegert 1990).

BIRDS

There are three species of bird that are exclusive to salt marshes: clapper rails (*Rallus longirostris*), long-billed marsh wrens (*Cistothorus palustris*), and seaside sparrows (*Ammodramus maritimus*). These birds use the stems and leaves of salt marsh plants to construct nests that are raised to avoid all but the highest tides. Other birds that visit the marsh to forage are the cattle egret (*Bubulcus ibis*) and several species of swallows (Montague and Wiegert 1990).

FISH

The principal salt marsh habitats for fish are tidal creeks and pools. The more common fish in saltmarsh creeks and pools include minnows: killfishes (*Fundulus* spp. and *Cyprinodon variegates*), livebearers (*Gambusia* spp. and *Poecilia latipinna*), and silversides (*Menidia* spp.). Spot (*Leiostomus xanthurus*), mullet (*Mugil* spp.) and pinfish (*Lagodon rhomboids*) also occur. Salt-marsh creeks and ditches also contain tarpon (*Megalops atlanticus*), snook (*Centropomus undecimalis*), and several drums and croakers who feed on the abundant minnows and juvenile spot, mullet, and pinfish (Montague and Wiegert 1990).

INVERTEBRATES

The stems and leaves of salt marsh plants provide the basis for a grazing food web. The invertebrates that graze here include abundant herbivorous insects, such as planthoppers (*Prokelesia* spp.), snails (*Littorina* and *Melampus* spp.), and marsh crabs (*Sesarma* spp.). These species, in turn are preyed upon by carnivores, varying from tissue-eating grasshoppers (*Orchelimum* and *Conocephalus* spp.) to cattle egrets. Several ant species, wolf and other spiders, wasps, and fiddler crabs also find the salt marshes useful as a residence or for transient use (Montague and Wiegert 1990).



WETLAND FOREST

Big Cypress National Preserve, Biscayne National Park, Canaveral National Seashore, Dry Tortugas National Park, and Everglades National Park

Drawdown—
Lowering of the
surface elevation
of a body of water
by pumping or
otherwise
withdrawing
water.

Forested wetlands include cypress swamps and bay swamps in the south Florida parks. There are no forested wetland areas in the Caribbean parks because of the rocky terrain, topography, and climate. Forested wetlands are especially vulnerable to exotic-plant infestation when hydrological cycles are disturbed, such as during droughts or when human intervention has caused draining or drawdown. One exotic plant especially threatening to wetland forests is Old World climbing fern. This species requires no disturbance to become established in a forested wetland, and its effects can be devastating.

MAMMALS

Most mammals that live in forested wetlands occupy the ecotones between herbaceous systems and the forested wetlands. At least 15 mammal species forage, den, nest, or take refuge in forested wetlands and the areas around them. These mammals include large predators, such as the Florida panther and the black bear, as well as prey species, such as the white-tailed deer, bats, and small rodents (U of M 2003).

AMPHIBIANS AND REPTILES

During the summer, reptiles and amphibians dominate forested-wetland vertebrate communities, while birds become more abundant in winter. Reptiles and amphibians are prevalent in forested wetlands because of their ability to adapt to the fluctuating water regime. The relatively high winter temperatures allow them to remain active through the cooler seasons. Two of the best-known reptiles are the American alligator (*Alligator mississippiensis*) and the cottonmouth moccasin (*Agkistrodon piscivorus conati*), a poisonous water snake. Other water snakes, such as several species of *Natrix*, are usually more important in terms of number and biomass (U of M 2003).

In addition, huge aquatic salamanders called “sirens” (*Amphiuma means*), striped crayfish snake (*Regina alleni*), and the glossy crayfish snake (*Regina rigida*) can be found in swamps (Ewel 1990; University of Georgia n.d ref added). Cypress swamps lack understory and are not often used by amphibians and reptiles (except alligators), while still-water swamps are the ideal habitat for all amphibians and frogs because of the wet-dry cycles that occur. Amphibians and reptiles that rarely occur outside this kind of swamp include: the marbled salamander (*Ambystoma opacum*), four-toed salamander (*Hemidactylium scutatum*), dwarf siren (*Pseudobranchius striatus*), bird-voiced tree frog (*Hyla avivoca*), mud snake (*Farancia abacura*), and rainbow snake (*F. erythrogramma*) (Ewel 1990).



BIRDS

Bird densities are higher in forested wetlands during winter, mostly because of the presence of wintering birds. The forested wetland habitat includes raptors, canopy-feeding passerines, a few mid-story species, and the wood duck. The forested wetlands of south Florida are essential to migratory birds as a place to rest and to feed (U of M 2003).

Passerine—Relating to the largest order of birds, which includes more than half of all living birds and consists primarily of perching songbirds, whose young are hatched in an immature and helpless condition.

FISH

There is not a great deal of available material on the types of fish found in forested wetlands. An obvious assumption is that density and biomass increase during the dry season, because the forested wetlands remain flooded while the water levels fall in the surrounding habitats. During these times, the forested wetlands often become the only forage areas for piscivorous species.

Piscivorous—Fish that feed on other fish.

MANGROVE

Big Cypress National Preserve, Biscayne National Park, Canaveral National Seashore, Dry Tortugas National Park, Everglades National Park, Buck Island Reef National Monument, Salt River Bay National Historic Park and Ecological Preserve, and Virgin Islands National Park

Mangrove wetlands are found in eight of the nine parks of the study area, with Christiansted National Historic Site as the only exception. Biscayne National Park protects a 14-mile stretch of mangroves, the longest stretch of mangroves on the east coast of Florida. Mangroves are important not only as habitat but as buffer areas against tropical storms and as filters of storm-water runoff, protecting coastal waters. Habitats adjacent to mangroves can be infested, which could affect the health and survival of mangroves.

MAMMALS

A number of medium-sized and large carnivores appear to use south Florida mangrove areas, but only three of these species are common: the bobcat, striped skunk, and raccoon. Two species of marine mammals, bottle-nosed dolphin and West Indian manatee, frequent mangrove-lined waterways. The dolphin feeds on mangrove-associated fish. Although the manatee feed primarily on sea grasses and other submerged aquatic plants found outside the mangroves, the manatee commonly appears in canals, coastal rivers, and embayments close to mangrove swamps (U of M 2003). The decline of the mangrove habitat to Brazilian pepper encroachment or shading by Australian pines would affect these important species. Manatees are described in greater detail in the “Special Status Species” section in this chapter.

AMPHIBIANS AND REPTILES

Mangroves support at least 10 species of turtles, 3 species of lizards, 6 species of snakes, 3 species of amphibians, and 2 important reptile species: the American alligator and the American crocodile (U of M 2003). The reptiles and amphibians of mangrove forests include species found in the park’s interior, such as the



American alligator, several species of snakes, anoles, and geckos. Alligators are sensitive to saltwater and venture into marine environs only to feed, keeping a freshwater source nearby. The American crocodile is a permanent resident of the ponds and creeks of mangrove estuaries. Crocodiles tolerate a wide variety of salinity because they can osmoregulate (control their own internal salinity levels). However, juveniles lack this ability, and, when the choice is available, will seek freshwater areas, such as black mangrove stands (RECOVER 2004).

Several species of sea turtles occasionally venture into the mangrove estuaries as they forage and all are federally-endangered. These include the hawksbill sea turtle (*Eretmochelys imbricata*), Atlantic Kemp's ridley sea turtle (*Lepidochelys kempfi*), and the green sea turtle (*Chelonia mydas*).

BIRDS

*Avifauna—All
bird species.*

Mangroves present a more diverse structural habitat than most coastal ecosystems. It harbors a greater variety of birdlife than areas such as salt marshes, mud flats, or beaches. The birds present include shorebirds, wading birds, surface-feeding-and-diving birds, passerine and nonpasserine birds, and tree-nesting birds. The composition of the avifauna community in mangrove ecosystems is highly diverse (U of M 2003).

Hérons, egrets, ibises, bitterns, and spoonbills are the most conspicuous groups of birds found in mangrove swamps, which function as breeding habitat and feeding grounds for these and other wading birds. Twenty-nine species of ducks, grebes, loons, cormorants, and gallinules were identified as populating mangrove areas in south Florida. Among the birds of prey, the bald eagle, osprey, and peregrine falcon depend on the mangrove ecosystem, where they feed extensively on the wealth of fish found associated with mangroves (U of M 2003).

FISH

The fish in the mangrove areas include goldspotted killifish (*Floridichthys carpio*), rainwater killifish (*Lucania parva*), pinfish (*Lagodon rhomboides*), mojarras (*Eucinostomus* spp.), spotted seatrout (*Cynoscion nebulosus*), red drum (*Sciaenops ocellatus*), gray snapper (*Lutjanus griseus*), sheepshead (*Archosargus probatocephalus*), black drum (*Pagonias cromis*), and snook (*Centropomus undecimalis*). Wet season conditions introduce a strong freshwater influence, and the presence and importance of freshwater fish increase. The majority of dry season resident fish cannot tolerate the reduced salinity, and depart for the more marine conditions found in Florida Bay. Certain species, like snooks, prefer the low-salinity conditions and remain in the mangroves throughout the year, interacting with the freshwater invaders (USFWS 1999b).

Mangroves are important nursery areas for sport and commercial fish. For example, snappers (*Lutjanus* spp.), spotted sea trout (*Cynoscion nebulosus*), and red drum (*Sciaenops ocellatus*) use the mangroves as a juvenile nursery. The young use the shallows and prop roots as shelter until they are of sufficient size to avoid most predators. The critical value of mangrove systems as nursery



habitats for fish and invertebrates is well established. Sport and commercial fisheries decline when mangrove ecosystems are destroyed (USFWS 1999b).

UPLAND DRY / MESIC FOREST

Big Cypress Preserve, Biscayne National Park, Canaveral National Seashore, Everglades National Park, Buck Island Reef National Monument, and Virgin Islands National Park

Upland forests consist of a diverse number of habitats in Big Cypress National Preserve, Biscayne National Park, Canaveral National Seashore, Everglades National Park, Buck Island Reef National Monument, and Virgin Islands National Park. This category includes such endangered habitats as the tropical hardwood hammocks and pine rocklands of south Florida and the tropical dry evergreen forests that make up the majority of the forested vegetation of the Virgin Islands. It also includes some of the most common habitat in south Florida—pine flatwoods—which are found in Big Cypress National Preserve, Canaveral National Seashore, and Everglades National Park. The hammocks in Canaveral National Seashore include a temperate overstory and tropical understory, reflecting the park's location along the frost line. All of these habitats are important for the myriad of wildlife species they support.

MAMMALS

Of the more than 32 native mammals that use the tropical hardwood-hammocks for foraging, cover, and nesting sites, only 10 are native to this rare habitat (USFWS 1999b). The pine flatwoods and oak-scrub communities of Canaveral National Seashore are home to mice, squirrels, opossums, raccoons, and deer. The only native mammal species in Virgin Islands National Park are six species of bats.

AMPHIBIANS AND REPTILES

Approximately 20 species of reptiles and amphibians can be found in the pine rocklands of south Florida, including the brown anole (*Anolis sagrei*), eastern narrow mouthed toad (*Gastrophryne carolinensis*), greenhouse frog (*Eleutherodactylus planirostris*), southeastern five-lined skink (*Eumeces inexpectatus*), southern leopard frog (*Rana sphenoccephala*), and southern toad (*Bufo terrestris*).

About 13 species of reptiles and amphibians are native to the pine flatwoods and oak scrublands of Canaveral National Seashore (USFWS 1999b). One important species is the gopher tortoise, which is listed as threatened in the state of Florida. The tortoise digs burrows that provide shelter for many commensal species, including the federally listed eastern indigo snake. The tortoise forages on grassy forbs and other species that require full sun. Areas overgrown by Brazilian pepper and melaleuca do not provide suitable habitat for gopher tortoises. In addition to the gopher tortoise, 50 reptile and 19 amphibian species inhabit Canaveral National Seashore, but some of those species are more commonly found near wetlands. Exotic amphibians and reptiles have also made their way to

Commensal—Living with another animal, but not deriving nourishment directly from the host. A symbiotic relationship where only one organism benefits.



the park, including the brown anole, Mediterranean gecko, and Indo-Pacific gecko.

Lizards, especially the common tree lizard (*Anolis acutus*), are the most abundant form of vertebrate life in the upland forests of Virgin Islands National Park and Buck Island Reef National Monument (NPS 1983a). The terrestrial reptiles and amphibians on St. John include the following species: three native frogs, two geckos, three anoles, one tortoise, two lizards, three snakes, and one skink. More species are expected to be discovered during the inventories to be conducted (NPS 2003b).

BIRDS

Tropical hardwood hammocks are very important for migrating birds, because the native vegetation provides forage and cover. An estimated 120 native-bird species have been inventoried in tropical hardwood hammocks in south Florida. These include resident and migratory birds. The hammocks are important for breeding birds, with reported breeding-bird densities of 5 to 13 species, and between 14 and 125 breeding birds per hectare. The most common include cardinal, red-bellied woodpecker, pine warbler, white-eyed vireo, great crested flycatcher, Carolina wren, black whiskered vireo, and blue jay, as well as special-status species described in the “Special Status Species” section in this chapter (USFWS 1999b).

The pine flatwoods and oak scrub communities of Canaveral National Seashore are home to a large number of birds, including game birds, migratory species, and several endangered species, such as the Florida scrub jay and the bald eagle.

In the upland forests of Buck Island Reef National Monument, about 40 species of birds have been recorded, including brown pelicans that roost on the north side of the island.

The upland forests of Virgin Islands National Park support 170 resident and migratory species of birds. The island is an important stopping point on the migratory route, so maintaining the native forests is important to these species.

INVERTEBRATES

Invertebrate species found in tropical hardwood hammocks include ants, moths, skippers and butterflies, and land snails. These species are both temperate and tropical in origin. Other indigenous invertebrates include banded tree snail, crablike spiny orb weaver, Florida tree snail, giant orb weaver, and many-lined drymaeus. Sinkholes provide habitat for isolated populations of many species that would be unable to survive in otherwise drier areas, including crayfish, isopods, and amphipods (Florida Department of Natural Resources 1997).

The pine flatwoods and oak scrub communities of Canaveral National Seashore have representatives of 202 families of arthropods, including 84 insect families.

The invertebrate species of the Virgin Islands National Park and Buck Island Reef National Monument are only recently being investigated. An inventory of terrestrial invertebrates initiated in 1987 has determined that there are at least 1,500 beetle species on St. John and at least 8 species on Buck Island Reef National Monument. Other surveys have identified 232 common insect species, mainly arachnids (NPS 2003b).

BEACH / DUNE

Big Cypress National Preserve, Biscayne National Park, Canaveral National Seashore, Everglades National Park, Buck Island Reef National Monument, Salt River Bay National Historic Park and Ecological Preserve, and Virgin Islands National Park

Beaches and dunes provide important nesting sites for sea turtles and shore birds and provide habitat for snakes, rodents, and several species of invertebrates, including crustaceans and meiofauna (tiny animals measuring between 0.1 and 1 millimeter).

MAMMALS

Some rodents that occur in dune habitats include the beach mouse (*Peromyscus polionotus*), cotton mouse (*Peromyscus gossypinus*), cottontail rabbit (*Sylvilagus floridanus*), and marsh rabbit (*Sylvilagus palustris*). Beach mice live in the dunes that are located just above the high-tide line and are vulnerable, because their habitat is solely beach dunes (Fairchild Garden 2005). Other mammals are also known to use beaches as feeding grounds, such as raccoons, feral cats and foxes, which are known to patrol the wrack line at the high-water mark and scavenge eggs from sea turtle nests (Smithsonian Marine Station 2005).

AMPHIBIANS AND REPTILES

Reptiles and amphibians that depend on this type of habitat for nesting or food include five species of federally listed sea turtles and various species of snakes, including the Florida rough green snake (*Opheodrys aestivus carinatus*) (Fairchild Garden 2005).



Leatherback sea turtle hatchling

BIRDS

Although many species of birds are often observed on beaches, five species of shorebirds are common nesters on bare sands. These include the snowy plover (*Charadrius alexandrinus*), black skimmer (*Rynchops niger*), least tern (*Sterna antillarum*), royal tern (*Sterna maxima*), and sandwich tern (*Sterna sandvicensis*). In addition, the American oystercatcher (*Haematopus palliatus*), Wilson's plover (*Charadrius wilsonia*), willet (*Catoptrophorus semipalmatus*), laughing gull (*Larus atricilla*), gull-billed tern (*Sterna nilotica*), Caspian tern (*S. caspia*), sooty (*S. fuscata*), and noddy tern (*Anous stolidus*) nest in areas with at least some vegetation (Johnson and Barbour 1990). Many other species use beaches as feeding areas, including pelicans, sandpipers, herons, and other shorebirds and wading birds.

Bivalve—A mollusk whose shell is two pieces joined by a muscular hinge. Clams and oysters are bivalves.

INVERTEBRATES

Many successful animal inhabitants of beaches include the often overlooked, but highly abundant, meiofauna (tiny animals measuring between 0.1 and 1 millimeter) that live between sand grains and the more familiar species of annelid worms that burrow into the substratum. Various bivalve and snail species, as well as many species of small crustaceans, such as isopods and amphipods, inhabit the wrack-line along the shore. Surf clams (*Donax variabilis*) and mole crabs (*Emerita talpoida*) are two species that stand out as inhabitants of the surf zone. Both of these animals are extremely fast burrowers, able to rebury themselves almost as fast as they become exposed in shifting sands. Further up the beach, somewhat removed from intense wave action, is where the ghost crab (*Ocypode quadrata*) makes its home by burrowing into the sand (Smithsonian Marine Station 2005).

GRASSLAND / COASTAL STRAND

Big Cypress National Preserve and Salt River Bay National Historic Park and Ecological Preserve

Dry grasslands are found in the northern portion of the Big Cypress National Preserve, and on the hills around the Salt River Bay National Historic Park and Ecological Preserve. The dry grasslands at Salt River Bay National Historic Park and Ecological Preserve, however, are predominantly exotic grasses and are, therefore, not evaluated here.

MAMMALS

The mammals of the dry grasslands are the same as those found in the pine flatwoods, upland forests. Many of these areas are used as rangelands for cattle.

AMPHIBIANS AND REPTILES

The amphibian and reptile species found in the dry grasslands of the Big Cypress National Preserve are the same as those found in the pine flatwoods.

BIRDS

The bird species found in the dry grasslands of the Big Cypress National Preserve are the same as those found in the pine flatwoods, with the addition of the burrowing owl and the Florida grasshopper sparrow.

INVERTEBRATES

The invertebrate species found in the dry grasslands of the Big Cypress National Preserve are the same as those found in the pine flatwoods.



AIR QUALITY

The EPA defines ambient air as “that portion of the atmosphere, external to buildings, to which the general public has access” (40 CFR 50). In compliance with the 1970 *Clean Air Act* and the 1977 and 1990 *Clean Air Act* Amendments, the EPA has promulgated national ambient air quality standards and regulations. The National Ambient Air Quality Standards (NAAQS) were enacted for the protection of public health and welfare of the environment. To date, the agency has issued standards for six criteria pollutants, including carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO₂), ozone (O₃), particulate matter [10 microns or less in diameter (PM₁₀) and 2.5 microns or less in diameter (PM_{2.5})], and sulfur dioxide (SO_x). If an area does not meet the NAAQS over a 3-year period, the EPA designates it as a “nonattainment” area for that particular pollutant.

There are two types of ambient air quality standards: primary and secondary.

1. *Primary standards* are designed to protect sensitive segments of the population from adverse health effects, with an adequate margin of safety, which may result from exposure to criteria pollutants.
2. *Secondary standards* are designed for the protection of public welfare, including protection against decreased visibility, or damage to animals, crops, vegetation, and buildings.

Each state and locality has the primary responsibility for air pollution prevention and control. Under the *Clean Air Act* and the *Clean Air Act Amendments*, state and local air pollution control agencies have the authority to adopt and enforce ambient air quality standards that are more stringent than the national standards.

Florida and the U.S. Virgin Islands are responsible for regulating air quality in each of their regions. The territories in the U.S. Virgin Islands have adopted, without change, the federal national ambient air quality standards, and Florida has adopted ambient air quality standards that are slightly more stringent than the national standards. The national ambient air quality standards and Florida standards are shown in table 28.

Congress designated Class I areas under the *Clean Air Act*. These are given the highest degree of air quality protection, with little allowance for deterioration of air quality. Class I areas apply to international parks, national wilderness areas or national memorial parks larger than 5,000 acres, or national parks larger than 6,000 acres, that were in existence on August 7, 1977. Other national parks are designated Class II areas. Of the nine parks included in this plan, Everglades National Park and Virgin Islands National Park are designated Class I areas, and the other seven parks are designated Class II areas.



TABLE 28: STATE OF FLORIDA AND NATIONAL AMBIENT AIR QUALITY STANDARDS FOR CRITERIA POLLUTANTS

Pollutant	Averaging Time	Florida Standard	Primary NAAQS Standard	Secondary NAAQS Standard	Purpose
Carbon monoxide (CO)	1-hour 8-hour	9 ppm ^a (10 mg/m ³) 35 ppm	9 ppm 35 ppm	None None	Prevent high levels of carboxy-hemoglobin
Nitrogen dioxide (NO ₂)	Annual	0.053 ppm (100 µg/m ³)	0.053 ppm (100 µg/m ³)	Same as primary	Prevent breathing difficulties, reduce smog and acid rain formation, and improve visibility
Particulate matter (PM ₁₀)	24-hour Annual	150 µg/m ³ 50 µg/m ³	150 µg/m ³ 50 µg/m ³	Same as primary	Prevent chronic diseases of the respiratory tract and improve visibility
Particulate matter (PM _{2.5})	24-hour Annual	65 µg/m ³ 15 µg/m ³	65 µg/m ³ 15 µg/m ³	Same as primary	Prevent chronic diseases of the respiratory tract and improve visibility
Ozone (O ₃)	1-hour 8-hour	0.12 ppm 0.08 ppm	0.12 ppm 0.08 ppm	Same as primary	Prevent breathing difficulties, eye irritation, and biological effect on sensitive species
Sulfur dioxide (SO ₂)	3-hour 24-hour Annual	0.5 ppm (1,300 µg/m ³) 0.10 ppm (260 µg/m ³) 0.02 ppm (60 µg/m ³)	— 0.14 ppm 0.03 ppm	0.50 ppm (500 ppb)	Prevent increased respiratory damage, acid rain, and crop damage and to improve visibility
Lead (Pb)	Quarterly average	1.5 µg/m ³	1.5 µg/m ³	Same as primary	Prevent impaired production of hemoglobin

Source: 40 CFR 40, Part 50, July 1991, "Ambient Air Quality Standards"; Florida Department of Environmental Protection (FDEP) 2002.

a. ppm = parts per million.

b. mg/m³ = milligrams per cubic meter; µg/m³ = micrograms per cubic meter.

BIG CYPRESS NATIONAL PRESERVE

Big Cypress National Preserve is a designated Class II area under the *Clean Air Act*. The Act requires that all national monuments, primitive areas, and preserves (including Big Cypress) be reviewed for possible redesignation to Class I status if their air quality related values are considered important attributes. These values include visibility, plants, animals dependent on the air environment, water quality, and historic and archeological objects and structures. In 1979, NPS found that the air-quality related values at Big Cypress National Preserve were, indeed, important attributes, and on June 25, 1980, the park was listed for consideration by the states and Indian tribes for redesignation to Class I (45 FR 43002). To date, the state of Florida has not acted on this recommendation (NPS 1991a).

Big Cypress National Preserve lies within Collier, Monroe, and Miami-Dade counties, all of which are in attainment for ambient air quality standards. Miami-Dade County is considered an attainment/maintenance area for the pollutant ozone, because it has been previously classified as nonattainment but has successfully reduced air pollutant concentrations to below the standard. It must, however, maintain some of the nonattainment area plans to stay in compliance with the standards (FDEP 2002).



The park's air quality is generally very good because of its remote location. Prevailing winds carry emissions from the metropolitan areas and regional oil-fired power plants into the park and periodically affect air quality and visibility. Other temporary air quality degradation within the park results from prescribed fires, vehicle use, and NPS maintenance and management operations. Prescribed fires, performed for both fire management and exotic plant management, emit particulate matter and smoke and its components into the surrounding air and temporarily degrade visibility. Prescribed burning activities are coordinated through the Florida Division of Forestry to ensure compliance with state air quality regulations and to minimize air quality effects (NPS 1991a; NPS n.d.g).

*Attainment
Area—An area
that meets air
quality
standards.*

EVERGLADES NATIONAL PARK

Everglades National Park is a designated Class I area under the *Clean Air Act*. The park lies in portions of Miami-Dade, Monroe, and Collier counties. All of these areas are in attainment of ambient air-quality standards, with Miami-Dade County classified as an attainment/maintenance area for ozone. Much of the park experiences very little air pollution because of the remote wilderness nature of the majority of the park. Visibility is occasionally diminished by high humidity and salt sea mist in the coastal areas because of the climate. Local sources of pollution are generated by vehicle and motorboat emissions in the park's developed areas and marinas. Visibility and air quality are also affected periodically from natural and prescribed fires within the park. Everglades National Park coordinates prescribed burning activities through the Florida Division of Forestry to minimize air quality effects and ensure compliance with state air quality regulations.

Outside influences to the park's air quality include agricultural practices and development activities on the eastern border of the park. Prevailing winds from the east carry dust and emissions from the Miami metropolitan area into the park and occasionally affect air quality and visibility (NPS 1994a).

The park participates in several air quality monitoring programs, including the National Atmospheric Deposition Program / National Trends Network, Clean Air Status / Trends Network (CASTNet), and the Interagency Monitoring of Protected Visual Environments (IMPROVE) network. The air quality monitoring stations associated with the programs record a variety of parameters, from wet and dry deposition of sulfate, nitrate, and ammonium, to ozone, mercury, and visibility. To date, there have been no exceedances of prescribed Class I air quality criteria under the ambient air quality standards. However, the collected data are used to analyze trends and determine if sensitive resources may be affected at pollutant concentrations below those established in the air quality standards.

Everglades National Park has identified air quality related values considered most sensitive. These include aquatic resources, fauna/wildlife (specifically those susceptible to mercury within the park), night skies, vegetation, and visibility. Plant species with documented sensitivity to ozone that occur in Everglades National Park include red maple (*Acer rubrum*), Virginia creeper (*Parthenocissus*



quinqueflora), American elder (*Sambucus canadensis*), smooth cordgrass (*Spartina alterniflora*), and poison ivy (*Toxicodendron radicans*) (NPS 2004h).

CANAVERAL NATIONAL SEASHORE

Canaveral National Seashore is designated a Class II area and is located in Volusia and Brevard counties. Both of these counties are in attainment of ambient air quality standards for the six criteria pollutants (FDEP 2002). Canaveral's air quality is generally good due to its remote location; however, quality is periodically affected by NASA operations, vehicular traffic by Kennedy Space Center employees, prescribed burning by adjacent Merritt Island National Wildlife Refuge, and emission sources outside of the park. Prevailing winds often disperse pollutants, and atmospheric inversions are usually rare over the Canaveral area. When they do occur, air quality impacts are often of short duration (NPS 1998a).

SALT RIVER BAY NATIONAL HISTORIC PARK AND ECOLOGICAL PRESERVE AND VIRGIN ISLANDS NATIONAL PARK

The regional air quality around the U.S. Virgin Islands is generally considered excellent. Under typical wind conditions, there are no major urban areas upwind of the islands for thousands of kilometers. During the summer months, dust (PM₁₀) is transported to the U.S. Virgin Islands from the Sahara Desert in Africa, which can at times reduce the visibility to less than two miles (USGS 1997). Vehicle and motorboat emissions in the area generate local sources of air pollution for Salt River Bay National Historic Park and Ecological Preserve and Virgin Islands National Park. One of the world's largest oil refineries is located on the southern portion of St. Croix. Although the park is located on the northern portion of the island, air quality from the oil refinery can periodically affect Salt River Bay National Historic Park and Ecological Preserve when the wind blows onshore for a persistent length of time (Federal Register 1997).

Virgin Islands National Park is the only Caribbean park that is a designated Class I area. The park participates in the National Atmospheric Deposition Program / National Trends Network, CASTNet, and the IMPROVE network. Monitoring stations to monitor wet deposition, dry deposition, ozone, and visibility are now in operation; however, they have not been in operation long enough to detect trends. Ozone has been continuously monitored at Virgin Islands National Park since 1998, and no exceedances of the National Ambient Air Quality Standards for ozone have ever been detected (NPS 2002e). A 2003 report on the ozone air quality at Virgin Islands National Park by the National Park Service Air Resources Division noted that ozone concentrations are near levels expected for the mid-Atlantic Ocean and are well below ambient air quality standards. Furthermore, the day-to-night change in ozone concentration is very low (about 3 parts per billion), which is a good indication that local production of ozone is small (NPS 2003i). Air quality related values the park has identified as sensitive include surface waters in the park, night skies, and visibility. The ozone sensitivity of plant species in Virgin Islands National Park is currently unknown (NPS 2004h).



CULTURAL RESOURCES

OVERVIEW OF PREHISTORY AND HISTORY OF AREAS WITHIN FLORIDA PARKS

PREHISTORY

Earliest evidence of the human use of south Florida comes from the Cutler Fossil site, located adjacent to the northwest corner of the Biscayne National Park. This site contains evidence of Paleo-Indian occupation of this area, beginning about 10,000 years before present. Artifacts and marine faunal remains at the site demonstrate a continual link between man and the sea that has characterized the human adaptation in south Florida, Biscayne Bay, and the Florida Keys for 10,000 years (NPS 1998b). However, sites from this period have not yet been discovered in Everglades National Park, Biscayne National Park, or in Big Cypress National Preserve.

The next cultural period, the Archaic, lasted from about 7500 to 500 B.C. and is divided into three broad time periods. These periods are the:

- Early Archaic, 7500 to 5000 B.C.
- Middle Archaic, 5000 to 3000 B.C.
- Late Archaic, 3000 to 500 B.C.

These periods were based mainly on stylistic changes in projectile points and the introduction of fiber-tempered pottery in the Late Archaic Period.

By about 9000 to 7000 years before present, the climate in south Florida had become extremely arid. Some areas sparsely occupied by Early Archaic groups may have been abandoned. Only a few pre-ceramic sites, mostly burials, have been found in south Florida to document this period, known as the Middle Archaic. Excavations of a shell midden in the Pine Island area of Everglades National Park provided radiocarbon dates of 2985 and 3675 B.C., the earliest dates so far found along the southwest Florida coast (Griffin 2002). “Sites lacking ceramics and suggesting pre-Glades times also were encountered in the Big Cypress” (Griffin 2002).

Midden—A prehistoric refuse heap, usually composed of shells.

The Late Archaic Period (ca. 4000 to 2500 before present) is indicated in much of Florida by the appearance of some of the earliest pottery known in the continental United States. The area surrounding the Everglades appears to have been sparsely settled during this period, and as far as can be determined, the “Everglades proper were not yet being used, perhaps because of their immature stage of development” (Griffin 1988). However, a pottery shard found near Onion Key suggests a presence in that vicinity about 1000 B.C. (NPS 1998b).

With the maturation of south Florida’s productive estuaries at the end of the Late Archaic, people began to move into the area to exploit its resources, a cultural adaptation known as the Glades Tradition (500 B.C. to A.D. 1700). This tradition



was based on the exploitation of tropical coastal waters, with dependence on shell fish, as well as game and some use of wild plant foods.

An archeological site on Sands Key (Biscayne National Park) documents use of the area from the Glades IIB-IIIIB Period (ca. A.D. 500 to ca. A.D. 1500) up to early European contact, around A.D. 1650. The site includes extensive mounds of worked shell and middens, suggesting intensive settlement on the key by A.D. 1000, if not earlier (NPS 1998b).

HISTORY

Juan Ponce de Leon was the first European to document contact with the Indians of south Florida (probably the Ais) in 1513, although the aggressive response from local tribes suggests that other unrecorded predecessors may have encountered these native groups before then.

The Florida tribes used large, seaworthy canoes to harvest marine resources. The Calusa practiced some horticulture and used a broad spectrum of wild plant foods, fish and other seafood, and small animals. Their temples were set on mounds, and their spacious houses were clustered in villages set on high ground to avoid the “mosquitoes” (Griffin 2002).

The Tequesta migrated seasonally from the shore to the inland regions and back, subsisting on native plants and animals, including both manatee and turtle. Archeological evidence suggests that the “Miami Circle,” a series of large and small basins and holes cut into limestone bedrock near Biscayne Bay, marks the footprint of a large prehistoric Tequesta Indian site dating to about A.D. 100.

In 1743, Spanish missionaries documented small groups consisting of the remnants of several tribal nations, but by 1763, Spanish writers noted that the Calusa had been transported to Cuba. When the English gained control of Florida in 1793, only a few hundred members of these tribes remained.

The late 1700s marked the movement of the Seminole communities to the east and south as a result of the so-called First Seminole War. The Seminole expanded southward down the Florida peninsula, establishing the town of Ochupocrassa (Echeepocrassa) near Biscayne Bay about 1820.

The Second Seminole War (1835 to 1842) was a result of pressures to remove the Indians, forcing those Seminoles who had not been removed to Indian Territory already to escape further south into the Everglades. The remaining Florida Seminole were forced into major lifeway changes—from traditional town-based agricultural subsistence to small camps practicing field horticulture, supplemented by hunting and gathering. Small, scattered family groups of Miccosukee speakers had moved south and west of Lake Okeechobee and to the Ten Thousand Islands.

The Third Seminole War was the final war between the Seminole Indians and the U.S. Government. During the 1850s, when government surveyors intruded on Seminole property belonging to a chief named Billy Bowlegs, conflict was reignited. Eventually, U.S. military incursions reduced the Seminole population to



between 200 and 300, and the third war ended with Bowlegs' surrender in 1858. Shortly thereafter, the U.S. government abandoned efforts to remove all the Seminoles from Florida.

During the years preceding the American Civil War, unsettled international affairs led to the construction of Fort Jefferson, now part of Dry Tortugas National Park, as part of nineteenth century American coastal defenses, known as the “Third System,” a defense program designed to address the deficiencies of earlier fortification systems (NPS 2001b). During the Spanish-American War, the Fort Jefferson served as a coaling station. It was abandoned by the military after 1906, but it continued to serve military purposes during World War I. During the 19th century, the lighthouses built earlier on Loggerhead Key and Garden Key began to provide warnings of the dangerous reefs at Dry Tortugas.

By 1877 there were “but a few dozen settlers” in Biscayne Bay for there was not a lot of arable land, and much of what was there was covered with hardwood hammocks. Settlers cleared the “scrubby woods” by burning them, then planted fields or groves (NPS 1998b). Pineapple became the first successful crop to be grown in the keys. This area, mostly within what is now Biscayne National Park, produced all of the pineapples grown in the United States until around 1884. Asa Sweeting and his family were among the earliest homesteaders on Elliott Key in the area that is now part of Biscayne National Park, settling there in 1882, constructing a small dwelling and a cistern, cultivating a variety of fruits and vegetables, with pineapples and key limes as the primary crops.

In the Canaveral area, permanent settlement began after the American Civil War. One of the important historic settlements in the area, the Eldora settlement, dates to 1876 to 1898. This now-abandoned settlement was an important stopover for vessels traveling the Intracoastal Waterway during the late 1800s. Eldora represents a typical, early-Florida waterway community, developed first for its agriculture, and then, over time, for its steamboard shop, lifesaving service, and house of refuge.

Early in the twentieth century, Key West merchants hired people to farm the shell sites of the Ten Thousand Islands, now part of Everglades National Park, and fishing camps were established along the coasts to supply fish for consumption in south Florida. Fish-house operations were opened in the Everglades (fish were caught, salted, dried, and exported to Cuba). These operations were accompanied by the development of ice plants to supply ice to the fish houses (NPS 2003k). Drainage and canal projects, beginning in 1906, “turned land formerly used by the Indians into agricultural and pastoral use,” and homesteaders began to farm land formerly occupied by prehistoric and early historic tribes (Griffin 2002).

Railroad construction and a road linking Florida City to Cape Sable were part of a larger movement to drain and develop the Everglades. The final “intrusive element came with the opening of the Tamiami Trail in 1928” (Griffin 2002). At the same time, politicians, the Florida Federation of Women’s Clubs, and several influential naturalists, were working to protect the Everglades, resulting in the creation of Royal Palm State park in 1916. The area currently known as the “Hole-in-the-Donut” restoration area was rented to tomato farmers to help support the park.

Arable—Land that is fit for cultivation.

Cistern—A small tank (usually covered) or a storage facility used to store water for a home or farm.

Two American Indian tribes presently reside in south Florida. The contemporary Seminole and Miccosukees of south Florida are descended from fewer than 200 survivors left at the end of the last Seminole War in 1858 (Weissman 1999). The Seminole Tribe of Florida and the Miccosukee Tribe of Indians of Florida, were federally recognized in 1957 and 1962, respectively (Weissman 1999). Many members of the Seminole Tribe now occupy the Big Cypress Seminole Reservation. There are still members of both groups that remain unaffiliated and politically independent of the federally recognized American Indian Tribes designation. The Miccosukee Tribe of Indians of Florida has constructed, and now operates, a casino northeast of Everglades National Park. The Seminole Tribe of Oklahoma (including descendants of the Seminoles removed from Florida during the mid-1800s) also is affiliated with Everglades National Park and Big Cypress National Preserve.

CULTURAL LANDSCAPES IN FLORIDA PARKS

A preliminary identification of potential resources within the parks was conducted in 1996 and 1997 by the Southeast Region of the NPS (Hasty 2004). Information from that preliminary identification has been incorporated into the following cultural resources descriptions.

BIG CYPRESS NATIONAL PRESERVE

Archeological Resources

Archeological surveys by the Southeast Archeological Center (SEAC) of the NPS have located 395 archeological sites in Big Cypress National Preserve (NPS 2000f). Sites include black earth middens, sand mounds, rock mounds, and transient camps dating back to the Glades I Period, about 2000 B.C. Only one site clearly dates to the Archaic Period (before 2000 B.C.); 283 sites are from the Glades (2000 B.C. to A.D. 1800) Period of occupation. A number of sites are multicomponent, containing more than one discrete cultural occupation. Among these are 116 sites dating to both the Archaic and Seminole occupations. Some sites were defined only as “Prehistoric” because of a lack of diagnostic data. Six sites date to the historic American period, and seven sites remain undetermined chronologically. Many of the sites are transient campsites.

Historic Structures and Districts

Two structures are on the list of classified structures for Big Cypress National Preserve: Monroe Station and the H.P. Williams Park marker. Monroe Station was built in 1928, moved in 1957, and altered in 1960. Monroe Station is listed on the National Register and is locally significant for its association with the early history of the Tamiami Trail and Collier County. The Williams Park marker is a commemorative structure erected in 1965. The Ingraham Highway has been determined eligible for the National Register of Historic Places and a National Register nomination for the 41-mile length of the Old Ingraham highway is currently being prepared by NPS staff at the Southeast Regional Office (NPS 2000g).

Ethnographic Resources

Eleven Indian villages that are currently used are located along U.S. 41 and the Loop Road. Most of the estimated 150 individuals who live in Big Cypress National Preserve are independent Miccosukee Indians or traditional Seminole who do not belong to the federally recognized tribes, and who choose not to live on reservation land. The preserve has three known sacred sites for the Miccosukee and Seminole people.

An ethnohistory of Big Cypress National Preserve was prepared in 1982 and focused on land use by Seminole and Miccosukee Indians and Euroamericans (Goss 1995). Some Miccosukee elders consider the Calusa among their ancestors, for when the Miccosukee and Seminoles settled here beginning about 1820, they moved into Calusa sites and adopted many aspects of their culture. Members of the two groups are thought to have intermarried. Most of the mounds visible today were Calusa sites, but they may also be claimed by the Seminole and Miccosukee as related.

The preserve is a source of natural materials used for housing, crafts, and religious purposes. Brazilian pepper and other exotic plants often grow on middens or mounds. Tribes harvest guavas from roadside areas, grow tobacco, bananas and other cultivars near residences, and plant maize at ceremonial sites (Burch 2003).

Cultural Landscapes

The park itself has been identified as a cultural landscape, with several component landscapes (Hasty 2004). For example, U.S. 41 (the Tamiami Trail) crosses the Big Cypress National Preserve from east to west, and has been designated as a scenic byway by the Federal Highway Administration (USDOT 2003). Along the road are vistas of mixed vegetation types found throughout the preserve, including hardwood hammocks, tropical flowers, and expanses of sawgrass. Another potential cultural landscape lies along Loop Road in the south-central portion of the preserve. In places, shady patches of lush swamps near the road can be easily viewed by visitors. Soil berms, covered with vegetation, mark the previous locations of rail lines for cypress-logging operations, and the Florida trail winds into the interior of the area.

The preserve also includes a number of mound sites (some with burials), Indian settlements and sites, either listed, or potentially eligible for nomination to the National Register of Historic Places. Unfortunately, this preliminary identification does not include the 146,000-acre expansion to the preserve made in 1996 (Hasty 2004).

Previous Investigations

Previous investigations at Big Cypress National Preserve include five seasons of fieldwork by the NPS SEAC (Taylor and Komara 1983).

Ethnography—A branch of anthropology that studies and describes modern human cultures (rather than human behavior or physical attributes).

National Register of Historic Places and National Historic Landmarks

Sites Listed on the National Register of Historic Places as of August 2004

- Burns Lake Site
- Halfway Creek Site
- Hinson Mounds
- Monroe Station
- Ostl, C.J., Site
- Platt Island
- Plaza Site
- Sugar Pot Site
- Turner River Site

Sites Considered Eligible to be Listed on the National Register of Historic Places

- Pier Site
- Lost Dog
- Callahan
- Monroe Strand Village
- Mud Lake Site
- Corn Dance Site
- Odum Site
- Alligator Camp
- Johnny Walker Site
- Long Lake Site
- Turner River Archeological District
- East Crossing Strand Archeological District

Threats

Threats to archeological resources include landscaping activities, unauthorized collecting, utility excavations, and other ground-disturbing projects, along with hurricanes, heavy rainfall, and erosion, which, along with vegetation growth, also threaten the integrity of the park's historic structures.

BISCAYNE NATIONAL PARK

Archeological Resources

Biscayne Bay and the Miami River were prehistoric highways for trade, communication, and access to natural resources. Of the approximately 104 archeological sites in the park, about half are terrestrial. Most are on Totten and Sands keys, but sites are also found on Soldier and Elliott keys (Lanzendorf 2004). The earliest site found in the park, a midden (or shell mound) site on one of the offshore keys, indicates intensive settlement by A.D. 1000. Sites also include a major Tequesta village that was occupied approximately 2,000 years ago. Other Tequesta archeological sites found within the park include fishing and hunting camps used by the inhabitants of this Tequesta village. Eight prehistoric sites (containing a variety of materials, such as pot shards, shell middens and rock mounds, celts and bone fragments) are located on the keys within the park and represent Glades II (A.D. 750 to 1200) and Glades III (A.D. 1200 to 1513), periods characterized by seasonal occupancy of sites.



The Cutler Fossil site (immediately adjacent to the park on the mainland) dates to about 8000 B.C., suggesting that the lands and waters of Biscayne National Park have the potential for even earlier archeological sites than presently found. The Cutler Fossil site also has evidence of having been used by the Tequesta approximately 2000 years ago.

The remains of the Sweeting Homestead are included in an archeological district on Elliott Key. This site contains remains of the first pioneering homestead on these keys near the end of the nineteenth century. Other historical archeological sites are mainly remains of homesteads on Elliot and Adams keys dating from the 1870s through the 1930s. These remains include cisterns, house foundations, nonnative landscape, and agrarian vegetation.

Historic Structures and Districts

Few historic buildings survive in Biscayne National Park. Hurricanes, the subtropical climate, and the accidental and purposeful actions of humans, have all contributed to the destruction of human-made structures on the keys. The historic resources of Biscayne National Park include a complex of stone and concrete structures built on Boca Chita Key between 1937 and 1940 by Mark Honeywell, founder of Honeywell Industries. This private resort, recently listed on the National Register of Historic Places, is locally significant. The district consists of 10 historic structures that were associated with the development of the Miami area as a vacation destination during the first half of the twentieth century, including the lighthouse, chapel, picnic pavilion, garage, engine house and cistern, bridge, stone walls, canal, retaining walls, and walkways. The architecture represents typical resort architecture for the Miami area in the 1930s. According to the park's list of classified structures, five of the structures are in good condition, one is in poor condition, and four are in fair condition.

The Fowey Rocks Lighthouse is within the park but is owned by the U.S. Coast Guard.

Ethnographic Resources

An ethnographic overview and assessment was completed for Biscayne National Seashore in 2004.

Cultural Landscapes

The entire Biscayne National Park was identified as a cultural landscape, with Boca Chita Key as a component landscape. The Sweeting Homestead Site covers 240 acres on Elliott Key. Exotic plants within this homestead landscape include coconut and date palm (*Cocos nucifera* and *Phoenix reclinata*), sisal hemp (*Agave sisalana*), and sapodilla (*Manilkara zapota*). Additionally, pineapples, tomatoes, and key limes were grown by these homesteaders for market, and traces of limes and other exotic plants may still be present in selected areas. The Jones property on Porgy Key also may have exotic plants that help define its landscape.



Previous Investigations

In 1944, Goggin found indications of prehistoric occupation on Elliott Key (NPS 1983b). Sears and McGregor (1973) surveyed portions of Sands, Elliott, and Old Rhodes keys and identified sites on two of the keys but not on Old Rhodes Key (NPS 1983b). Two sites tested by Sears and McGregor (1973) show disturbance, and many of the mainland Glades Period sites have been destroyed by modern construction (Fischer 1975, cited in NPS 1983b). Most of the park's historic archeological resources are related to shipwrecks and salvage camps, but archeological resources from the historic period are likely to be found on the keys, and many are related to Euroamerican settlement, beginning in the 1800s (Newman 1975 and Fischer 1975, cited in NPS 1983b).

National Register of Historic Places and National Historic Landmarks

The Sweeting Homestead and Boca Chita Key Historic District are listed on the National Register of Historic Places.

Threats

Threats to archeological resources include landscaping activities, unauthorized collecting, utility excavations, and other ground-disturbing projects, along with hurricanes, heavy rainfall, and erosion. Factors such as hurricanes, heavy rainfall, vegetation growth, and erosion also threaten the integrity of the park's historic structures.

CANAVERAL NATIONAL SEASHORE

Archeological Resources

To date, 98 archeological sites have been listed on the park's cultural sites inventory. Sites include prehistoric middens and mounds dating as far back as 4,000 years, historic shipwrecks, a Civil War saltworks, remnants of a turn-of-the-century waterway community, and two historic canals. The Armstrong Site may be a shipwreck survivor's camp from the French fleet of 1565. One of the largest sites in the park is Snyder's Mound at Seminole Rest. This large, quahog clam processing center was used primarily between A.D. 700 and 1100, and, with other adjacent mounds, is significant because it is the only remaining site known to have data covering the Orange–St. John II cultural periods (NPS 1998c). Two historic structures, built in the late 1800s, are situated on the mound. Many other archeological sites, not yet recorded, undoubtedly occur within the park.

Historic Structures and Districts

Seventeen historic structures have been documented within the park, of which eleven are on the list of classified structures for the park. The Eldora Historic District includes the Eldora State House and five cisterns. Two historic structures located at Seminole Rest are known to be over 100 years old: the caretaker's house and the main house (Snyder House). The Old Haulover Canal, constructed in 1854, connected Mosquito Lagoon to the Indian River and was an important part of the inland waterway until the late 1880s.



Ethnographic Resources

Some sites within the park represent remnants of the historic black communities established to support the area's citrus industry. Local families who had commercially fished or grown citrus in the park over several generations, and former residents of Allenhurst, Clifton, Shiloh, and Eldora, are also part of the park's ethnographic history.

Native Americans

The Seminole Tribe has expressed an interest in cultural resources at Seminole Rest.

Cultural Landscapes

The Eldora Historic District, Haulover Canal, Indian River Citrus District, and Seminole Rest were tentatively identified as cultural landscapes for Canaveral National Seashore. Century plants, located at the former House of Refuge / U.S. Lifesaving Station, have also been identified as part of the historic landscape.

Previous Investigations

Numerous archeological surveys have been conducted in the Canaveral National Seashore area over the years. As early as 1877, J. Francis LeBaron, an engineer for the St. John and Indian River Railroad, surveyed mounds along both shores of Mosquito Lagoon. Additional work by a variety of researchers between 1885 and 1963 is described in Canaveral's draft *Archeological Overview and Assessment* (Ehrenhard 1976). The first comprehensive survey of the Kennedy Space Center lands was conducted by George Long (1967) and included the southern two-thirds of today's park area. When the park was created in 1975, the NPS conducted a limited survey of the additional park lands to the north (Ehrenhard 1976). In 1992 and 1996, surveys of the area adjacent to the western boundary of the park (along State Road 3) and the southwestern portion of Canaveral National Seashore were funded by NASA (Deming 1992, Deming and Koski 1996). Castle Windy Midden and Ross Hammock were investigated in the late 1950s and early 1960s by Ripley Bullen et al. (1959, 1967). The Ross Hammock site (1996), the Armstrong Site in 1990 and 1995, and Seminole Rest were investigated in 1993 (Horvath et al. 1994; Horvath 1995). NPS SEAC completed a magnetometer survey of 24 miles of beach front in 1994, searching for evidence of historic shipwrecks. Archeological investigations were conducted at Seminole Rest in 1993 (Horvath 1995).

A draft of the *Archeological Overview and Assessment* was completed in 1991, but it lacks information on subsequent investigations at the Seminole Rest and Armstrong sites. The Historical Base Map needs to be revised as the Cultural Sites Inventory is updated, and a Historic Resource Study has been initiated.

National Register of Historic Places and National Historic Landmarks

The Eldora Historic District, containing 18 historic and nonhistoric structures, was nominated for the National Register of Historic Places, but it was rejected



with a recommendation from the State Historic Preservation Office to submit individual buildings for consideration instead. The Eldora Hotel had to be razed in 1992, because of its advanced state of deterioration.

Six archeological sites are listed on the National Register of Historic Places. Three are of statewide or regional significance (Turtle Mound, Old Haulover Canal, and Seminole Rest) and three are of local significance (Ross Hammock Midden, Ross Hammock Burial Mounds, and the Confederate Saltworks). Included within an archeological district in Volusia County are: Turtle Mound, Castle Windy, Ross Hammock Midden and Ross Hammock Mounds, Cat Hammock, Canaveral Shipwreck, Confederate Saltworks, the Tip of Shelton Kurt Island, an unnamed site, and some 15 other sites (NPS 1994d). These sites are considered eligible for the National Register of Historic Places. Seminole Rest, a large midden with associated smaller middens and two historic structures, was recently added to the National Register. This site may be the largest and least disturbed St. John I and II period-site remaining on the east coast of Florida. The main house at Seminole Rest has been determined eligible for the National Register (NPS 1994d).

A recently discovered historic site, the Armstrong Site, has been partially investigated and is suspected to be a shipwreck survivor's camp from the French fleet of 1565, commanded by Jean Ribault. If so, the site relates directly to several other NPS sites—Ft. Caroline National Memorial, Ft. Matanzas National Monument, and Castillo de San Marcos National Monument (St. Augustine). The destruction of Jean Ribault's Fleet had such an impact on the history of North America that the site could be of national significance.

Several significant sites, closely related to those within Canaveral National Seashore, lie just outside the park's boundary within Merritt Island National Wildlife Refuge and include Ft. Ann, (a Seminole War site), several prehistoric burial mounds, and the Sugar Mill Ruins. Other sites extend across both areas, such as the Old and New Haulover canals and Dummett Homestead.

Threats

Many sites and structures within the park have been impacted by human activities. Digging mosquito ditches and creating impoundments have severely damaged many sites located along the shoreline of Mosquito Lagoon. Vandalism and foot traffic have also taken a toll. Several of the island middens, located on high ground, have been traditionally used by local residents as backcountry campsites.

Natural forces are another source of threats to cultural resources within Canaveral National Seashore. Storms and high water are eroding many lagoon sites; feral hogs and armadillos have dug into middens and mounds; and exotic century plants cover one side of Castle Windy midden, causing changes in stratigraphy.

Threats to archeological resources also include landscaping activities, unauthorized collecting, utility excavations, and other ground-disturbing projects. Hurricanes, heavy rainfall, vegetation growth, and erosion also threaten the integrity of the park's historic structures and archeological sites.



DRY TORTUGAS NATIONAL PARK

Archeological Resources

No prehistoric sites have been documented within the park, and of the park's 30 historic archeological sites, 28 are shipwrecks. The remaining sites are associated with Fort Jefferson on Garden Key and with the lighthouse on Loggerhead Key. These resources date to the 19th and 20th centuries.

Fort Jefferson represents a major effort on the part of the United States in the 1840s and thereafter to safeguard shipping lanes and prevent foreign powers from gaining a foothold in the Gulf of Mexico. This fort was the most extensive and ambitious fort built as part of America's 19th-century coastal defense program, and the archeological remains form a representative example of military life, beginning in 1846, in this isolated area.

Remains associated with the early lighthouses also help document the vital role that these sites played in protecting ships from shoals and other natural hazards.

Historic Structures and Districts

The list of classified structures for Dry Tortugas National Park contains a number of structures, including: 3 commemorative markers, the Garden Key Lighthouse, Fort Jefferson and 10 associated structures, and the Dry Tortugas Lighthouse (with 8 associated structures). The markers and lighthouses are in fair-to-good condition, and the individual buildings at Fort Jefferson (powder magazines, hot-shot furnace, officers quarters) are generally in good condition. However, the fort itself is in poor condition because deterioration and expansion of the embedded iron contributes to the crumbling of the structural walls, and maintenance efforts cannot keep pace with the deterioration. The Carnegie Research Laboratory of 1910 is present on Loggerhead Key.

Fort Jefferson represents the strategic importance of Dry Tortugas to American coastal defenses in the 19th century. The fort was built as part of the federal program of integrated coastal defenses known as the "Third System," a program designed to address the deficiencies of earlier fortification systems. The United States wanted a strong and permanent military presence in the Gulf of Mexico to protect trade and ports, and to prevent hostile entities from using the anchorage at Dry Tortugas (NPS 2001b).

During the Civil War, the fort was under Union control, and after the war, the fort functioned as a prison for about 800 Union Army deserters and other offenders, including several of those convicted for conspiracy in the assassination of President Lincoln. Not only did Fort Jefferson serve as part of the coastal defenses during the 1800s, but the site was later used as a quarantine and disinfecting station (1889 to 1900) and as a coaling station from 1899 to 1912.

Ethnographic Resources

An ethnographic study has not been done for Dry Tortugas National Park, and no ethnographic resources are currently identified for the park.



Cultural Landscapes

Preliminary findings of a Cultural Landscape Inventory currently underway for Dry Tortugas National Park identified Fort Jefferson, on Garden Key, as a cultural landscape. The Fort Jefferson landscape incorporates the natural and cultural elements associated with the historic activities, events, and people of Fort Jefferson. The fort is one of the largest masonry fortifications in the Western Hemisphere and was part of the historical events of the United States and the world from the mid-1800s to 1935, when it became part of a continuing movement to help preserve our nation's cultural heritage (NPS 2000e). Its size, design, and overall feeling aptly represent the state of technology during its construction, the value of marine trade and traffic, and the political concerns during the early history of the United States.

Buttonwood trees were present at Dry Tortugas during the period of significance. Later introduced plants include: coconut palms, *Casuarina*, pawpaws, figs, *Hymenocallis*, oleanders and *Hibiscus*, *Thespesia*, *Agave*, *Pedilanthus*, and asparagus. By 1942, the once-dominant *Surinana* began to be replaced by *Opuntia*, *Chamaesyce*, *Agave*, and others; the most prolific exotic being *Casuarina*. By 1980, nearly all of the native communities were being out-competed by two species: *Casuarina equisetifolia* and *Agave sisalina* (Ryan 2004).

Some of the features of this cultural landscape include the vegetation, ruins, and structures within the parade ground and outside of the fort, as well as the north and south coaling docks.

The Loggerhead Key lighthouse area has been tentatively identified as a historic landscape, and a draft National Register nomination form has been prepared. The landscape includes exotic plants, structures and structural remains, paths and other means of access, and circulation patterns. The location of this lighthouse on the key was vital, because it needed to be highly visible to ships to help prevent wrecks. The equipment used and the design of the lighthouse and adjacent buildings also represent this historic 19th century period in American architecture and technology.

Previous Investigations

Past archeological investigations primarily focused on submerged resources, including archeological resources related to Spanish and European explorations and the later consolidation of control of commercial development. Underwater investigations from 1970 to 1971 included moat investigations and an architectural evaluation of Fort Jefferson's submerged walls (Murphy 1993). Land-based investigations of the areas within or outside the walls for Fort Jefferson, however, have not been extensive and have generally focused on survey and testing in advance of ground-disturbing activities. An example of monitoring projects include the 1975 installation of a drainfield, which discovered a dump and a line of bricks 100 feet long (NPS 1975). Testing was conducted in 2003 by the NPS SEAC in advance of construction of a wastewater treatment plant, associated leach field, and a brine concentrate disposal mound in the parade ground. This work discovered a monument and a brick-lined path in the parade ground, among other features (Schwadron 2003). Previous survey



work included identifying the 1825 Garden Key Lighthouse brick foundations, lightkeeper's quarters' foundations, probable gravesite of the lightkeeper's wife, and a 1969 surface survey for prehistoric sites on Garden and Loggerhead Keys (NPS 1969).

The fort and its individual character-defining features have been well documented in a long series of studies, including construction history (Manucy 1961); Historic Structure Report, Historical Data Section (NPS 1983c); Architectural Data Section (NPS 1988a); and several preservation reports (NPS 1986b; RSA 1994; Grieves et al. 1999).

National Register of Historic Places and National Historic Landmarks

Dry Tortugas National Park is listed on the National Register of Historic Places.

Threats

Threats to archeological resources include landscaping activities, unauthorized collecting, utility excavations, and other ground-disturbing projects, along with hurricanes, heavy rainfall, and erosion. Factors such as hurricanes, heavy rainfall, vegetation growth, and erosion also threaten the integrity of the park's historic structures.

EVERGLADES NATIONAL PARK

Archeological Resources

Of the 196 archeological sites in Everglades National Park, 64 are multicomponent, containing materials from more than one cultural period. Over half the known archeological sites in Everglades National Park date from the Glades II Period, from A.D. 750 to 1200. Most of these are large shellwork sites consisting of low but conspicuous shell works of oyster, conch, and clam shells along with some bone, mulch, and sand (NPS 1998a). Some of these sites occupy up to 60 acres. Many of these sites were occupied by tribes linguistically related to groups speaking the Muskogean dialect. Many of the mounds were erected as places of worship, places to honor their dead, or places to elevate homesites above the water level. The Calusas built many of the mounds and middens found in the park, and their sites were reoccupied by later groups.

Historic settlement began in the late 1800s with the establishment of settlement farming and fishing. Numerous land schemes and attempts to drain the Everglades also created canals and other sites. One historic archeological site shows evidence of use during the 18th century, and six sites have 19th century materials. Twenty-one sites have components dating to the Euroamerican contact period. Forty-five sites have evidence of 20th century occupation, often in the same spot as earlier prehistoric sites. The Hole-in-the-Donut area was a farming area now being reclaimed by the park.



Historic Structures and Districts

The list of classified structures for Everglades National Park includes 54 structures. However, many of these are prehistoric mound sites, best described as archeological resources. Many of the mound sites have had later historic occupation and have been farmed. Often, there are remnants of historic foundations, cisterns, or farm equipment. Other structures include outdoor sculpture or markers that commemorate individuals or the status of the park as a World Heritage and Biosphere site. Other historic structures and districts within Everglades National Park include the Old Ingraham Highway, and buildings at Flamingo and the Nike missile base.

Ethnographic Resources

Twenty-one archeological sites in the park have traces of Native American usage, and of these, 18 can be attributed to the Seminole. Both the Seminole Tribe of Florida and the Miccosukee Tribe of Indians of Florida live in the area, as do politically independent, unaffiliated members of both tribes. These groups have a strong interest in the park and its resources. No specific sites have been identified as traditional cultural properties, but burial areas and archeological sites are valued by these groups.

The Miccosukee tend to value most of the native plants, because many are used in native medicine. Wild guava, although not considered native, is a special food source. Coontie Island (planted) are valued as a food source, as are wild oranges. On some of the islands in Shark Slough, an Elephant Ear type plant called “ak choobee” is a food plant and is no longer found anywhere but in Everglades National Park. Medicine plants are so large in number it would be difficult to separate them out for each island unless a thorough site-mapping were conducted.

Cultural Landscapes

The Nike missile site landscape has been tentatively identified as a cultural landscape, and the site has been listed on the National Register. Other landscapes and features may include sites dating to the state park era, such as canals, roads, and mounds as well as areas at Pine Island, Flamingo, and Shark Valley.

Previous Investigations

A synthesis of the archeology of Everglades National Park was written in 1988 by John W. Griffin and republished with new material in 2002. As early as 1775, Florida’s mounds and remains of “habitations, built, or rather piled up on stones” were noted by early travelers (Griffin 2002). Numerous other accounts and studies were published, but the most definitive of the researchers was John M. Goggin who began to study Florida archeology in the 1930s, and continued to explore and to write through the mid-1950s. The list of researchers and publications is too lengthy to include here, but can be reviewed in Griffin (2002).



National Register of Historic Places and National Historic Landmarks

The Mission 66-era buildings at the Flamingo District have been evaluated as potentially eligible for the National Register. The Nike missile site has been nominated to the register, and the following sites and districts were listed on the National Register in November 1966. The Old Ingraham Highway has been determined eligible for the National Register, and the following sites and districts are listed on the National Register.

- Anhinga Trail
- Monroe Lake Archeological District
- Shark River Slough Archeological District
- Bear Lake Mounds Archeological District
- Cane Patch
- Rookery Mound
- Nike Missile Site
- Ten Thousand Islands Archeological District.

Threats

Threats to archeological resources include landscaping activities, unauthorized collecting, utility excavations and other ground-disturbing projects, along with hurricanes, heavy rainfall, and erosion. Some exotic plant treatments (soil removal, inundation, and fire) also may threaten archeological sites. Factors such as hurricanes, heavy rainfall, vegetation growth, fire, and erosion also threaten the integrity of the park's historic structures.

OVERVIEW OF PREHISTORY AND HISTORY OF THE CARIBBEAN

PREHISTORY

The basic sequence of human occupation in the Virgin Islands is generally divided into five major periods:

- Casimiroid (also known as Lithic, dating between ca. 4000 and 2000 B.C.)
- Ortoiroid (also known as Archaic, dating between ca. 2000 and 500 B.C.)
- Saladoid (Early Ceramic, ca. 500 B.C. to A.D. 500)
- Ostionoid (Late Ceramic, ca. A.D. 500 to 1492)
- Taino (European Contact, A.D. 1492 to 1550)



*Horticulture—Farming
using human labor and
simple tools such as
digging sticks and hoes.*

The prehistory of the Caribbean Islands extends back perhaps 4,000 years (ca. 2000 B.C.), when groups of nomadic hunter-gatherers, known as the Casimiroids, migrated to the Antilles, eventually resulting in colonization of the Virgin Islands. Most scholars believe the migrants originated in the Yucatan, but these groups also may have come from South America.

Some of these immigrants brought with them a knowledge of horticulture as evidenced by remains in Puerto Rico of manioc griddles for making cassava bread, and wild avocado (*Persea* sp.), yellow sapote (*Manilkara zapot*; *Sapotaceae*); and remains from the Krum Bay site on St. Thomas of wild fig (*Ficus carica*; *Ficus* sp.), portulaca (*purslane*; *Portulaca oleracea*), and sapodilla (*Manilkara zapota*) (Hardy 2004). The Krum Bay cultural complex of St. Thomas and St. John has been dated from 500 B.C. to A.D. 200. Other mainland domesticated plants introduced into the Virgin Islands by these early immigrants include: yucca, manioc (cassava), soursop, papaya, guaba, sapote, and guava (Hardy 2004). On St. Croix, many people of the Elenan culture lived at, or near, the same sites as had their Saladoid predecessors, fished in the ocean, and collected shellfish.

HISTORY

By perhaps A.D. 1425, the Ostionan cultures of the islands had become the Taino (Arawak) chiefdom societies encountered by Columbus. At the same time, the “Island-Caribs or *Kalinago* ...were invading the islands of the Lesser Antilles, conquering people they (Caribs) called *Igneri*” (Rouse 1992, cited in Hardy 2004). The Caribs were an agricultural people who planted manioc and sweet potatoes in garden plots near villages in the rain forest.

These island Taino populations were supported by farmers growing cassava (*Manihot walkerae*) and other root crops (sweet potato – *Ipomoea batatas*, llerenes – *Calathea allouia*, yautia – *Montrichardia aborescens*, and peanuts – *Arachis hypogaeae*) in enriched soil mounds. They also cultivated corn, squash, beans, peppers, pineapples (*Ananas comosus*), hobo and hikako, the coco or West Indian plum (*Chrysobalanus icaco*), papaya (*Papaya carica*), and guannaba or soursop (*Annona muricata*). Hardwood trees were harvested for canoes, fruit from the hibuero tree (*Crescentia cujete*) was used for storage containers, and tobacco was used for rituals. Palm nuts, guava berries and guáyiga roots were collected, as was wild cotton. Bark from dogwood (*Piscidia carthagenensis*; *Piscidia piscipula*) was used to stupefy fish trapped in weirs.

The lives of most of the island peoples were to change drastically after Christopher Columbus reached the West Indies. Columbus’ journeys began the process of “Europeanizing” the Caribbean by introducing “oranges, citrons, lemons, pomegranates, figs, and bananas as well as seeds and cuttings of wheat, melons, onions, chickpeas, radishes, grape vines, fruit stones for fruit trees, and...sugarcane” (Cunningham 1997). Following European contact, over 50 species of animals have become extinct in the West Indies, including 6 bird species, 34 mammals, and 10 reptiles (Hardy 2004). Numerous domestic animals, including large attack dogs, horses, cattle, pigs, sheep, goats, and chickens, were introduced. Grazing animals quickly changed the character of the native vegetation and introduced rats and mongoose (*Herpates javanicus*



auropunctatus) spread rapidly, preying on native wildlife and feeding on native plants (Cunningham 1997).

The Euroamerican settlement on Salt River was built, in part, atop prehistoric site(s), and it served as a system of plantations growing cotton, indigo, tobacco, sugar, and food staples. After the 1660s, the settlement at Salt River was relocated to what is now Christiansted, and Salt River Bay became an “unofficial” port for the shipment of sugar, molasses, and rum and, later, was used for extensive agricultural development (NPS 2004i). As the economy declined, St. Croix was abandoned and the populace moved to St. Domingo. The vegetation quickly reverted to nature.

St. Croix was purchased by the Danish West India and Guinea Company in 1733, and during the second quarter of the eighteenth century, the town of Christiansted was established by the Danish West India and Guinea Company on the site of an earlier French settlement.

The Kingdom of Denmark had been a “relatively late entrant in the scramble for colonies” (Hall 1992), because choices in the Caribbean were limited by the lack of feasible alternatives (the other larger and more fertile areas had been colonized by other European nations).

The sugar plantation economy, based on the slave system, tended to integrate the various tropical islands, but the interaction of economic, social, cultural, political, and demographic factors often intervened. White indentured labor was attempted, but African slave labor quickly “became the exclusive basis of the monocrop culture of the Danish West Indies” (Hall 1992). Livestock grazing was initiated in places such as Buck Island. Here, a few colonists occupied the Royal Signal Station, built to help ships going to and from the harbor at Christiansted avoid Buck Island’s coral reefs.

Although the slave populations made up the majority of the islands’ total population, and imports of slaves continued throughout the late 1700s, the number of slaves gradually declined as rates of mortality exceeded fertility. By the 1790s, it had become the custom for slaves to fend for their own food with “uncertain supplemental rations of flour, salted meat or fish provided by the plantation” (Hall 1992).

During the late 1700s, African slaves held by St. Croix colonists were being sent to Buck Island to harvest *lignum vitae* trees (Hardy 2004). *Lignum vitae* was prized for its extremely strong, hard wood, which is very durable, as well as self-lubricating (Hardy 2004). The *lignum vitae* wood was sold by weight for special uses in bearings and bushing blocks for steamship propeller shafts (Woodbury and Little 1976). This subtropical deciduous hardwood forest (along with other *lignum vitae* forests on St. John and other Virgin Islands) was decimated during the 18th and 19th centuries, resulting in the present-day subtropical dry forest.

After 1835, slaves gained civil liberties. Then, in 1848, slavery was terminated. By this time however, Virgin Islanders reflected a complex cultural intermingling of Danish official classes, Dutch and German missionaries, Jewish and French traders and craftsmen, English and Irish plantation owners, Scots-Irish overseers,



and multicultural African peoples (Hall 1992). Small groups of people continued to inhabit Buck Island during the 1800s—growing sweet potatoes, cutting trees for charcoal production, and raising sheep and goats (Hardy 2004).

In 1917 the United States purchased the Virgin Islands for \$25 million, and the U.S. Navy assumed administrative duties until 1931, when the Department of the Interior assumed control. Sugar cane and cattle-raising continued, but they were barely viable economically because of decreased soil quality, unreliable rainfall, difficult topography, high evaporation rates, and decreasing labor supplies.

Ornamental—A plant species or cultivar that is grown in gardens and parks for its beauty (in its end use), rather than commercial or other value.

As a result of these developments, Virgin Islands' society has undergone two major changes in less than a century and a half. It evolved from a plantation society, based on slave labor, that exported goods primarily for the benefit of European economic interests, to a society based on a subsistence and exchange economy. Then, in the more recent past, the subsistence and exchange economy was supplanted by a tourist-based economy developed by capital from the United States. Establishment of Virgin Islands National Park changed St. John's small farms, grazing lands, and former open fields into a verdant vacation land. St. Croix has seen fewer changes, but after about 1950, industrial development, such as oil refineries, helped to revitalize (and change) the island's subsistence patterns and land uses.

CULTURAL LANDSCAPES IN THE CARIBBEAN PARKS

A preliminary identification of potential landscapes in regional parks was performed in 1996 and 1997 by the Southeast Region of the NPS (Hasty 2004). Information from that preliminary identification has been incorporated into the following cultural resources descriptions.

ETHNOGRAPHIC RESOURCES AND EXOTIC PLANTS

The following list includes exotic plants present in the Virgin Islands that are priority species for treatment. Some of these plants are valued by traditional groups for food, dyes, landscaping, or medicine (Smithsonian 2004).

- Tan tan or wild tamarind: used for fodder
- Mother-in-law's tongue: used as an ornamental plant
- Australian pine: used as an ornamental plant
- Guinea grass: medicinal uses
- Lime berry: used as an ornamental plant and for its fruit
- Genip: used for food, wine, and medicine
- Penguin bromeliad: used as an ornamental plant
- Monk orchid: no cultural use listed



Guinea grass

- Boerhavia: no cultural use listed
- Ginger thomas: used for medicine, ornamental plantings, and liquor
- Tamarind: used as an ornamental plant and for its fruit
- Starvation apple or Painkiller or Noni: used for medicines, food, and dyes
- Aloe: used for medicines, shampoo, and bug repellent
- Guinea hen weed: may serve as a marker for archeological sites
- Coconut palms, aloe, Australian beefwood or horsetail casuarinas, jumbie-bead, rattlebox, lime tree, Spanish lime tree (kinep), Soland, otaheita, or portiatree: and *Bromelia penguin* may be markers for historic sites

Other traditionally valued exotic plants that are more easily controlled and do not tend to spread rapidly, are discussed under individual parks, below.

BUCK ISLAND REEF NATIONAL MONUMENT

Archeological Resources

Five archeological sites have been documented within the study area on Buck Island Reef National Monument. Artifacts at the prehistoric “Buck Island Site” date it to the end of the Ostionoid period, when Taino culture dominated the Greater Antilles. The other four archeological sites are historic, dating to the 18th and 19th century signal station and residences, and include foundations, trash deposits, cisterns, and a well (NPS 2004f).

Historic Structures and Districts

There are no historic structures or districts on Buck Island. Structural ruins are included with Archeological Resources, above.

Ethnographic Resources

As described for Christiansted National Historic Site, many West Indians are descendents of peoples who occupied the island during early historic times. Cultural traditions and practices passed down from generation to generation form an important part of life, and a number of plants—both exotic and native—are valued. Ethnographically important plants may include those with medicinal properties, those that bear edible fruit, and those that are used in crafts or that mark special events or places. Exotic plants at Buck Island Reef National Monument include boerhavia, seaside mahoe, ginger thomas, tamarind, aloe, coconut palms, and Guinea grass. Guinea grass was brought in as an experimental cattle food and was spread across the island by donkeys and goats.



Measures to preserve ethnographic resources include protection of several historic tamarind trees on the north and west side of the island (there are no plans for eradication of these historic trees). Forty *lignum vitae* trees have been planted on the island to help restore some of the native vegetation present when Euroamericans first arrived at the island (Lohr 2004).

Cultural Landscapes

According to NPS Southeast Regional Office, no cultural landscapes have been documented for Buck Island Reef National Monument (Hasty 2004). However, several extremely old tamarind trees (thought to be over 250 years old) can possibly be “attributed to the period Johan Deidrich owned the island (1754) or perhaps earlier, such as during the French occupation of St. Croix when Buck Island was known as *Isle Verte*” (NPS 2004f). In addition, bromeliads on Buck Island reflect its historic occupancy.

Previous Investigations

A number of archeological investigations have been conducted on Buck Island since the monument was established. A prehistoric site was first identified and investigated in 1975 by L.S. Robinson and G.S. Vesceius (NPS 1976a, 1976b, 1976c). In 1976, the NPS SEAC conducted a reconnaissance survey of the terrestrial and submerged cultural resources of Buck Island Reef National Monument (NPS 1976a, 1976b, 1976c), focusing on three known cultural resource sites: (1) a historic homestead; (2) an aboriginal site; and (3) a historic period shipwreck (NPS 2004f). In 1982, Barbara Johnson and a small crew assessed the integrity of the prehistoric site identified in 1976. In 1984, Elizabeth Righter tested this site and conducted a pedestrian survey of selected sections of Buck Island (NPS 1985a).

In September 1985, NPS archeologist Larry Murphy documented two submerged historical sites on Buck Island (NPS 1985b), and Brenda Lanzendorf assessed storm damage to the island’s archeological resources in 2000 (NPS 2000j). From July 16 to 26, 2002, Meredith Hardy of the Regional Archeological Survey Program (RASP, NPS, SEAC, Tallahassee, Florida) visited St. Croix and Buck Island Reef National Monument to conduct archival research and to assess the archeological artifacts and archival materials (NPS 2004b). In 2003, the RASP SEAC conducted an archeological pedestrian survey and limited subsurface testing at Buck Island (NPS 2004b).

To date no ethnographic studies (ethnographic overview and assessment or oral history) or cultural landscape studies have been conducted for Buck Island Reef National Monument.

National Register of Historic Places and National Historic Landmarks

No National Register or National Historic Landmark properties have been recorded for Buck Island Reef National Monument.



Threats

Threats to cultural sites include vegetation growth, erosion, and damage by hurricanes or storms; unauthorized collecting; and ground disturbing activities such as construction or restoration of native species.

CHRISTIANSTED NATIONAL HISTORIC SITE

Archeological Resources

Past archeology at Christiansted National Historic Site reveals that extensive and potentially significant archeological remains, related primarily to colonial development, underlie the present-day landscape all across the site. Potential also exists for discovery of prehistoric resources in beach-side settings. Thus, much of the area underlying the park may still have unidentified archeological resources.

Historic Structures and Districts

Christiansted's 18th century historic district is located in an urban environment between the modern town of Christiansted and Christiansted Harbor. The park includes the following structures within the larger historic district:

- Fort Christiansvaern, the largest and most impressive building on the site, was completed in 1749 and is the best preserved of the three remaining Virgin Islands forts. The Fort Christiansvaern Stable Building is an 1835 to 1840 addition to the fort.
- The centrally located Danish Customs was originally part of the Danish West India and Guinea Company compound and is now part of the NPS administrative offices.
- The Scale House, built in 1856, housed offices and facilities for weighing and inspecting imports and exports, and it is currently used as an interpretive visitor contact point.
- The Danish West India and Guinea Company Warehouse, built in the 1970s, served as the post office until acquired by the NPS in 2001.
- The Steeple Building (also known as The Church of Our Lord of S(Z)abaoth) was built between 1750 and 1753 to be the official Lutheran Church for Christiansted.
- The Government House, originally two separate structures built between 1747 and 1797, is situated a block south of the main historic site and is managed by the Government of the Virgin Islands.
- The bandstand is an octagonal wood structure constructed in 1918 by the U.S. Navy.

These buildings have been inventoried, their condition assessed (they are all in good condition), and they are listed in the regional list of classified structures (NPS 2004j). Over the past three centuries, the moist climate, salt air, hurricanes,



and termites have contributed to deterioration of these structures, and it is only with vigilance and continued upkeep that the park is able to maintain them in a good state of repair.

Ethnographic Resources

Christiansted National Historic Site is a historical park whose planned landscape includes mostly ornamental (exotic) plants, so few, if any, traditionally valued plants are found within the park.

Cultural Landscapes

The park's 7-acre, designed, historic landscape is dominated by its colorful colonial buildings, set among 2 acres of green open space, which are planted with a mixture of native and exotic plant species. These include banyan, fan and date palms, flamboyant tree, mango, mahogany, tamarind, hogplum, lignum vitae, bougainvillea, shrubs, and grass. Benches and picnic tables are scattered across the grassy areas.

The size, scale, and design of the buildings, their organization, and the planned landscape are all representative of Danish cultural mores at this time and place in history, reflecting trends in 18th-century architectural design and urban planning that were borrowed from Italian Renaissance and Baroque traditions.

One of the park's management objectives is to "implement historic landscaping that will resemble the mid-1800s scene as closely as possible" (NPS 1986a).

Previous Investigations

Archeological projects conducted at Christiansted National Historic Site include work related to:

- Installing restroom facilities at the warehouse (NPS 1988b; Horvath 1989)
- Examining areas suffering hurricane damage and monitoring trenching for buried utility lines (NPS 1989b, 1990a)
- Demolishing nonhistoric structures 1999
- Restoring the fort (NPS 1960)
- Restoring the church (NPS 1960)
- Improving the Customs House in 1976 to 1977

To aid past rehabilitation and upkeep of the buildings, various reports and structural assessments have been completed for Christiansted National Historic Site (NPS 2004k). To date, no ethnographic studies (ethnographic overview and assessment or oral history) have been conducted.



A Cultural Landscape Report was written in 1985 by Robert Bradley for the 19th-century evolution of Christiansted's wharf area. The entire park is considered to have potential as a cultural landscape (Hasty 2004).

National Register of Historic Places and National Historic Landmarks

Christiansted National Historic Site was placed on the National Register of Historic Places on March 5, 1999, as part of the Christiansted National Register District that includes nearly 600 buildings that existed in this area in 1796. The park's buildings are nationally significant under National Register criteria A and C for their association with the Danish colonization of the West Indies and their representative Danish colonial architectural style. The bandstand is locally significant under National Register criterion A for its association with U.S. Navy operations in Christiansted between 1917 and 1931.

Threats

Threats to archeological resources include landscaping activities, unauthorized collecting, utility excavations, and other ground disturbing projects, along with hurricanes, heavy rainfall, and erosion. Factors such as hurricanes, heavy rainfall, vegetation growth, and erosion also threaten the integrity of the park's historic structures.

SALT RIVER BAY NATIONAL HISTORIC PARK AND ECOLOGICAL PRESERVE

Archeological Resources

Salt River Bay National Historic Park and Ecological Preserve "encompasses the entire spectrum of human history in the West Indies" (Taino, Caribbean, African, and other pre-European societies, the Columbus contact and Spanish, French, Dutch, English, and Danish periods) (NPS n.d.h).

Salt River Bay is considered the most important archeological site in the project area, because it was inhabited by all three of the major pottery-making cultures found in the Virgin Islands in prehistoric times: the Igneri, Taino, and Carib. The Igneri lived in this area from about A.D. 100 until about A.D. 700, when they were gradually absorbed by the Taino, who were, in turn, conquered and enslaved by the Caribs about A.D. 1425 (NPS n.d.h).

Salt River Bay is also known as the site where Columbus landed on November 14, 1493, during his second voyage of exploration to the New World. Salt River Bay is the first, and only, positively documented of the two sites associated with Columbus on what is now U.S. territory, and most of the past archeology has been focused in this general area (NPS 1990b). The encounter between the Caribs and the Spaniards was also the first documented Native American resistance to European encroachment (NPS n.d.h).

In addition to prehistoric sites, such as the Igneri / Taino / Carib villages and the Taino ball court, historic archeological sites include the English / French village (1645 to 1665) and the 1493 Columbus landing site, as well as structural and archeological remains at Fort Flamand / Fort Salé (1642 to 1665), Greig's Fort



(1788 to 1801), the Danish well tower (ca. 1760s), and the English and French Plantations in the Judith's Fancy area. For purposes of this document, the entire park has been considered an archeological resource.

Historic Structures and Districts

No historic structures are listed on the Southeast Region list of classified structures for Salt River Bay National Historic Park and Ecological Reserve (NPS 2004j). Ruins of the Danish customs post (1788) are located just outside the park.

Ethnographic Resources

As described for Christiansted National Historic Site, many of St. Croix's present-day residents are West Indians, descendants of peoples who occupied the island during early historic times. Cultural traditions and practices passed down from generation to generation form an important part of life on St. Croix, and a number of plants—both exotic and native—are valued, including those with medicinal properties, that bear edible fruit, that are used in crafts, or that mark special events or places. Among the exotic plants at Salt River Bay are tan tan, Australian pine, and large stands of Guinea grass. These plants are widely available across St. Croix and have not been identified as park ethnographic resources.

Cultural Landscapes

Salt River Bay National Historic Park and Ecological Preserve has been identified as a potential cultural landscape (Hasty 2004). The landscape includes archeological and historical resources, and the exceptional seaside viewshed recalling the historic nature of this site.

Previous Investigations

In 1587, John Wilte, enroute from England to Virginia, stopped at Salt River Bay for a couple of days and reported seeing natives and pottery scattered near the landing. Danish Engineer Ramsing did field work at Salt River Bay around 1900. More formal archeological investigations at Salt River Bay began with a survey of the island and excavations in 1917 by Theodoor de Booy. In 1923, Danish archeologist Gudmund Hatt discovered the Tainan ceremonial ball court or plaza at Salt River Bay (Wilson 1997). Numerous others followed, including Folmer Andersen in 1930, Herbert Krieger in 1937, Gary S. Vescelius in 1951, and Vescelius and Tilden in the late 1970s (Wilson 1997).

National Register of Historic Places and National Historic Landmarks

In recognition of its nationally-significant resources, Salt River Bay was made a National Historic Landmark in 1960 and a National Natural Landmark in 1980 (NPS n.d.h).



Threats

The archeological resources at Salt River Bay National Historic Park and Ecological Preserve have numerous threats, including unauthorized collecting, vandalism, erosion, and wear and tear from site usage for recreation. Parts of the Salt River Bay area are overgrown with exotic plants, especially Guinea grass. Removal of large areas of this exotic plant at one time could leave site areas vulnerable to additional erosion. Guinea grass burns easily, so unplanned fires could badly damage archeological resources. Roots from genip or other trees could penetrate sites and damage resources.

VIRGIN ISLANDS NATIONAL PARK

Archeological Resources

There are 15 known prehistoric sites and 4 multicomponent sites within Virgin Islands National Park (Wild 2003). Two of these, the Cinnamon Bay site and the Reef Bay petroglyphs, are listed on the National Register, and nine additional sites may be eligible for National Register listing. Most of the prehistoric sites date to Archaic times, and generally are situated near the outer edges of the island.

On St. John, archeological investigations have documented that the northern Virgin Islands are associated with Classic Taino culture, which in turn has predominantly been associated with sites containing ceremonial centers, religious artifacts, and ball courts.

The majority of the historic archeological sites on St. John are colonial sites that were part of an island-wide larger plantation/sugar cane agricultural system. These sites include around 500 structures, of which about 120 are in ruins and are considered historical archeological sites (Wild 2003). Of the standing structures, 181 currently are on the park's list of classified structures (NPS 2004j). Other historic archeological sites include mills, cemeteries, a marine railroad, a leprosy colony, and ship careening sites.

Archeological remains on Hassel Island are related to a short British occupation during the 1800s when a garrison was constructed consisting of officer's quarters, enlisted men's barracks, a hospital, cisterns, powder magazines, latrines, and mess buildings. Other archeological remains on Hassel Island are related to the Creque Marine Railway facility, which was one of the earliest steam-powered marine railways in the Western Hemisphere and the oldest surviving example of a steam-powered marine railway in the world (Virgin Islands e-magazine n.d.).

Historic Structures and Districts

Some of the approximately 380 park structures date to the early 1700s, reflecting 300 years of island history. Most are situated within historic districts (see table 29 (NPS 2004j; NPS 2004l). There are 11 National Register Districts, and a number of single site nominations. During the Danish period, plantations were scattered across the entire island. Typically plantations would have a windmill or horse mill, sugar works (mill and factory), cisterns, cook houses and bake ovens, privies, schools, cattle pens, gardens, stables, storage structures, slave quarters,



provisional farms for the slaves, and a “great house” that was generally occupied by an overseer because most of St. John’s plantation owners lived either on St. Thomas or in Europe (Olwig 1985). Following the failure of the plantation system during the mid-1800s, plantation buildings fell into disrepair and the grounds were overtaken by native and exotic plants. Currently there are 46 historic plantations within park boundaries, 31 of which are on federal land.

Seventeen of these buildings still have roofs, or vestiges of roofs, and nine are still in use. The most significant and complete of the historic structures in the park have been cleared of vegetation and stabilized against deterioration.

Most of the park’s structures have been inventoried, their condition assessed, and they are listed in the park’s list of classified structures (NPS 2004j).

Cultural Landscapes

Although eight cultural landscapes (Annaberg School, Annaberg Sugar Plantation, Catherineberg Sugar Plantation, Cinnamon Bay Sugar Plantation, Dennis Bay Plantation, Jossie Gut Factory landscape, Lameshur Plantation, and Reef Bay Valley) have been identified for Virgin Islands National Park (Hasty 2004), numerous additional park areas retain elements of the original circulation system, buildings, plants, and organization. For example, many of the present-day roadways generally follow original cart roads.

Many of the exotic plants present today formed an important part of Virgin Islands early landscapes. St. John has 150 exotic plant species, many of them within the park (Clark 2003). Some of these, such as the coconut palm, frangipani, and the flamboyants, do not pose a serious invasive threat, but may be character-defining elements of the cultural landscape at historic sites. For example, the early settlers grew yucca and casabah at Annaberg (Clark 2003), and some exotic plants are preserved in Annaberg’s demonstration garden. The wild pineapple was brought in during slavery times. It was used as an ornamental plant and often marks old homesteads. It was also used as a “living fence” to confine livestock and slaves.

However, other plants, such as tan tan, genip, and limeberry—originally imported and planted for food or ornamentation—have become wild, engulfing historic ruins and beach areas while displacing native plants. Genip and sweet lime were brought to St. John by early immigrants; genip may have been on the island as long as 1,000 years (Wild 2003). Hassel Island has a dense growth of drought-resistant brush, cacti, and grasses, but it is not clear whether a cultural landscape has been defined for this area.

Ethnographic Resources

Many of the West Indian residents of St. John are descendents of peoples who occupied the Virgin Islands during early historic times. As in the other Caribbean islands, cultural traditions and practices passed down from generation to generation form an important part of life on St. John. A number of plants—exotic and native—are valued, especially those that have medicinal properties, bear edible fruit, are used in crafts, or mark special events or places.



Among these special plants are “magic” and “jumbie” trees or plants, related to beliefs about spirit trees in West Africa. Plants such as baobab (*Adansonia digitata*), tamarind (*Tamarindus indica*), and kenip/genip have acquired a reputation as spirit trees (University of the Virgin Islands n.d.). Such trees also may be important because of their association with burials or tragic events, such as hangings.

Caribbean peoples believed genip brought good fortune and planted these trees around their villages. A large genip tree at Annaberg is valued for its shade and because it is a “story-telling” tree. The fruit of the genip also was a valued food item, and the leaves, stems, and fruit have medicinal uses (Thomas 1997).

Other exotic plants on St. John include tan tan, mother-in-law’s tongue, and Australian pine. Ginger thomas and guinea grass were both traditionally used for medicinal purposes, and ginger thomas remains a popular ornamental plant, as well as being the Virgin Islands territorial flower.

Many other exotic plants on the Virgin Islands also were traditionally used for medicine, ceremonies, insect repellents, food, crafts, or livestock fodder (Thomas 1997; Honychurch 1986). However, most of these plants do not pose a serious invasive problem and are not discussed in this draft EPMP/EIS.

Previous Investigations

Several of the archeologists who conducted archeological surveys and excavated sites on St. Croix also investigated sites on St. John and the other Virgin Islands (Morse 1997). A chronological listing of archeological research in the Virgin Islands is contained in the park’s Archeological Overview and Assessment (Brewer and Hammersten 1987) but is too voluminous to include here. More recently, investigations have been conducted on St. John by Wild (2004). However, archeological surveys have only been conducted on small areas of the island, and the potential exists for the discovery of additional prehistoric resources, especially in beach-side settings, ruins, and other sites associated with historic occupancy.

National Register of Historic Places and National Historic Landmarks

Twenty-one historic and archeological sites and districts are listed on the National Register of Historic Places (table 29). Fourteen additional historic districts and one individual building situated on holdings within the authorized boundary of Virgin Islands National Park may qualify for nomination to the National Register of Historic Places for their historical association and integrity. Reef Bay Great House has been nominated as a National Historic Landmark and six properties are considered “worthy of nomination” (M. Barnes 1990, cited in NPS 2003b).

TABLE 29: HISTORIC SITES AND DISTRICTS ON THE NATIONAL REGISTER

Historic Sites and Districts on the National Register	Date Added to the Register	Sites/Districts Potentially Eligible for the National Register Located on Inholdings	Under Consideration for the Register	Other Historic Sites within the Park (Brewer and Hammersten [1987])
Annaberg Historic District	7/23/1981	Caneel Bay Plantation	—	America Hill
Brown Bay Plantation Historic District	7/23/1981	Susannaberg Plantation	—	Annaberg School (Individual Site)
Catherineberg-Jockumsdahl-Herman Farm	3/30/1978	Adrian Plantation	—	Base Hill / Johnny Hern
Cinnamon Bay Archeological Site	7/11/1978	Oynes Point Custom Guard House	—	Bordeaux Plantation
Cinnamon Bay Plantation	7/11/1978	Leister Bay Plantation	—	Bordeaux West
Dennis Bay Historic District	7/23/1981	Frederiksdal and Mount Pleasant	—	Cabritte Horn
Hermitage Plantation Historic District	7/23/1981	Frederiksvaern, Fortsberg, Coral Bay	Nominated by SHPO	Caneel Bay Estate House
Jossie Gut Historic District	7/23/1981	Whistling Cay Customs Guard House	Nominated by SHPO	Genti Bay (Little Reef Bay)
L'Esperance Historic District	7/23/1981	—	—	Hope Plantation
Lameshur Plantation	6/23/1978	—	—	Lameshur School
Liever Marches Bay Historic District	7/23/1981	—	—	Lindholm Great House Complex
Lind Point Fort	7/23/1981	—	—	Mary Point Custom Guard House (Individual Site)
Mary Point Estate	5/22/1978	—	—	Mollendahl Plantation
More Hill Historic District	7/23/1981	—	—	Paquereau Plantation
Reef Bay Petroglyph Site	7/7/1982	—	—	Par Force Plantation
Reef Bay Great House Historic District	7/23/1981	—	—	Sieben Plantation
Reef Bay Sugar Factory Historic District	7/23/1981	—	—	—
Rustenberg Plantation South Historic District	7/23/1981	—	—	—
Trunk Bay Sugar Factory	7/23/1981	—	—	—
Hassel Island	07/19/1976	—	—	—
Hassel Island Historic District	08/29/1978	—	—	—

SHPO = State Historic Preservation Office



Threats

The primary threat to archeological resources in Virgin Islands National Park includes landscaping activities, utility excavations and other ground disturbing projects, hurricanes, wear and tear from visitor use, excessive rainfall, and erosion. Basic inventories are incomplete, so portions of structures and archeological sites buried beneath vegetation are still being discovered.



VISITOR USE AND EXPERIENCE

Enjoyment of parks and their resources is a fundamental part of the visitor experience. Visitor satisfaction is affected by the quality of park programs, facilities, and services, whether provided by NPS, a concessionaire, or a permittee.

BIG CYPRESS NATIONAL PRESERVE

Recreational activities in the preserve today include bird watching, wildlife observation, camping, canoeing, hunting, driving off-road vehicles, fishing, bicycling, and hiking. The use of off-road vehicles is a popular recreational activity within Big Cypress National Preserve. This activity and associated impacts were studied in depth in the *Final Recreational Off-Road Vehicle Management Plan and Supplemental Environmental Impact Statement* (NPS 2000f). The result was that the plan closed the area around the proposed sites to off-road vehicular travel.

White-tail deer and feral hogs are the most popular large game animals among the hunters. Fishing is popular in canals along major roads, and the canals are also prime locations for viewing wildlife. Visitors drive Turner River Road and Loop Road to view birds, alligators, and other wildlife in the roadside canals. Canoeing along Turner River and Halfway Creek provides anglers and recreational boaters opportunities to explore more remote areas of the preserve, and commercial tours taking frequent trips from U.S. Highway 41 to the Everglades City area. Bicycling gravel roads and limerock trails provides scenic vistas and access to a variety of habitats found in the preserve. This activity is gaining in popularity, particularly in the Bear Island area and along the Loop Road and Turner River Road / Birdon Road corridor.

Campgrounds and undeveloped campsites are used mainly by hunters and winter visitors. Both frontcountry and backcountry sites are used for camping. In 1999, there were 16,301 overnight stays (tent camping and recreational vehicle camping). Backcountry camping statistics were collected only for hikers using Florida Trail campsites and totaled 10,158 overnight stays. Hiking opportunities include Fire Prairie Trail and a section of the Florida National Scenic Trail. The principal hiking trail in the preserve is the Florida National Scenic Trail where use is increasing. Many hikers will walk the first 10 miles of the trail north of Oasis and then turn around, rather than hiking all the way through to Interstate-75 or points farther north.

Formal and informal interpretation is available to visitors at the current Big Cypress Visitor Center at Oasis and at the Concho Billie, Bear Island, and Turner River areas. Guided bicycle trips, canoe tours, and environmental education activities, as well as swamp walks and hikes on the Florida Trail, are offered each winter season from mid-December through early April.



Visitor facilities include one visitor center, two picnic areas, one developed campground, five primitive campgrounds, and an interpretive trail on Loop Road. Planned projects include the Tamiami Trail Welcome Center, interpretive trails, a canoe landing, and improved parking / off-road vehicle staging areas.

Visitation statistics maintained at the Oasis Visitor Center (table 30) report the total number of Preserve visitors from 1989 to 2002 as approximately 4.7 million. Visitation increased from 1989 to 2000 but decreased in 2001 then increased again in 2002 to 449,481 recreational visits (NPS 2003).



*Hiking at
Big Cypress
National Preserve*

The Florida Department of Transportation maintains a traffic count station along U.S. Highway 41 east of SR 29 inside the preserve as well as Annual Average Daily Traffic data. Annual Average Daily Traffic is the total volume of traffic on a highway segment for one year, divided by the number of days in the year. Both directions of traffic volumes are reported as well as total two-way volumes. Annual average daily traffic volume from this station is shown in table 31 for the years from 1991 to 2001 (FDOT 2003).

The *Big Cypress National Preserve Visitor Study* conducted in the winter of 1999 by the Cooperative Park Studies Unit, University of Idaho (Meehan 1999), identified general visitor demographics. These findings are based on 857 questionnaires that were distributed January 2 to 10, 1999, at nine locations. A total of 582 surveys were returned for a 68% response rate.

Of the total visitors surveyed, 25% were Florida residents. New York, Indiana, and California followed, with 4% each. International visitors from 21 countries comprised 21% of the visitors surveyed. Germany, Canada, and England were the most frequently cited foreign countries of origin.

On the surveyed visit, the most commonly visited sites were the visitor center (60%) and H.P. Williams Park (28%). The least-visited sites included Bear Island Campground (4%) and the Florida National Scenic Trail (4%). Bird watching (66%), sightseeing (66%), visiting the visitor center (63%), viewing wildlife (60%), and driving through to another destination (60%) were the most common activities. Bird watching, viewing wildlife, sightseeing, experiencing wilderness, and experiencing solitude were rated as the most important activities by those surveyed.

Hunting is also a popular recreational activity in the preserve, although only 7% of those visitors surveyed rated it as “extremely important” or “moderately important.” Hunting seasons run from September through April. Fishing was rated by 16% and airboating was rated by 15% as “extremely important” or “moderately important.”


TABLE 30: VISITATION AT PARTICIPATING NATIONAL PARKS

Year	Big Cypress National Preserve (visitors)	Biscayne National Park (visitors)	Canaveral National Seashore (visitors)	Dry Tortugas National Park (visitors)	Everglades National Park (visitors)	Buck Island Reef National Monument (visitors)	Christiansted National Historic Site (visitors)	Virgin Islands National Park (visitors)
1989	81,157	589,957	949,201	19,441	913,372	73,779	128,656	664,032
1990	127,790	573,376	1,079,022	19,402	957,925	32,337	101,859	664,735
1991	159,172	488,134	1,159,001	18,231	1,292,014	51,542	110,626	710,180
1992	212,682	307,512	1,032,992	21,581	1,025,686	48,621	124,512	772,470
1993	234,830	19,950	1,211,492	24,020	973,706	60,204	113,883	807,093
1994	294,307	25,147	1,432,880	16,736	886,455	57,294	118,067	635,291
1995	365,463	584,519	1,380,438	32,870	820,466	57,716	117,766	536,058
1996	424,920	338,603	1,496,961	35,127	890,167	45,618	111,891	475,942
1997	462,553	392,069	1,368,632	47,224	989,532	53,583	108,825	592,537
1998	474,895	403,239	703,301	60,136	1,118,215	46,455	107,223	556,849
1999	503,110	442,585	846,512	74,186	1,073,982		104,081	425,345
2000	505,062	393,151	1,115,345	83,704	995,390		98,947	703,992
2001	409,771	489,343	1,062,962	79,186	1,049,851		112,915	677,401
2002	449,481	513,397	1,075,747	79,582	968,909	50,213	110,209	693,494

Note: No visitation data are available for Salt River Bay National Historic Park and Ecological Preserve.

**TABLE 31: HISTORICAL ANNUAL AVERAGE
DAILY TRAFFIC FROM STATION 030104
(BIG CYPRESS NATIONAL PRESERVE)**

Year	Average Daily Volume
1991	3,998
1992	3,600
1993	3,600
1994	2,400
1995	3,100
1996	2,800
1997	2,300
1998	2,700
1999	4,300
2000	3,200
2001	3,400

BISCAYNE NATIONAL PARK

During FY 2002, Biscayne National Park had 513,397 recreational visits (NPS 2003). Table 30 summarizes the recreational visitation counts from 1989 through 2002. In the *Biscayne National Park Visitor Study, Spring 2001*, the results of a visitor study at the park during March 3 to 11, 2001, are described (Simmons and Littlejohn 2002). Of the distributed questionnaires, 380 were returned for a 62.8% response rate. The greatest number of visitors surveyed (80%) were from Florida, followed by Pennsylvania (2%) and Michigan (2%). Twenty-seven other states and Washington D.C. were represented. Nine percent of all visitors surveyed were international, with 45% from Canada, 14% from Cuba, and 8% from Germany. On the surveyed visit, the most common activities were nature viewing (53%), walking or hiking (48%), and fishing (31%). The most commonly visited sites in the park were Elliot Key (34%), Boca Chita Key (33%), Dante Fascell Visitor Center (31%), and Black Point Marina (26%). Of the visitor groups surveyed, 80% rated the protection of water quality and flow as “extremely important.”

Most visitors enter the park by private boat. They fish, cruise, and enjoy the waters of the park. In addition, they can picnic and camp on the islands. With snorkels or dive tanks, visitors can explore the living coral reefs. The remainder of the park visitors arrive by car at Convoy Point, the location of the park's headquarters and the Dante Fascell Visitor Center. Here, visitors can picnic, fish, canoe, explore the visitor center, or take one of the boat tours offered by the park's concessionaire. The concession offers gift sales, canoe rentals, glass-bottom boat tours, snorkel trips, scuba trips, and transportation to the island for campers. In addition, special programs are offered throughout the year, including boat trips, canoe tours, ranger talks, Family Fun Fests, Discovery Series lectures, concerts, and art exhibits.

Convoy Point offers a tranquil setting, with picnic tables and charcoal grills, a canoe beach where visitors can launch their own canoe, kayak, or sailboard, and



a boardwalk that passes along the shoreline out to the rock jetty beside the boat channel heading to the bay. Fishing from the shoreline in the bay is allowed under Florida State fishing regulations and licensing requirements.

The Dante Fascell Visitor Center, completed in the summer of 1997, offers information, exhibits, park videos, book sales, and a veranda with a scenic view.

Camping is offered in the designated campgrounds on Boca Chita Key and Elliott Key. Access to these campgrounds is by boat only. The park's concessionaire can provide transportation for those campers who do not have a boat. On Elliott Key, all campsites have a picnic table and a grill. A group campsite is also available. In addition, Elliott Key has freshwater, cold water showers, and restrooms. There are trails and a buoyed swim area. Fishing is accessible from the maintenance dock, as well as from the no-wake zone, the shoreline outside of the harbor, and the swimming area. A fire ring is provided 0.25 miles east of the harbor on the ocean side of the island. Pets are permitted in the developed areas of Elliott Key, with provisions. All campsites on Boca Chita Key have a picnic table and a grill, and both individual and group campsites are available. A saltwater restroom is available, but no sinks or showers are provided. Fishing is allowed except in the harbor, where the shoreline is bulkheaded, or in the creek going into the wetlands.

Biscayne National Park protects four distinct but interrelated natural systems in addition to cultural resources spanning 2,000 years (and maybe as many as 10,000 years). This provides great opportunity for education at the park where currently the park is developing a "Discovery Room" at the Dante Fascell Visitor Center that provides facilities for educational field trips to the park.

The Environmental Education Camping Program for groups of 5th and 6th graders began in 1976 as an extension of the Everglades National Park education program. The program originated on Elliott Key but was moved to Adams Key during the 1980–81 school year. At that time, Biscayne National Park began to operate the program on its own. Over the years, the program has grown, and the park's proximity to Miami attracts a diversity of participants: inner city schools, private schools, groups with disabilities, and home-schooled students. The camping program has been held at Elliott Key since Hurricane Andrew in 1992. It is a 3-day, 2-night field trip for 5th and 6th grade classes. Study habitats include the mangrove shoreline, coastal transition forest, hardwood hammock, intertidal zone, and marine meadows. Activities in these habitats may include shoreline "wet" walks, hammock explorations, night walks, and campfires.

CANAVERAL NATIONAL SEASHORE

During FY 2002, Canaveral National Seashore had 1,042,090 recreational visits (NPS 20031). Recreational visits are summarized for Canaveral National Seashore in table 30. The Visitor Service Project, Canaveral National Seashore, describes the results of a visitor study during August 21 to 27, 1994 (FitzGerald and Madison 1995). Of the 510 distributed questionnaires, 365 were returned for a 72% response-rate. Visitors from foreign countries comprised 4% of the visitation. Eighty percent came from Florida, with smaller percentages from



many other states. The most visited sites at Canaveral National Seashore were Playalinda Beach (55%), Turtle Mound (36%), and Apollo Beach (33%). Sixty-one percent of visitors surveyed stayed four hours or less during their visit. The most used facilities were parking lots (95%), beaches (91%), and roads (76%). The most important facilities were the beaches and the restrooms.

Visitors may enjoy walking the nature and historical trails during the cool winter months. Throughout the year, opportunities for recreational activities include: lagoon and surf fishing, boating, canoeing, surfing, sunbathing, swimming, hiking, horseback riding, and backcountry camping.

Self-guided trails are located in the North District, near New Smyrna Beach and at Seminole Rest, located in Oak Hill. Accessible beach crossovers are available. Backcountry camping is offered in the North District, and both island and beach camping are available. Turtle watches are available in June and July. Park visitors can join a ranger and watch a loggerhead sea turtle nest on the beach. Fishing piers are available in both the North District and the South District. A paved boat ramp to Mosquito Lagoon is located north of the Information Center and primitive boat ramps to the lagoon are also available.

The park provides visitors with interpretive talks and tours including the Backwaters of Mosquito Lagoon Journey, an interpretive tour on a pontoon boat, and the walk to the historic Eldora Statehouse. In addition, there are Junior Ranger Programs for children and other special events scheduled throughout the year.

DRY TORTUGAS NATIONAL PARK

Visitors travel to Dry Tortugas National Park by commercial or private boat or by seaplane. Two ferry vessels each bring as many as 100 passengers from Key West to Garden Key daily. Travel time by ferry is about 2.5 hours each way, and visitors spend about 4 hours on Garden Key. Ferry operators provide an in-transit narration and may show a video describing park resources. They also conduct an interpretive tour of the fort and provide lunch and snorkeling equipment for their passengers. Seaplanes carrying from five-to nine-passengers make trips daily from Key West. Flying time is about 35 minutes each way.

Recreational opportunities available to visitors include swimming, snorkeling, fishing from the dock, beachcombing, bird and wildlife watching, photography, camping, kayaking, picnicking, and scuba diving to view coral, fish, and shipwrecks.

Visitors currently receive park information in various ways. The park website and park headquarters at Everglades National Park provide basic information about the history, natural and cultural resources, recreational and educational opportunities, and how to obtain transportation to the park. Visitors to Garden Key may tour the fort guided by an NPS interpreter or by an employee of a ferry-boat operator. A self-guided tour permits visitors to follow an interpretive trail around the fort independently. Because of the small staff, ranger-led tours and special interpretive programs are limited.



Although commercial fishing is prohibited in the park, recreational saltwater fishing is allowed, if visitors have a Florida fishing license. Charter fishing boats carrying up to six people are allowed if they have been granted permits by the NPS. There are also dive boats that bring customers to the park.

Food service or freshwater showers are not available for visitors on the islands. Visitors must bring their own supplies and must carry all trash with them when they leave the park.

A visitor study at Dry Tortugas National Park from March 20 to 26, 2002 (Le and Littlejohn 2003) distributed four hundred questionnaires; 311 were returned for a 77.8% response rate. United States visitors were from Florida (22%), New York (10%), Pennsylvania, Michigan, Minnesota, and California (5%), 33 other states, and Washington D.C. Four percent of all visitors were international, with 44% of those from Canada, 16% from Holland, and 9% from Japan.

The most common reasons for visiting Dry Tortugas National Park on the surveyed visit were learning about history (78%) and snorkeling/diving (77%). The most commonly visited locations in the park were Garden Key and fort (98%), Loggerhead Key (7%), and natural/cultural zone areas (7%). The most common fishing location was Garden Key and fort (95%).

Visitors rated coral reefs, water quality and flow, endangered species, and healthy fish populations the most important to protect. The most used visitor services and facilities were restrooms (89%) and beach and swimming areas (83%). The most important services and facilities were the campground (95%), restrooms (89%), and beach and swimming areas (85%).

Visitation to the park has increased from a low of 16,736 recreational visits in 1994 to almost 84,000 recreational visits in 1999 and then dropped slightly to just above 79,500 in 2002. Recreational visitation from 1989 to 2002 is summarized in table 30.

In 2002, about 3,678 visitors camped overnight. About 62% of the park's visitors arrived by ferry, nearly 20% traveled by private boats, about 10% came by seaplane, and about 7% by commercial boats (fishing). The remaining 1% were NPS staff and/or researchers. The dock, campground and restrooms become crowded during peak visitation periods. In 2002, peak visitation occurred from March to July, and more than 8,000 visitors arrived each month.

EVERGLADES NATIONAL PARK

During FY 2002, Everglades National Park had 968,909 recreational visits (NPS 2003). Table 30 summarizes recreational visits from 1989 to 2002. The *Everglades National Park Visitor Study, Spring 2002*, describes the results of a visitor study at the park during March 17 to 23, 2002 (Littlejohn 2002). Of the 804 questionnaires distributed, 623 were returned, a 77.5% response rate. Florida represented the greatest number of visitors surveyed (34%) followed by New York (7%) and Michigan (6%). Forty-three other states and Washington, D.C. were also represented. Fourteen percent of all visitors were international, with



36% from England, 19% from Canada, and 17% from Germany, as well as from 15 other countries.

On the survey visit, the most common activities were nature viewing / bird watching (75%), walking / hiking (66%), and photography / painting / drawing (43%). Nature viewing / bird watching and walking / hiking were the most important activities to visitors on this visit. Most visitor groups used private vehicles (88%) to travel in the park. The most commonly visited sites in the park were Flamingo (38%), Royal Palm / Anhinga Trail (37%), Shark Valley (35%), Ernest F. Coe Visitor Center (31%) and 10,000 Islands (30%).

Visitors can enjoy biking, horseback riding, wildlife viewing / bird watching, boating, camping, fishing, hiking, kayaking, and stargazing. Everglades National Park has many miles of hiking and biking trails. Biking is permitted along the main park road, on the Shark Valley tram road, on the Old Ingraham Highway, on Long Pine Key Nature Trail, and on the Snake Bight and Rowdy Bend trails at Flamingo. Bikes can be rented at Shark Valley. Trails include the Anhinga Trail, Gumbo-Limbo Trail, Lone Pine Keys Trails, Pineland Trail, Pahayokee Overlook, Mahogany Hammock Trail, West Lake Trail, Snake Bight Trail, Rowdy Bend Trail, Christian Point Trail, Bear Lake Trail, Eco Pond, Guy Bradley Trail, Bayshore Loop, Coastal Prairie Trail, Bobcat Boardwalk, Otter Cave Hammock Trail, and Tram Road. Horseback riding is allowed in the park with a permit. Visitors can rent boats, kayaks, and canoes and enjoy guided boat tours at Flamingo and Everglades City. Ranger-guided programs and activities are offered throughout the park.

BUCK ISLAND REEF NATIONAL MONUMENT

Authorized concession operations provide marine-life viewing and boating recreation for visitors at Buck Island Reef National Monument from Christiansted Water Front and Green Cay Marina. Glass-bottom boat tours and trips by catamaran, sailboats, and motor vessels are available. Visitors can take daily trips to the park for a half or full day. Once there, they can enjoy swimming, sunbathing, picnicking, snorkeling or scuba diving through the reef to view tropical marine life, or hike over the island. The park contains underwater and overland trails.

Buck Island Reef National Monument had 50,213 recreational visits during FY 2002 (NPS 2003). Table 30 summarizes the recreational visitation counts from 1989 to 2002.

CHRISTIANSTED NATIONAL HISTORIC SITE

During FY 2003, Christiansted National Historic Site had 117,338 recreational visits (NPS 2003). Recreational visits from 1989 to 2002 are summarized in table 30.

There are six historic structures on the grounds: Fort Christiansvaern, the Danish West India and Guinea Company Warehouse, the Steeple Building, Danish



Custom House, Government House, and the Scale House. These are used to interpret the drama and diversity of the human experience at Christiansted during Danish sovereignty–colonial administration, the military and naval establishment, international trade (including the slave trade), religious diversity, architecture, trades, and crime and punishment. The visitor's information center in the old Scale House contains information relative to the history of the site. Visitors can also tour the museums at Fort Christiansvaern, the Steeple Building, and the Scale House at the site. Fort tours and historical talks are provided on a regular basis.

SALT RIVER BAY NATIONAL HISTORIC PARK AND ECOLOGICAL PRESERVE

The park was established in 1992. There are currently no visitor services authorized by NPS at Salt River Bay National Historic Park and Ecological Preserve. There are no campsites at Salt River Bay National Historic Park and Ecological Preserve. Scuba diving, snorkeling, kayaking, and hiking tours can be arranged. Other activities include bird watching, nature walks, stargazing, and swimming.

VIRGIN ISLANDS NATIONAL PARK

While Annaberg Sugar Mill and Trunk Bay are the most frequently visited park sites, Virgin Islands National Park has diverse beaches, coral reefs, historic ruins, and hiking trails for visitor enjoyment. The park also provides opportunities for solitude and reflection. Activities for visitors include swimming, snorkeling, scuba diving, sunbathing, sailing, kayaking, windsurfing, camping, hiking, photography, and bird watching. Private operators provide day-long charters for-sail or boat snorkeling tours, as well as two-hour, safari-bus island tours.

Hawksnest Bay is a white sand beach on the north shore. Facilities include a large parking lot, two picnic pavilions, picnic tables, charcoal grills, toilets, and changing areas. Trunk bay is one of the Caribbean's most photographed beaches and features an underwater self-guided snorkeling trail. Facilities include a gift shop, snorkel rental, snack bar, showers, toilets, changing areas, telephones, and a picnic pavilion. There is also an information kiosk staffed by Friends of the Virgin Islands National Park volunteers.

Cinnamon Bay beach, about one mile long, is the longest beach in the park. Cinnamon Bay Campground is located at the beach, with services including an activity desk, toilets, changing areas, showers, telephones, restaurant, general store, and beach shop. The campground offers cottages, tents, and bare campsites. There are Danish plantation ruins across Route 20 from the campground, and the Cinnamon Bay Trail, connecting North Shore and Centerline roads, and the self-guided Cinnamon Bay Loop Trail, is located behind the ruins.

Maho Bay has a white sand beach. Its only facility is a pavilion. Limited roadside parking provides quick and easy beach access. Annaberg Sugar Mill was



established in 1718, and is one of St. John's best-preserved examples of the island's cultural past during the colonial and post-emancipation era. Self-guided and ranger-guided tours take visitors through the sugar factory ruins. Parking is provided a short distance from the ruins

Cruz Bay Visitor Center is located in downtown Cruz Bay, a short distance from the public ferry dock. The Reef Bay Trail is 2.2 miles long, beginning from Centerline Road to the Reef Bay Valley, and ending at Reef Bay sugar factory near the Genti Bay beach. The 0.3-mile Petroglyphs Trail intersects Reef Bay Trail 1.6 miles from the trailhead on Centerline Road. Carved in the rocks beside the freshwater pool are pictures and symbols whose origin has yet to be determined.

During FY 2002 the park had 693,494 recreational visits (NPS 2003). Table 30 summarizes recreational visits from 1989 to 2002. The *Virgin Islands National Park Visitor Study, Spring 1997* describes the results of a visitor study at the park during March 1 to 9, 1997 (Littlejohn 1997). Of the 1,328 questionnaires distributed, 1,039 were returned, a 78% response rate. International visitors comprised 5% of total visitors surveyed. They were from Canada (40%), Germany (14%), Norway (11%), United Kingdom (7%), Denmark (6%), and 17 other countries. United States visitors were from Massachusetts (19%), New York (10%), Puerto Rico (7%), Pennsylvania (6%), and 40 other states, Washington, D.C., and the Virgin Islands.

In the park, 48% of visitors surveyed stayed less than one day; while 29% stayed seven or more days. Common activities at Virgin Islands National Park were snorkeling (81%), sunbathing (80%), swimming (76%), photography (60%), hiking / walking (52%) and visiting ruins (49%). The most visited places in the park were Trunk Bay (69%), Cinnamon Bay (56%), Annaberg Sugar Mill (51%), and Maho Bay (48%). The most often listed reasons for visiting were to enjoy recreation, view scenery, and seek quiet and solitude. Rental vehicles, taxis, and boats were the most used forms of transportation to get around in the park.

The most used services or facilities by 835 respondents were the park brochure / map (62%), Trunk Bay restroom / change area (47%), and trails (46%). According to visitors, the most important services were the Cinnamon Bay Campground (88% of 174 respondents), mooring buoys (88% of 82 respondents) and trails (87% of 364 respondents).



SOUNDSCAPES

*Ambient—The
surrounding
area or
environment.*

The soundscape of the nine parks in this draft EPMP/EIS includes existing and potential sources of natural sound, as well as potential sources of interference (noise) to natural sounds. Both mechanical and natural sounds that might vary in character from day to night or from season to season, may comprise the soundscape. Natural soundscape is created by natural processes, including but not limited to, sound created by biological and physical components such as wind, flowing water, wave action, mammals, birds, and insects. Natural ambient sound is the natural soundscape condition that exists in the park in the absence of noise made by humans.

Some human-caused sound can be considered acceptable if it is related to the purposes and uses for which the park was created. *Director's Order 47* (NPS 2000h) requires park units to determine the level of human-caused sound necessary for park purposes, and to achieve that level by reducing noise and restoring the natural soundscape to the greatest extent possible.

Noise, an element that can degrade the natural soundscape, is defined as undesirable human-caused sound (NPS 2000h). Sound can be perceived as noise because of loudness, frequencies, duration, occurrence at unwanted times or from an unwanted source, or because it interrupts or interferes with a desired activity. A sound that is considered neutral or desirable by one person may be considered unpleasant noise by another person because of a perception of inappropriateness or disturbance. Noise can adversely affect park resources or values, including the natural soundscape, wildlife, wilderness, and visitor experience. Noise can modify or intrude on the natural soundscape, masking the natural sounds that are an intrinsic part of the environment. Noise levels usually change continuously during the day, and exhibit daily, weekly, and yearly patterns.

BIG CYPRESS NATIONAL PRESERVE

Big Cypress National Preserve provides an overall quiet environment for park visitors. The preserve provides many places relatively free from the noise of civilization, and it is not on the flight path to any major cities. Within the preserve, protected shorelines tend to be the quietest sites (NPS 2000i).

During the day, the soundscape has a higher incidence of human-induced noise (NPS 2000i). In the developed zone and along the roadways of Big Cypress National Preserve, higher visitor and personnel use of these areas results in a higher incidence of human-induced noise from vehicles and maintenance equipment. Off-road vehicle use occurs in the preserve. The preserve permits the use of swamp buggies and all-terrain cycles only on designated trails and between 5:00 A.M. and 10:00 P.M. All off-road vehicles are required to have working mufflers. These factors limit the extent of the impact from off-road vehicle use on the preserve's soundscape. Natural sounds, such as vocalizations by wildlife, predominate during the nighttime (NPS 2000i).

Noise is also generated periodically throughout the preserve from helicopters and planes used to manage exotic plants by performing initial and follow-up



treatments, or to survey the extent of infestation. The reconnaissance flights to survey for infestation take place every two years and are conducted daily for a week. Helicopters are also used in the park to support fire management. The use of chainsaws, chippers, and other mechanized equipment to treat exotic plants generates noise during daylight hours when management activities occur.

BISCAYNE NATIONAL PARK

Many Biscayne National Park visitors come to enjoy the natural beauty and serenity of Biscayne Bay, including its soundscapes. The park's soundscape includes the terrestrial and ambient-air soundscape and the submerged, aquatic sound environments. Visitors to Biscayne National Park experience this natural sound by listening to breaking waves, seabirds, thunderstorms, and sea breezes rushing across the bay. Intermingled with these natural soundscapes are the sounds of maritime activities that add a human dimension to this terrestrial and aquatic landscape. Protected shorelines within the park tend to be the quietest sites, and natural sounds within the park are at their highest levels during the night (NPS 2000i).

During the day, the soundscape has a higher incidence of human-induced noise (NPS 2000i) resulting from activities associated with using Biscayne National Park. Noise from powerboats (access and recreation), social events (gatherings of 10 or more people and music), generators, and routine maintenance activities, contribute to the soundscape of the park in some areas, such as Stiltsville.

Noise is also produced as a result of exotic plant management activities. Noise is generated from the use of chainsaws, chippers, and other mechanized equipment to treat exotic plants. Noise from airplanes used for reconnaissance flights is present during daylight hours for limited periods while treatment activities are occurring.

CANAVERAL NATIONAL SEASHORE

The soundscape within Canaveral National Seashore ranges from areas that are readily accessible to the public to remote undeveloped areas. In those areas that are easily and readily accessible to the public, the soundscape is often accentuated by human-caused sounds, such as visitors talking and motorized vehicles and boats. In more remote locations, there are undeveloped areas, such as long stretches of beaches or wilderness islands, where natural sounds of wildlife and the sea predominate.

A range of noise-producing activities is associated with the use of Canaveral National Seashore. Human-induced noise results from the use of power boats, vehicular traffic, and routine maintenance activities that contribute to the soundscape of the park, particularly in developed areas of the park. In addition, regional noise from air traffic and the occasional activity at Kennedy Space Center can contribute and, for short periods of time, dominate the soundscape in the park.



Noise is also produced as a result of exotic plant management activities. During daylight hours, for limited periods of time when treatment activities are occurring, noise can be generated by crews, vehicles, chainsaws, and other mechanized equipment to treat exotic plants.

DRY TORTUGAS NATIONAL PARK

Dry Tortugas National Park has a range of soundscapes. An ambience of extreme quiet and natural soundscapes with a backdrop of the ocean and wind can be found on outer islands such as Loggerhead and East Keys. Garden Key is the center of human activity in this remote park. At night, human noise on Garden Key includes engine noise from boats in the harbor and generator noise from inside the fort and the dock. During the day, there are varying levels of constant noise (though not considered to be intrusive by most) from low-flying or taxiing aircraft, boat engines, and NPS maintenance and operations. In the spring, nesting sooty terns on Bush Key can be heard calling day and night, even on neighboring Garden Key. After the nesting season, visitors can walk around Bush Key and experience sounds of the wind and ocean similar to Loggerhead Key.

Very limited amounts of noise during short periods are generated because of exotic plant management activities on Loggerhead and Garden Keys. Human-made sounds from the presence of workers and the use hand tools, as well as the noise from boat engines when used to transport crews and materials, would be present during the daytime when activities are occurring.

EVERGLADES NATIONAL PARK

Everglades National Park provides a diversity of soundscapes, including large areas where visitors can escape the noise of civilization. Serene ocean sounds can be experienced along the coasts and the many keys. Protected shorelines within the park tend to be the quietest sites (NPS 2000i). The wilderness and remoteness of the greater portion of the park provide opportunities to experience the sounds of a myriad of wildlife species, including a wide diversity of birds. During the day, the soundscape has a higher incidence of human-induced noise, while at night natural sounds such as vocalizations by wildlife predominate (NPS 2000i).

Developed areas of the park have higher levels of visitor and staff use and the soundscape is influenced by human-induced sounds during the day from sources, such as vehicular use, and operation and maintenance equipment by NPS staff. Motorized boat use along the shores of the park and air boat use in designated areas of the park on established trails generate noise (mostly during the day), and aircraft from regional airports and Homestead Air Force Base can also be heard throughout the park.

The park employs helicopters and fixed-wing aircraft periodically during the year to manage and survey park resources similar to the description for Big Cypress National Preserve. Natural areas of the park, including designated wilderness areas, provide longer periods of time when the natural ambient sounds can be appreciated without interruption. The soundscape in the Everglades wilderness



area is less impacted by noise from mechanized equipment. Exotic plant management activities that occur in the developed or natural zones of the park result in noise from the use of machinery such as chainsaws, chippers, air boats, and helicopters.

BUCK ISLAND REEF NATIONAL MONUMENT

Buck Island Reef National Monument is a serene and quiet environment with sounds predominantly of seabirds and the ocean.

The park receives a large number of visitors, on average 40,000 to 60,000 visitors, that arrive at the island via private boat or park concessions vessels. In high-use areas of the park, along the north eastern shore where a picnic area is located, motorized boating activity and human sounds can be heard during the day. Progressing inland from the shore, natural sounds dominate, and there is opportunity for ambient sounds to be appreciated without interruption.

Very limited amounts of noise during short periods are generated because of exotic plant management activities. Human-made sounds from the presence of workers and the use of hand tools, as well as the noise from boat engines when used to transport crews and materials, would be present during the daytime when activities occur.

CHRISTIANSTED NATIONAL HISTORIC SITE

Christiansted National Historic Site is located on the mainland of St. Croix. It is an historic park located in a busy urban setting. The soundscape in this park is predominantly a result of human activity. Along the shoreline, powerboats and tour boats using the marinas and docks contribute to the soundscape. Other common sources of human-caused sound include maintenance and construction equipment related to the preservation and repairs of historic structures.

SALT RIVER BAY NATIONAL HISTORIC PARK AND ECOLOGICAL PRESERVE

Salt River Bay National Historic Park and Ecological Preserve is a small park with approximately 423 terrestrial acres. During daylight hours, both land- and water-based visitor activities contribute to the soundscape. Noise is generated during the day from visitors using the beach area for swimming and picnicking. Motorboat activity along the shoreline and within the bay also generate noise during the day. Areas along the bay or away from the road and beaches can provide visitors an opportunity to experience the natural sounds of wading birds and other wildlife, and the sounds of the sea. These natural sounds predominate during the nighttime. Because there are no NPS amenities within the park at this time, very little noise associated with maintenance activities occurs.



VIRGIN ISLANDS NATIONAL PARK

Virgin Islands National Park is primarily a serene and quiet environment, with ambient sounds including the surf on the shoreline, as well as numerous tree frogs singing after sunset.

During daylight hours, the human-made sounds result from watercraft use of the area, taxis and vehicles traveling in the park, aircraft, and human voices in high-use areas, such as beaches and picnic areas. Opportunities exist in undeveloped areas of the park for visitors to experience the natural ambient sounds of the park.

Management activities to control exotic plants have been limited in scope within the park. Noise from crews and the use of hand tools and chainsaws only occur during daylight hours, near heavily used beaches near roadsides, where the ambient level of noise would be higher than remote areas. Some activities have occurred near Annaberg Ruin where the human-induced noise of workers and hand tools would be slightly more noticeable against the quiet of the natural soundscape.

WILDERNESS

The *Wilderness Act*, passed on September 3, 1964, established a national wilderness preservation system, “administered for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness” (16 USC § 1131). Lands identified as being suitable for wilderness designation, wilderness study areas, proposed wilderness, and recommended wilderness (including potential wilderness) must also be managed to preserve their wilderness character and values in the same manner as “designated wilderness” until Congress has acted on the recommendations (NPS 1999a). Of the nine parks included in this plan, Everglades National Park is the only park with designated wilderness or with lands identified as suitable for wilderness designation. In addition, there are no lands with designated wilderness immediately adjacent to any of the nine parks that would affect management actions within the parks.

EVERGLADES NATIONAL PARK

In 1978, Congress designated approximately 86% of Everglades National Park as the “Everglades Wilderness.” The area was renamed in 1997 after Marjory Stoneman Douglas (PL 105-82), in honor of the famous Everglades activist. The wilderness area contains 1,296,500 acres of the park’s total 1,509,000 acres and is the largest wilderness area in the southeastern United States (figure 8). These lands are now shielded from development encroachment and are managed to protect the flora and fauna of the Everglades ecosystem. Approximately 529,300 acres of this is designated submerged marine wilderness. In these areas, the surface waters are nonwilderness backcountry allowing the use of powerboats, but the bottom substrate is wilderness. An additional 81,900 acres was designated potential wilderness because various constraints precluded them from wilderness designation at that time (NPS 1994c). Areas excluded from wilderness are the existing developed areas, marine surface waters, and an area in the park reserved for tribal use (NPS 1979). The developed areas within Everglades National Park remain basically unchanged from the 1960s and are limited to less than 0.1% of total park lands (NPS 2001i).

Since the park was established, construction of facilities has progressed with a concept of preserving wilderness qualities and keeping development to a minimum. The park manages the wilderness area in accordance with the *Wilderness Act* so that the wilderness retains its “primeval character and influence, without permanent improvements or human habitation” (16 USC § 1131). The predominant management activities that occur in wilderness and adhere to the minimum requirement concept include fire management, exotic plant management, and research/educational activities. Exotic plant management and fire management activities are conducted primarily for the protection and preservation of a healthy wilderness ecosystem. Each management project performs a minimum requirement analysis in order to determine the minimum management approach necessary to successfully complete the project. Minimum

Leave No Trace Principles

- *Plan Ahead and Prepare*
- *Travel and Camp on Durable Surfaces*
- *Dispose of Waste Properly*
- *Leave What you Find*
- *Minimize Campfire Impacts*
- *Respect Wildlife*
- *Be Considerate of Other Visitors*



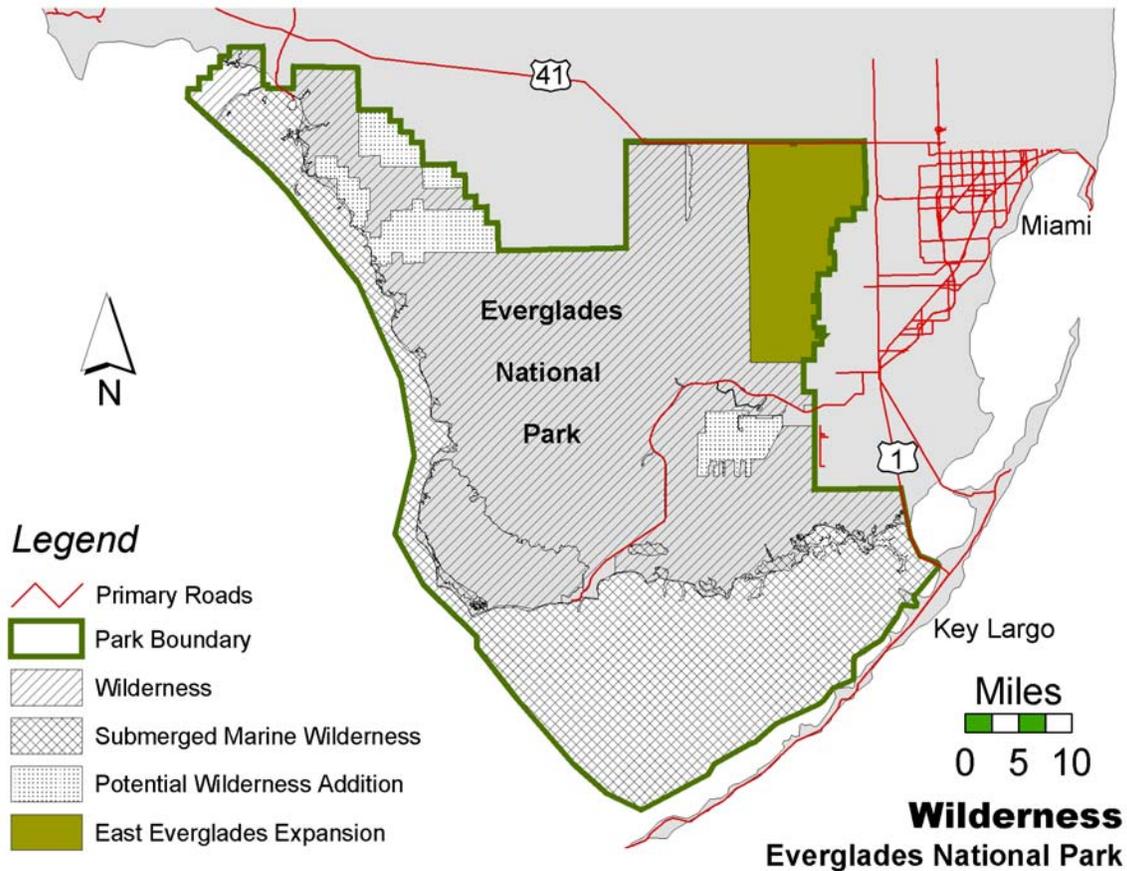


FIGURE 8: WILDERNESS IN EVERGLADES NATIONAL PARK

tools currently being used for exotic plant management include helicopters, trucks, airboats, motorboats, and all-terrain vehicles for transporting ground crews and equipment, helicopters and fixed wing aircraft for aerial treatment and reconnaissance, and chainsaws for mechanical treatments. Fire management activities include the use of chainsaws, motorized brushcutters, portable pumps, helicopters and fixed wing aircraft, and limited motorized vehicle use. Visitors to the park are also encouraged to follow “Leave No Trace” principles when recreating in wilderness to ensure its protection. These principles include disposing of waste properly, minimizing campfire impacts, respecting wildlife, being considerate to other visitors, and leaving wilderness resources as they are found.

PUBLIC HEALTH AND SAFETY

Big Cypress National Preserve, Biscayne National Park, Canaveral National Seashore, Dry Tortugas National Park, Everglades National Park, Buck Island Reef National Monument, Christiansted National Historic Site, Salt River Bay National Historic Park and Ecological Preserve, and Virgin Islands National Park

The parks are responsible for maintaining safe conditions that protect the health and safety of employees and the public. Parks are also subject to provisions of the law applicable to NPS units. This not only applies to providing safe facilities, utilities, and grounds within the park, but also includes NPS program and project operations. Public health and safety can be threatened because of the presence of exotic plants, in addition to the activities to treat and control exotic plants.

EXOTIC PLANTS

In general, exotic plants in the nine parks pose an insignificant health threat to the majority of the population. Highly allergic individuals can have serious complications when exposed to allergens (exotic plants or pollen), including constriction of airways and anaphylactic shock. Melaleuca produces large amounts of pollen that is allegedly a mild respiratory allergen, from which as much as 20% of the population may suffer allergic reactions (Rayamajhi et al. 2002). Brazilian pepper poses several health and safety concerns. The Brazilian pepper is a relative of poison ivy, and direct contact with the sap can cause severe skin irritation. Airborne chemicals from the blooms can cause sinus and nasal congestion, rhinitis, sneezing, headaches, and eye irritation in some people (Neal n.d.).

Allergen—A substance that causes an allergic reaction.

In addition, exotic plants may increase the risk of wildfire, and where this fire risk increases in populated areas, it poses increased risk to public health and safety. For example, guinea grass builds up a lot of biomass that can quickly catch fire, given the right environmental conditions, and it burns rapidly at high temperatures. Melaleuca trees burn with extremely hot crown fires because of high concentrations of oils in their leaves. These fires are difficult to extinguish, often threatening properties and public safety near infested areas (Rayamajhi et al. 2002).

HERBICIDES

Herbicides Used by Participating Parks. Herbicides are not risk-free. However, when used according to label instructions, the benefits outweigh the risks. The *Exotic Plant Management Teams Operations Handbook 2002* requires park staff and contract labor to follow label instructions and to observe other safety precautions presented in the handbook (NPS 2003m).

All herbicides used by NPS have been reviewed and registered by the EPA and have been determined to present no unreasonable risk to humans or the environment when used according to recommendations. Reading and following instructions on labels, which the NPS requires of employees and contractors, is the best way to ensure personal safety. In addition, applicators receive training in



proper application procedures and must wear protective clothing and equipment (NPS 2000b).

For noncancer health effects, toxic potency is expressed in terms of a reference dose, a daily exposure level or dose (usually expressed in units of milligrams of chemical per kilogram of body weight per day) that is likely to pose no appreciable risk of harmful effects for the human population. As the amount of chemical that an individual is exposed to increases above the reference dose, the probability that an adverse effect will occur also increases (Opresko et al. 1998).

Only applicators would be exposed for significant periods, and the use of personal protective equipment virtually eliminates any chance of reaching the reference dose (USFS 2004).

Risks to members of the general public are even less than the risk to workers from exposure to the same herbicide (USFS 1999b). The general public would not have sufficient exposure to reach the reference dose, even by walking through a recently treated area (USFS 2004). Moreover, signage warning of application would allow the public to avoid treated areas.

Prescribed Burning

Fire is being used as a tool in efforts to control exotic plants in Everglades National Park and Big Cypress National Preserve, as defined in the park's fire management plans. Florida encourages prescribed burns by all responsible landholders, whether public or private, to approximate the natural fire regimen of the region. The national parks follow the Florida Division of Forestry requirement to obtain a permit for all controlled burns (NPS 1997a). In addition, the NPS wildland fire training, qualification, and certification system meets or exceeds all National Wildfire Coordinating Group standards (NPS n.d.e). Using prescribed fire to control exotic plants can pose risks to some people, such as those who are sensitive to plants, such as melaleuca, are at risk for allergic reactions when exposed to smoke from the burning of such plants.

Mechanical Treatment

Power tools and heavy equipment can pose the danger of accidents for operators, other workers, and visitors. Pollution from vehicle exhaust or from fuel or lubrication spills can also be hazardous. These hazards are controlled by following procedures outlined in the *Exotic Plant Management Teams Operations Handbook 2002* (NPS 2003m).

To date, there have been no serious incidences of accidents or injuries within the parks related to exotic-plant management activities. Two minor incidences have occurred in Biscayne National Park and in Virgin Islands National Park, where workers applying herbicides became ill. However one incident could not be directly attributable to the herbicide use (Kellison 2004).



ESSENTIAL FISH HABITAT

The Council on Environmental Quality guidelines for implementing the National Environmental Policy Act requires an analysis of resources that would be considered ecologically critical areas. Within Biscayne National Park, Dry Tortugas National Park, Everglades National Park, Canaveral National Seashore, Virgin Islands National park, Salt River Bay National Historic Site, and Buck Island Reef National Monument, ecologically critical areas include: essential fish habitat, as identified by the South Atlantic Fishery Management Council (SAFMC 1998), Caribbean Fisheries Management Council (CFMC 2004), and the Gulf of Mexico Fisheries Management Council (GMFMC 1998), and habitat areas of particular concern, as defined by the National Oceanic and Atmospheric Administration and mapped by the councils listed above.

Fish habitat, or the geographic area where the species occur at any time during its life, can be described by ecological characteristics, location, and time. Essential fish habitat includes waters and substrates that focus distribution; for example, coral reefs, seagrass beds, mangroves, and other less-distinct structures, such as turbidity zones, salinity gradients, and thermoclines. Habitat use may change or shift over time because of climatic change, human activities and impacts, as well as other factors, such as change with life history stage, species abundance, competition from other species, and environmental variability in time and space. The type of habitat available, its attributes, and its functions are important to species productivity, diversity, health, and survival (CFMC 1998).

Essential fish habitats within the parks, as defined by the fishery management councils, include:

- submerged vegetation (seagrasses)
- intertidal vegetation (marshes and mangrove)
- benthic algae
- reefs
- sand/shell bottoms
- soft bottoms
- pelagic, oyster reefs, and shell banks
- hard bottoms.

A description of mangroves and seagrasses for the parks have been provided in the “Native Plants / Vegetation Categories” section of this chapter. The following description and importance of these essential fish habitats have been taken from the Comprehensive Amendment Addressing Essential Fish Habitat in Fishery Management Plans of the South Atlantic Region (SAFMC 1998), the Gulf of Mexico (GMFMC 1998), and the Final Environmental Impact Statement for the Generic Essential Fish Habitat Amendment to: Spiny Lobster Fishery Management Plan, as well as the Queen Conch Fishery Management Plan, Reef



Fish Fishery Management Plan, and Coral Fishery Management Plan for the U.S. Caribbean (CFMC 2004).

Seagrass meadows provide substrates and environmental conditions that are essential to the feeding, spawning, and growth of several managed species. Juvenile and adult invertebrates and fishes, as well as their food sources, utilize seagrass beds extensively (SAFMC 1998).

*Rookery—A nesting
colony of birds.*

Mangroves and marshes provide essential habitat for many managed species, serving as nursery grounds for larvae, postlarvae, juveniles, and adults. Mangrove habitats, particularly riverine, overwash and fringe forests, provide shelter for larval, juvenile and adult fish, and invertebrates, as will be discussed later, and dissolved and particulate organic detritus to estuarine food webs. Because of this linkage, both as habitat and as food resources, mangroves are important exporters of material to coastal systems, as well as to terrestrial systems (e.g., through bird use as a rookery and feeding on fish). They also provide shelter, foraging grounds, and nursery areas for terrestrial organisms. The root system binds sediments, thereby contributing to sedimentation and sediment stabilization (SAFMC 1998).

Corals and coral reefs support a wide array of hermatypic and ahermatypic corals, finfish, invertebrates, plants, and microorganisms.

Hard bottoms and hard banks often possess high species diversity but may lack hermatypic corals, the supporting coralline structure, or some of the associated biota. Hard bottoms are usually of low relief and on the continental shelf; many are associated with relic reefs, where the coral veneer is supported by dead corals. In deeper waters, large, elongated mounds, called deepwater banks and hundreds of meters in length, often support a rich fauna compared with adjacent areas.

Benthic algae occurs in both estuarine and marine environments and is used as habitat by managed species, such as the queen conch and early-life history stages of the spiny lobster. Threatened sea turtles utilize some benthic algae species directly as food. This habitat is also inhabited by invertebrate species, including mollusks and crustaceans, which are eaten by various fishes.

Sand/shell and soft bottom habitats are common throughout Florida and the Caribbean. These habitats are characterized as being high-energy and extremely dynamic. However, buffering by reefs and seagrasses allows some salt-tolerant plants to colonize the beach periphery. Birds, sea turtles, crabs, clams, worms, and urchins use the intertidal areas. The sand/mud subsystem includes all non-live bottom habitats or those with low percent cover (less than 10%). Sandy and mud bottom habitats are widely distributed, found in coastal and shelf areas, and include inshore, sandy areas separating living reefs from turtle grass beds and shorelines, rocky bottoms near rocky shorelines, and mud substrates along mangrove shorelines. Sand/shell habitat is utilized for foraging by abundant fishes, such as mojarras, and as substrate for solitary corals.

The **pelagic** subsystem explicitly includes the habitat of pelagic fishes. Pelagic habitat is associated with open waters beyond the direct influence of coastal



systems. In general, primary productivity in this zone is low and patchily distributed, being higher in nearshore areas as opposed to offshore areas. The pelagic system is inhabited by the eggs and larval stages of many reef fishes, highly migratory fishes, and invertebrates, some of which, like the spiny lobster, are commercially important.

Oyster and shell essential fish habitat can be defined as the natural structures found between (intertidal) and beneath (subtidal) tide lines that are composed of oyster shell, live oysters, and other organisms that are discrete. Oysters have often been described as the “keystone” species in an estuary and provide significant surface area as habitat. Oyster communities are critical to a healthy ecosystem, since oyster reefs can remove, via filter feeding, large amounts of particulate material from the water column and release large quantities of inorganic and organic nutrients. The ecological role of the oyster reef as structure, providing food and protection, contributes to its value as a critical fisheries habitat.

Whereas essential fish habitat must be described and identified for each species and life stage in the fisheries management unit, habitat areas of particular concern are identified on the basis of the condition of the habitat. The final rule to implement the essential fish-habitat provisions of the *Magnuson-Stevens Fisheries Act* lists the following considerations in the designation of habitat areas of particular concern (50 CFR 600.815 (a) (8)):

- The importance of the ecological function provided by the habitat
- The extent to which the habitat is sensitive to human-induced environmental degradation
- Whether, and to what extent, development activities are, or will be, stressing the habitat
- The rarity of the habitat type.

The designation of habitat areas of particular concern is intended to identify for anyone considering actions that might be potentially threatening to a habitat, those areas of essential fish habitat considered to be of the highest importance in the life cycles of managed species and most in need of protection. A habitat area of particular concern is expected to be a localized area of an essential fish habitat that is especially ecologically important, sensitive, stressed, or rare, when compared to the rest of the essential fish habitat (NOAA 2002).

Essential fish habitat is found within Biscayne National Park, Canaveral National Seashore, Dry Tortugas National Park, Everglades National Park, Buck Island Reef National Monument, Salt River Bay National Historic Park, and Virgin Islands National Park. Because of the greater extent of initial treatments of exotic plants and the extent of the area that could be potentially actively restored—Canaveral National Seashore, Everglades National Park, Virgin Islands National Park, Salt River Bay National, and Buck Island Reef National Monument—exotic plant management activities have the potential to affect essential fish habitat from erosion and subsequent sedimentation and the potential for

Estuary—The thin zone along a coastline where freshwater systems and rivers meet and mix with a salty ocean (such as a bay, mouth of a river, salt marsh, lagoon.



herbicides to degrade water quality. Therefore, essential fish habitat found in these parks will be discussed and analyzed further in this draft EPMP/EIS. Biscayne National Park and Dry Tortugas National Park, under all alternatives, would be maintaining previously treated sites and would have limited, if any, potential for active restoration of sites. Re-treatment in these parks would include spot treatment of exotic plants, fewer numbers of plants and acres being affected, and less herbicide use compared to initial treatments. The essential fish habitat within these parks would not be affected, or would be negligibly affected, by soil erosion into the aquatic environment or degradation of water quality as a result of the exotic-plant management activities under any alternative and, therefore, will not be discussed further.

BUCK ISLAND REEF NATIONAL MONUMENT, SALT RIVER BAY NATIONAL HISTORIC PARK, AND VIRGIN ISLANDS NATIONAL PARK

The Caribbean Fisheries Management Council identified the following essential habitat categories that occur within the parks: seagrasses, mangroves, benthic algae, reefs, sand/shell bottoms, soft bottoms, pelagic, and hard bottoms.

The Caribbean Fisheries Management Council has identified coral reefs, hard and soft bottoms, sand/shell bottoms, benthic algae, and seagrass as essential fish habitat in Virgin Islands National Park, Buck Island Reef National Monument, and Salt River Bay National Historic Park (CFMC 2004). Mangroves are identified as essential fish habitat at Virgin Islands National Park and Salt River National Historic Site, which also has estuarine essential fish habitat. Salt River estuary is a nursery area for many commercially and recreationally important finfish and shellfish species, including spiny lobsters. The estuary contains a fringing mangrove forest, extensive shallow seagrass beds, and a unique submarine canyon, with numerous coral species on nearly vertical sides of the canyon.

Salt River Bay National Historic Park has been designated as a habitat area of particular concern for reef fisheries because of the ecological importance, sensitivity to human-induced degradation, and undergoing development activities that stress the habitat. Buck Island Reef National Monument has been designated as habitat of particular concern for corals. Barrier reefs, deep reefs, patch reefs, extensive hard-bottom communities of gorgonid corals and sponges, unique elkhorn coral formations, and extensive seagrass beds, characterize the area. The park meets habitat area of particular concern considerations for ecological importance and sensitivity to human-induced degradation.

Essential fish habitat has been described for the Caribbean parks for reef fish, spiny lobster, queen conch, and corals and coral reefs, by the Caribbean Fisheries Management Council (CFMC 2004). Because the life stages of these species (including pelagic stages) collectively occur in all habitats of the U.S. Caribbean, essential fish habitat under the Generic Amendment included all waters and substrates (e.g., mud, sand, shell, rock, and associated biological communities), including coral habitats (coral reefs, coral hard bottoms, and octocoral reefs), subtidal vegetation (seagrass and algae), adjacent intertidal vegetation (wetlands



and mangroves), and pelagic waters. Therefore, essential fish habitat includes virtually all marine waters, substrates (mud, shell, rock, coral reefs), and associated biological communities within the defined exclusive economic zone, which includes the three Caribbean parks.

These habitats provide forage and nesting areas for reef fish, spiny lobster, queen conch, and corals and coral reefs. Appendix S provides a list of species that:

- have been observed or recorded in the Fishery Management Plans and associated amendments as present in the parks
- are potentially located within the project area
- have prey items that are found in the project area.

The tables provide information on the habitat utilized by various life history stages of the species. Table S-2 in appendix S is a list of the stony corals that have been identified to occur within the Caribbean parks.

Within the U.S. Virgin Islands, for each category of fishery, all waters, from mean high water to the outer boundary of the exclusive economic zone, are protected for eggs and/or larvae. For other life stages, the following essential fish habitats are defined:

- *Reef fish*—All substrates from mean high water to 100 fathoms depth.
- *Spiny Lobster*—Seagrass, benthic algae, mangrove, coral, and live/hard bottom substrates from mean high water to 100 fathoms depth.
- *Queen Conch*—Seagrass, benthic algae, coral, live/hard bottom and sand/shell substrates from mean high water to 100 fathoms depth.
- *Coral Fishery*—Coral and hard bottom substrates from mean low water to 100 fathoms depth.

The Caribbean Fishery Management Council has identified Buck Island Reef National Monument and Salt River Bay National Historic Park as containing habitat areas of particular concern. Buck Island Reef National Monument has been designated as a habitat area for particular concern because of the ecological importance of the reefs, extensive hard bottom communities of gorgonids and sponges, unique elkhorn coral formation, and extensive seagrass beds. The monument also meets the considerations because of its sensitivity to human-induced degradation (CFMC 2004).

The estuary of Salt River Bay is also considered as a habitat area of particular concern. Salt River estuary is a nursery area for many commercially and recreationally important finfish and shellfish species, including spiny lobsters. Numerous endangered species, including hawksbill, green and leatherback sea turtles are found within the park. The park contains a unique continuum of protected uplands, estuary, and coral reef ecosystems. The estuary contains a fringing mangrove forest, extensive shallow seagrass beds, and a unique



submarine canyon, with numerous coral species on nearly vertical sides of the canyon. Salt River Bay National Historic Park and Ecological Preserve meets habitat area of particular concern considerations for ecological importance, sensitivity to human-induced degradation, and undergoing development activities that stress the habitat (CFMC 2004).

CANAVERAL NATIONAL SEASHORE AND EVERGLADES NATIONAL PARK

The essential fish habitat within Everglades National Park and Canaveral National Seashore is comprised of estuarine waters and substrates (mud, sand, shell, rock, and associated biological communities), including submerged vegetation (seagrasses and algae), marshes and mangroves, and oyster shell (GMFMC 1998; SAFMC 1998).

Within Canaveral National Seashore, salt marshes, mangroves, and seagrass make up the essential fish habitats in Mosquito Lagoon and the Indian River. These habitats within Canaveral National Seashore have been described in the “Native Plants / Vegetation Category” section of this chapter. The estuary acts as an important nursery area for a number of commercially important ocean-going species, such as flounder, mullet, black drum, and shrimp. Mosquito Lagoon contains one of the last significant populations of oysters on the entire Atlantic Coast that have not been depleted by overharvesting or pollution. Shellfish, particularly clams and oysters, are also an important commercial resource at the park. Mosquito Lagoon is the only known estuary where red drum (*Sciaenops ocellatus*) spends its entire life cycle. A complete list of federally managed species that spend any portion of their life cycle in the essential fish habitat of Canaveral National Seashore is not available. Based on available distribution maps for some species, those fish species that are known to occur in the park are identified in table S-3 in appendix S.

The Gulf of Mexico Fisheries Management council identified six areas within Everglades National Park, Florida Bay, Lake Ingraham, Whitewater Bay, Cape Sable to Lostman’s River, Lostman’s River to Mormon Key, and Mormon Key, up to and beyond the park boundary, to Caxambas Pass, that contain essential fish habitat dominated by mangrove islands and mangrove forests that include marsh areas and areas of submerged aquatic vegetation (seagrass). The complex of six areas is referred to as Florida Bay and Ten Thousand Islands area. Mangroves in this area comprise approximately 117,970 hectares, and marsh areas 107,488 hectares. Cape Sable contains about two thirds of the tidal marsh and greater than 60 percent of the mangroves for the area. Submerged vegetation in the area totals nearly 106,840 hectares, contained mostly within Florida Bay.

Florida Bay in Everglades National Park has been identified as a habitat area of particular concern. Mangrove covered islands and submerged aquatic vegetation within the bay provide important habitat for many of the fisheries, such as pink shrimp, red drum, and spiny lobster. Florida Bay is stressed and has experienced algal blooms, anoxia, and die-off of submerged aquatic vegetation (GMFC 1998).



The essential fish habitats within the park provide forage and nesting areas for species, such as shrimp, red drum, spiny lobster, reef fish, and mackerels. Appendix S provides a list of species that have been observed or recorded in the Fishery Management Plans and associated Amendments as present in the parks, species that are potentially located within the project area, or species that have prey items that are found in the project area (GMFMC 1998; SAFMC 1998). The table provides an indication of the essential fish habitat identified for various life stages for each federally managed species that occur within the parks. A list of federally managed species for the south Atlantic is provided in the Comprehensive Amendment Addressing Essential Fish Habitat in Fishery Management Plans of the South Atlantic Region (SAFMC 1998).



MANAGEMENT AND OPERATIONS

Park staff provide the full scope of functions and activities to accomplish management objectives, performing duties that include law enforcement, emergency services, public health and safety, science, resource protection and management, visitor services, interpretation and education, community services, utilities, housing, and fee collection.

RESOURCE MANAGEMENT

Summaries of the exotic plant management component of the parks' operations are provided in the "Purpose of and Need for the Plan" chapter. Most field work is performed by personnel other than the parks' natural resource managers. Independent contractors under park supervision generally apply herbicides or physically remove plants, and NPS fire management specialists carry out prescribed burns.

Staff activities associated with exotic plant management include inventorying infested areas within the parks, setting priorities for plants and infested areas for treatment, overseeing control activities, and sometimes monitoring treated areas. These efforts place additional burdens on the staff, consuming time that could be used for other management and operation activities. Time constraints and other duties, in turn, limit staff opportunities to oversee plant treatment.

For the most part, the parks employ private contractors to treat selected exotic plants under the supervision of NPS staff. An NPS technical representative ensures that contractors comply with all aspects of the contract, while providing technical assistance and direction to the contractor in the field with regards to specific tasks or projects. Everglades National Park and Dry Tortugas National Park share a staff member who is dedicated full-time to exotic plant control; resource managers in the parks divide their time among various duties, including exotic plant management. Many of these managers have expressed regret that other responsibilities prevent them from devoting sufficient time to exotic plant control. In the Caribbean parks, one EPMT member from the NPS Southeast Region dedicates 50% of the work hours administering the exotic plant management programs in the four park units.

The following sections describe elements of park management and operations specific to exotic plant control for each of the individual parks.

BIG CYPRESS NATIONAL PRESERVE

To date, staff and contractors have treated 287,517 acres of exotic plants within the park, and they continue to re-treat in those areas to gain a maintenance level of control of the infestation. After herbicide treatment, woody exotic plants are burned to remove debris. The fire-management plan includes provisions to assist with the eradication of exotic plants, including using fire for removing individual stems and treated debris (NPS 1994e).



BISCAYNE NATIONAL PARK

To date, all infested acres within the park have been treated, allowing treatment activities to subside to maintenance levels in 2005. During the initial treatment phase, two staff members alternated supervising contract labor teams of six to eight workers, devoting 8 to 12 hours weekly during active treatment. This time came at the expense of fisheries management, wildlife management, and integrated pest management. When possible, regional exotic plant management staff also supervised contractors (Kellison 2004).

CANAVERAL NATIONAL SEASHORE

Canaveral National Seashore has conducted exotic plant treatments within the park with the cooperation of the USFWS with whom the NPS shares management responsibilities in the park, as well as having conducted treatments under the direction of the NPS Florida and Caribbean Exotic Plant Management Team. A cooperative effort between the park and the adjacent Merritt Island National Wildlife Refuge provided treatment of 400 acres of Brazilian pepper (*Schinus trebinthifolius*) in fiscal year 2004 (NPS 2003d). All other infested acres treated to date have been done by the EPMT. All work is performed by private contractors, who are checked at least once weekly, as time allows, by one of the two park staff involved with exotic plant control. Such checks reduce the EPMT staff availability to perform duties related to cultural resources, natural resources, and fire management (Stiner 2004b). The park has submitted an Operational Formulation System request to hire three seasonal workers whose duties would include exotic plant management. There has been no response to this request as yet.

DRY TORTUGAS NATIONAL PARK

A park superintendent and deputy superintendent headquartered near Homestead, Florida, are responsible for the management and operations of both Everglades National Park and Dry Tortugas National Park. Administrative functions are accomplished primarily at park headquarters. No on-site staff provides exotic plant management. Instead, the Everglades National Park botanist supervises private contractors that treat exotic plants in the park. To date, all infested acres within the park have been treated, allowing treatment activities to subside to maintenance levels by 2005.

EVERGLADES NATIONAL PARK

Everglades National Park has a staff member dedicated full-time to exotic plant management. Prior to 1998, NPS seasonal crews performed exotic plant control work. Contracted labor is now used for control, supervised by the park's botanist.

BUCK ISLAND REEF NATIONAL MONUMENT

NPS staff have conducted initial treatment of all infested acres on Buck Island and are conducting follow-up re-treatment of these areas. The focus of the park is its coral reefs, so the primary resource-management concern is protection of



those reefs. On-site assistance by personnel from the NPS Southeast Region and Everglades National Park treating exotic plants has minimized interference with other resource-management activities within the park (Hillis-Starr 2004).

CHRISTIANSTED NATIONAL HISTORIC SITE

As a landscaped historic site of only seven acres, the park is maintained as a landscaped recreation of life under Danish rule, from the mid-eighteenth century to the early twentieth century. The grounds reflect human intervention rather than native vegetation categories (Hillis-Starr 2004).

SALT RIVER BAY NATIONAL HISTORIC PARK AND ECOLOGICAL PRESERVE

To date, resources have not been expended for control of exotic plants within the park.

VIRGIN ISLANDS NATIONAL PARK

Park staff in resource management and maintenance, helped by volunteers and interns, have conducted limited exotic plant management, in conjunction with historic structure and trail clearing activities. There has been no response to an Operational Formulation System request, submitted 2 or 3 years ago, to hire two or three employees for exotic plant management (Boulon 2004b).

ANNUAL BUDGET

Table 32 presents the annual budgets for the nine participating parks.

TABLE 32: ANNUAL BUDGETS

Park	FY 2001	FY 2002	FY 2003	FY 2004
Big Cypress National Preserve	\$5,224,000	\$5,276,000	\$5,272,000	\$5,243,000
Biscayne National Park	\$3,435,000	\$3,465,000	\$3,456,000	\$3,434,000
Canaveral National Seashore	\$2,172,000	\$2,223,000	\$2,219,000	\$2,212,000
Dry Tortugas National Park	\$1,293,000	\$1,300,000	\$1,286,000	\$1,276,000
Everglades National Park	\$13,437,000	\$13,594,000	\$13,860,000	\$14,038,000
Buck Island Reef National Monument	—	—	—	—
Christiansted National Historic Site	\$1,250,000	\$1,260,000	\$1,250,000	\$1,242,000
Salt River Bay National Historic Park and Ecological Preserve	\$485,000	\$486,000	\$478,000	\$473,000
Virgin Islands National Park	\$4,782,000	\$4,843,000	\$4,818,000	\$4,792,000

Source: NPS information web pages available at <http://data2.itc.nps.gov/parksearch/atoz.cfm>.



CURRENT COST AND FUNDING OF EXOTIC PLANT MANAGEMENT PROGRAM

The EPMT receives \$600,000 annually from the NPS for control efforts in south Florida. Other funds for treating exotic plants come through grants obtained from neighboring counties and the state or federal government.

Big Cypress National Preserve. The park spends approximately \$388,000 annually on exotic plant management with funding received from the park's resource management and administrative budgets, the EPMT, and the state of Florida.

Biscayne National Park. The park has spent \$148,000 in 2000, \$106,150 in 2001, \$175,560 in 2002, \$300,000 in 2003, and \$400,000 in 2004, toward controlling exotic plants (Kellison 2003, 2004). The park receives 50% of its funding to treat exotic plants from the state of Florida and 50% from the NPS.

Canaveral National Seashore. Five projects have received \$540,000 from the NPS and \$222,610 from the Florida Department of Environmental Protection. In FY 2003, the park treated 200 acres for Brazilian pepper and Australian pine (*Casuarina equisetifolia* or *Casuarina* spp) at a cost of \$21,540, and a cooperative effort between the park and the adjacent Merritt Island National Wildlife Refuge provided an additional \$200,000 to treat 400 acres of Brazilian pepper in FY 2004 (NPS 2003d). Brevard County provides 25% of the herbicide that the park uses (Stiner 2003b).

Dry Tortugas National Park. The park expends approximately \$4,000 annually to keep exotic plants at a maintenance level.

Everglades National Park. Since 1989, the park has spent \$6,562,000 on exotic plant control. Recent expenditures include \$715,000 in 2002, \$516,000 in 2003, and \$1,225,000 for EPMT-approved projects in 2004. The park augments its EPMT funds with \$35,000 per year from the Florida Department of Environmental Protection and neighboring counties in grants earmarked for controlling exotic plants. In addition, the south Florida Water Management District provides approximately \$60,000 annually.

Buck Island Reef National Monument. Management of exotic plants is funded entirely by the EPMT, which spent \$100,000 in 2003 for on-the-ground contractors. Park discretionary funds have augmented base funding from the EPMT for the first two treatment phases (Hillis-Starr 2004).

Virgin Islands National Park. The park receives no direct funding for the control of exotic plants, although some base funding is used to purchase supplies. The Friends of the Virgin Islands National Park, a nonprofit organization, provides approximately \$1,000 to \$2,000 annually to buy herbicides. The NPS Southeast Region through the EPMT pays the salary for the team member whose time is 50% dedicated to the four Caribbean parks, as well as providing supplies for the control efforts (Boulon 2004b).

