

# CHAPTER 3



AFFECTED ENVIRONMENT



## INTRODUCTION

This chapter describes the characteristics of the environmental components identified as impact topics that could be affected by implementing the alternatives. It provides information for “Chapter 4: Environmental Consequences,” which assesses the effects that implementing the alternatives might have on these topics. The description of the affected environment focuses on only those environmental components that are potentially subject to effects from implementing one or more of the alternatives.

The Big Cypress National Preserve *General Management Plan and Environmental Impact*

*Statement* (NPS 1991) included a comprehensive description of the natural resources of the original Preserve. The *Recreational ORV Management Plan* (NPS 2000) also included detailed descriptions of the affected environment as it related to motorized use in the original Preserve. This *General Management Plan / Wilderness Study / ORV Management Plan / Environmental Impact Statement* for the Addition tiers from those documents, in conformance with the Council on Environmental Quality (1978) guidelines for implementing the National Environmental Policy Act.

## NATURAL RESOURCES

Information on the area's natural resources was gathered from several sources, including but not limited to, the following documents:

- *General Management Plan* for the original preserve (NPS 1991)
- *Recreational ORV Management Plan* for the original Preserve (NPS 2000)
- *South Florida and Caribbean Parks Exotic Plant Management Plan* (NPS 2007)
- *Water Resources Management Plan* (NPS 1996)
- the draft *Hydrology of the Addition Lands Report* (NPS 2002)
- *Fire Management Plan* (NPS 2005)
- *The Big Cypress National Preserve* (Duever et al. 1986)

## BIOLOGICAL RESOURCES

### Vegetation and Soils

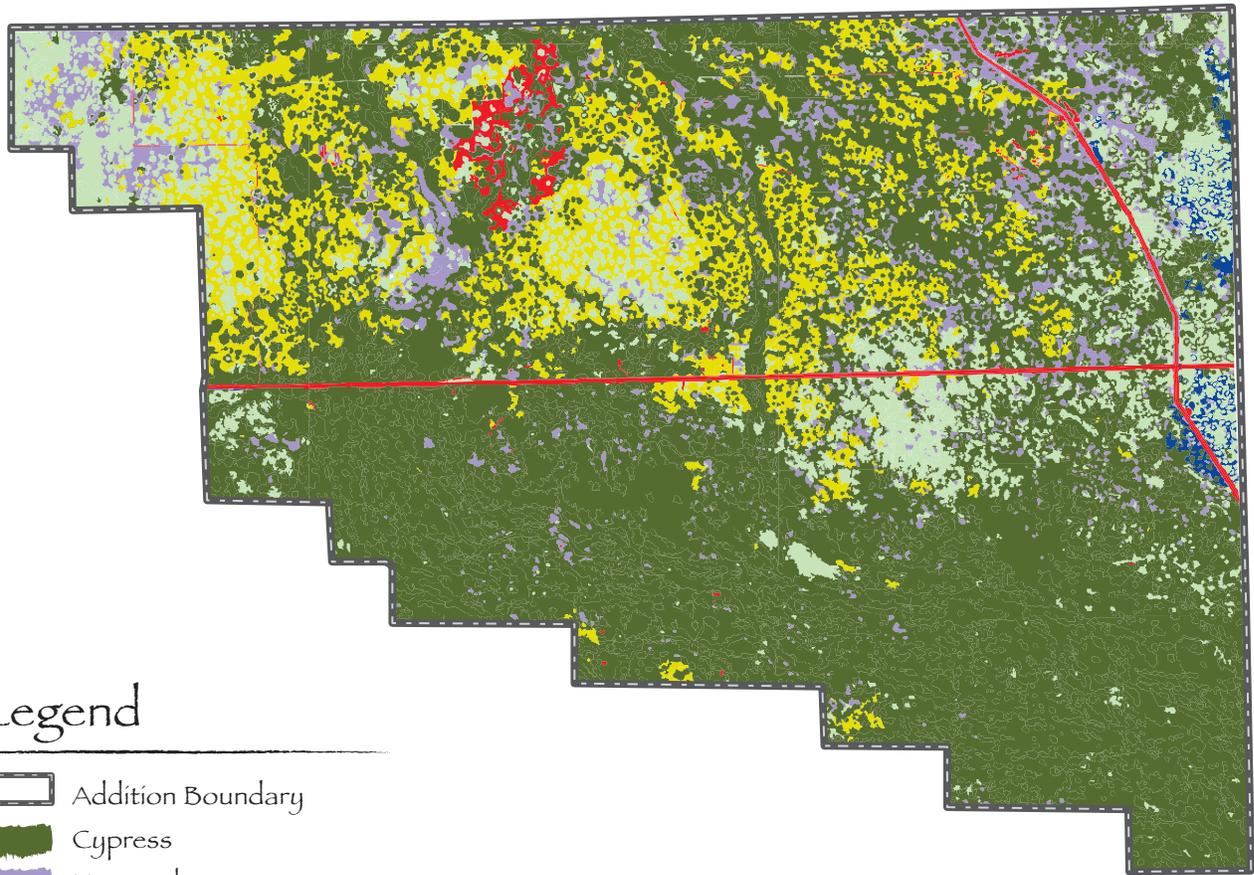
Five major vegetation communities can be found in the Addition: (1) cypress strands and domes, mixed-hardwood swamps, and sloughs, (2) prairies and marshes, (3) mangrove forests, (4) pinelands, and (5) hardwood hammocks. Disturbed areas can also be found throughout the Addition and are intermixed within all of these vegetation communities. Each of these communities is described below and identified in the following vegetation maps (Maps 9 and 10: Vegetation for the Northeast Addition and Western Addition) for the Northeast Addition and Western Addition. The vegetation classes used in this plan are the same as those used in the 2000 *Recreational ORV Management Plan*, with the exception of the addition of "disturbed areas." Disturbed areas were identified and described in the 1991 *General Management Plan / Environmental Impact Statement* for the original Preserve— so collectively, the descriptions provided below

tier to and are compatible with these two plans.

Temperate plants are abundant in Big Cypress, but most species are tropical. Pinelands, cypress strands and domes, and prairies, and marshes are the most prevalent vegetation types in the Addition and are dominated by temperate species. Tropical species primarily occur in hardwood hammocks, but are also found in pinelands, mixed-hardwood swamps, and cypress strands. Endemic plants, native only to the Preserve area, comprise 10 % of the Big Cypress vegetation (Long 1974). NPS staff are active in the NPS Inventory and Monitoring Program and have completed a thorough inventory of the Preserve's vascular plants.

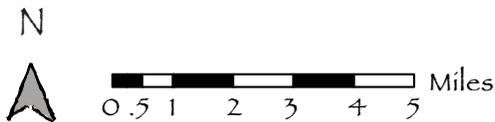
The dominant tree in the preserve is cypress. Two species have been identified — bald (*Taxodium distichum*) and pond (*T. ascendens*) — although the taxonomic distinctions are still in question. Cypress are deciduous trees that can grow to 130 feet tall and reach diameters of 7 to 10 feet. Most of the larger cypress trees have been removed by logging, and only a few large trees remain. Cypress trees are highly resistant to fire and thrive in saturated soils.

**Cypress Strands and Domes, Mixed-Hardwood Swamps, and Sloughs.** Cypress forests are swamp communities that are dominated by bald cypress trees. These communities assume differences in response to competition and abiotic factors, so that several types of cypress forest can be identified. In southern Florida, cypress strands, cypress domes, mixed-hardwood and cypress swamps, and dwarf (hatrack) cypress communities are common. The Big Cypress Swamp, much of which occurs in Big Cypress National Preserve, is mostly composed of these types of cypress forests. In many situations, the cypress trees here live in conditions that do not support robust growth so that the trees do not attain great size (e. g., dwarf cypress



## Legend

-  Addition Boundary
-  Cypress
-  Hammocks
-  Marsh
-  Pinelands
-  Prairie
-  Disturbed
-  Water



Map 9

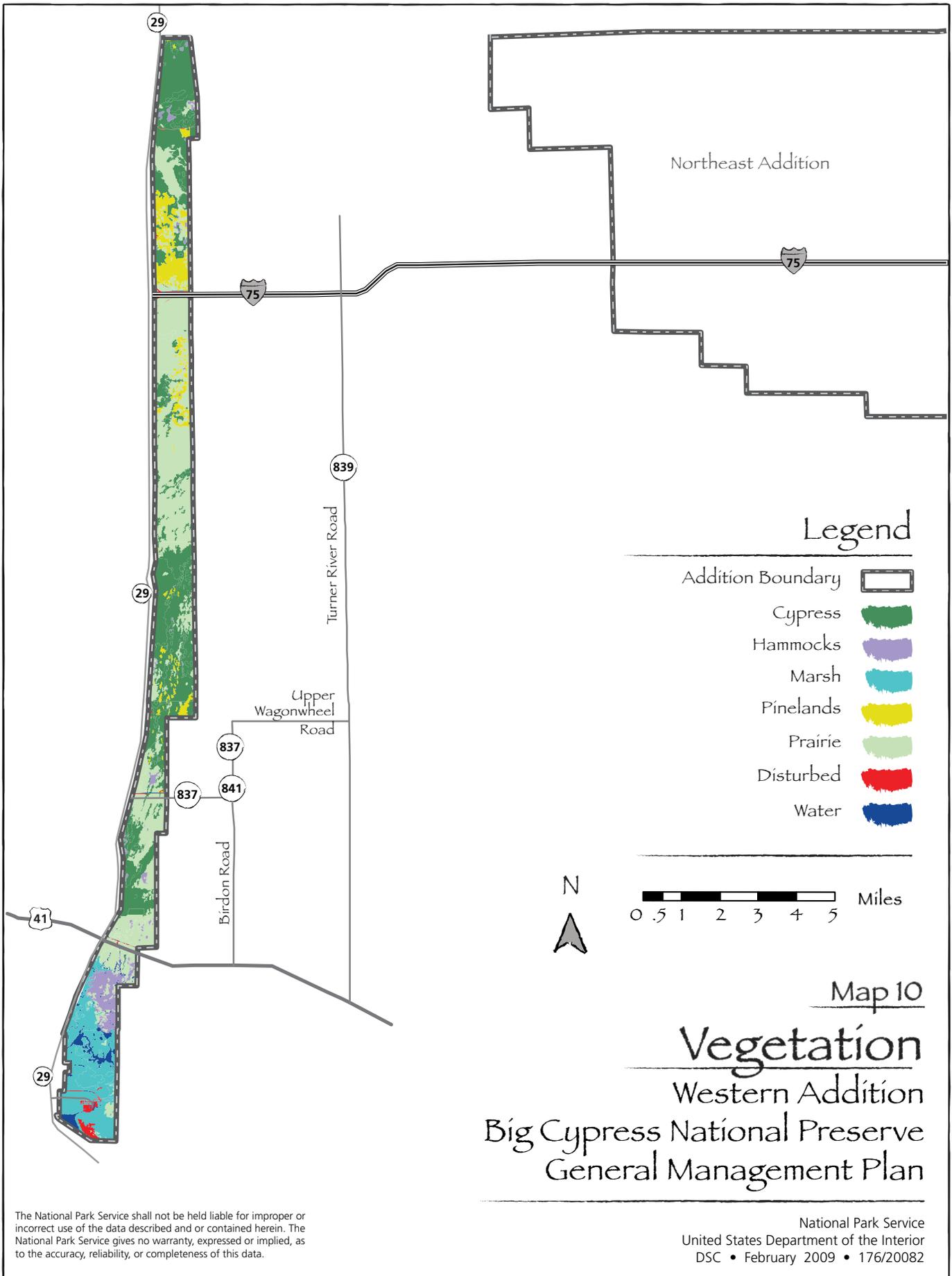
# Vegetation

## Northeast Addition Big Cypress National Preserve General Management Plan

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### Legend

- Addition Boundary
- Cypress
- Hammocks
- Marsh
- Pinelands
- Prairie
- Disturbed
- Water



Map 10

# Vegetation

## Western Addition

### Big Cypress National Preserve General Management Plan

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communities). The name “Big Cypress” is derived from the large area dominated by various cypress communities, rather than the size of the resident trees.

Limestone caprock, which is common throughout much of the Addition, is usually only a few inches beneath the ground surface. The fracturing and rearrangement of the limestone results in a depression of the substrate (the surface on which an organism lives), so that the ground surface in the depression or solution hole is closer to the water table than the surrounding area. Cypress forests typically occur in the areas of the solution holes. The breaks in the limestone also allow the roots of large plants to penetrate well below the soil surface, so trees are able to become established. Because the substrate surface is near to, or below, the water for most of the year (i. e., has a long hydroperiod), trees that are adapted to long hydroperiods survive and dominate these communities. In the region, bald cypress trees are the common dominants in these hydric communities. As cypress and other trees become established, the leaves and branches that are shed from the trees collect in the solution hole depression, which is usually underwater. As a result, organic material in the soils of these communities decomposes slowly and often becomes a thick mantle on the substrate surface.

This slow decomposition and buildup of organic material tends to increase the acidity of the water in these communities. Limestone (calcium carbonate), which is very common in the substrate surrounding the cypress forests, is soluble in acidic solutions and neutralizes acidity as it dissolves. The dissolution of limestone results in a surface water solution that is saturated with calcium. This is important in the formation of marl, a soil component of prairies.

**Cypress Strands** — Cypress strands are swamps that are dominated by bald cypress trees, similar to cypress domes (see below). The primary difference is that a strand is a

linear feature rather than a small, discrete, dome-shaped community. Strands are generally much larger than domes, and so may be more diverse and biologically complex. Strands often contain hardwood trees that are adapted for hydric conditions, such as pop ash (*Fraxinus caroliniana*) or red maple (*Acer rubrum*). Shrub layers are sparse, but may consist of scattered dahoon holly (*Ilex cassine*), myrsine (*Rapanea punctata*), or swamp dogwood (*Cornus foemina*). Ground cover may be nearly absent because hydroperiods are often long, or it may be ephemeral and appearing during the dry season; swamp fern (*Blechnum serrulatum*) is a common ground cover that is dominant in strands. Knolls within this vegetation type comprise a principal habitat for the rare royal palm (*Roystonea elata*), and older forests serve as homes for many birds, mammals, reptiles, and amphibians (U. S. Forest Service, Wade et al. 1980a). The substrates of these communities are inundated or saturated with water nearly year-round.

**Cypress Domes** — Cypress domes are small, relatively discrete areas of freshwater swamp dominated by bald cypress trees. These areas are nearly circular and are often surrounded by marl prairies or herbaceous marsh community with few trees. The domed shape of these communities is produced by taller cypress trees growing near the center of the community and progressively shorter trees occurring near the peripheral areas. The centers of the dome communities and their associated solution hole substrates support the growth of cypress trees, with marginal growth conditions in the peripheral areas.

In the margins of cypress domes, the community becomes transitional with the surrounding marl prairies. Limestone usually occurs near the substrate surface in these peripheral areas, and cypress trees are often unable to establish root systems

beneath this layer of rock. The trees that survive in this area are usually smaller than those near the wetter central part of the dome. Also, because the trees in this marginal area are scattered and do not form a complete canopy, sufficient sunlight reaches the ground to support a substantial grass community, similar to that found in the adjacent prairies.

Dry season fires are common in prairie communities, and they are carried into the cypress margins by the grassy ground cover. These fires ordinarily do not kill the cypress trees, but these fires can damage the trees enough to slow their growth. Thus, a difference in habitat conditions occurs, from a moist, nutrient-rich substrate with almost no fires near the center of the dome to a seasonally dry, nutrient-poor substrate with frequent fires at the periphery. The result is a community that supports tall, vigorous trees near the center of the dome with progressively shorter, less vigorous trees toward the margins.

**Mixed-Hardwood Swamps** — Cypress swamps that contain significant populations of hardwood trees that co-dominate the tree canopy with bald cypress trees are often referenced as mixed hardwood and cypress swamps. Mixed hardwood swamps are essentially wetlands dominated by trees. Red bay (*Persea borbonia*), sabal palm (*Sabal palmetto*), pond apple (*Anona glabra*), or laurel oak (*Quercus laurifolia*) commonly co-dominate these communities. Epiphytes are common in these communities, as greater tree diversities result in greater diversities of substrates available to epiphyte establishment.

Several bromeliads (*Tillandsia* spp., *Guzmania monostachia*) and orchids, such as epidendrums (*Epidendrum* spp), and ghost orchids (*Polyradicion (Polyrrhiza lindenii)*) are found on the trunks and branches of these trees. Epiphytic ferns, such as shoestring fern (*Vittaria lineata*)

and golden serpent fern (*Phlebodium aureum*), are common on the trunks of sabal palms. Vines, including poison ivy (*Toxicodendron radicans*), several grapes (*Vitis* spp.) and ratan vine (*Berchemia scandens*), are also common components of the tree canopy. These swamp communities are usually diverse, and may represent a stage of community succession later than the bald cypress-dominated community.

**Sloughs** — Sloughs are sinuous, elongated natural drainage channels that are inundated most of the time. Dominant species are aquatic plants and include white water lily (*Nymphaea odorata*), water hyssop (*Bacopa caroliniana*), and ludwigia (*Ludwigia repens*). Emergent plants are sparse, with spike rush common in some areas. Sloughs are generally a few feet to a few inches below adjacent marshes. Soils are mostly peat or muck, with submerged surface sediments rising and falling with fluctuating water levels. During severe droughts, surface sediments dry out and ground fires may develop, but generally sloughs are wet most of the year and have historically served as fire breaks for communities bordering the sloughs. When fires do occur, depressions are formed in the organic soils, and they fill with water to become ponds. Ponds and sloughs provide important habitat for alligators.

**Suitability for ORVs** — Cypress strands, cypress domes, mixed hardwood swamps, and sloughs are the wettest of all vegetated communities in the Addition. The interiors of these areas serve as important refuges and concentration points for water-dependent wildlife during the annual dry season. Generally these communities are natural barriers to off-road vehicles. Because these wetlands are associated with topographic depressions, water depth increases substantially from their edges to the center. Most of the areas covered by these wetlands have unstable substrate, water that is too deep, or too many trees to support ORV use.

Deep water and large, closely spaced trees confine off-road vehicles to established, previously cut trails threading along the margins where mineral soil or bedrock provides sufficient traction and water depth is relatively shallow. ORV tracks usually encircle or skirt cypress domes along their outermost perimeter for the same reasons. There are relatively few ORV trails that are perpendicular to the forested drainages. ORV trails crossing strands and swamps are normally on well-established, deeply entrenched routes where the forest narrows and water levels are shallower. In the original Preserve, Duever et al. (1981) found that established ORV trails through strands and swamps had the deepest ruts of all vegetation types, and that typically trails were worn down to bedrock and filled with standing water. Sloughs typically contain deep water and deposits of muck or peat, all of which discourage the use of wheeled off-road vehicles.

### Prairies and Marshes.

**Prairies** — Prairies are treeless areas dominated by grasses and grasslike plants. Herbaceous (wet) prairies and cypress prairies can be found in the Addition. Herbaceous (wet) prairie communities in the region are typically seasonally inundated short-grass communities. Herbaceous broad-leaved plants are common components of these communities, but these plants do not usually dominate them. Graminoids (herbaceous grasses or grasslike plants) such as muhly grass (*Muhlenbergia capillaris*), blue maidencane (*Amphicarpum muhlenbergianum*), or south Florida bluestem (*Schizachyrium rhizomatum*) often dominate these prairies. Prairie communities may occur on many soils, but these communities are often found on frequently flooded fine sands or calcium carbonate marls. Limestone is commonly near the soil surface in prairie areas, which does not support trees; thus

vegetation is limited to ground cover. These areas are inundated for part of the year, and they receive much sunlight.

Prairies will burn during periods of drought and when sufficient fuel is present. Fire maintains prairies by eliminating invading trees and shrubs.

Cypress prairies are communities that transition between short-grass prairies and cypress-dominated swamp communities and typically contain elements of both. Cypress prairies are usually dominated by graminoid ground cover made up of species common in prairies, such as muhly grass (*Muhlenbergia capillaris*), or saw grass (*Cladium jamaicense*). Bald cypress trees are common in these prairies, but seldom attain a large size. This is partly because the limestone caprock that is a common component of substrates in the region is close to the soil surface and inhibits the establishment and growth of cypress trees unless there are fractures in the limestone where the cypress trees can establish limited growth. These trees are called dwarf or hatrack cypress. These areas are inundated (usually less than 1 foot of water depth) through much of the wet season.

**Suitability for ORV Use** — Prairies appear to be the vegetation community most impacted by ORV use. ORV trails in this community are easily distinguished on aerial photography. The tracks made by off-road vehicles persist and are even visible on small-scale aerial images. Impacts of ORV traffic in prairies include vegetation loss and exposed soils. Duever et al. (1981) and Duever et al. (1986b) described effects of ORV traffic in marl marshes and sand marshes in the original Preserve. Based on the species composition of these areas, these now appear to be classified as prairies. Duever et al. (1986b) observed that sand marshes that were not inundated were less likely to sustain heavy impacts from ORV use. This suggests that

seasonal variation in hydrology may be an important factor in determining ORV effects, and that ORV use in prairies during the wet season should be minimized.

ORV uses have been shown to alter plant community structure. After one year of recovery in the original Preserve, Duever et al. (1981) found that sawgrass and muhly grass were reduced in the tire lanes. Hyssop (*Bacopa* sp.) and bladderwort (*Utricularia* sp.) were common in the rutted areas; this was attributed to an increased hydroperiod in the tire ruts and increased sunlight from tree or shrub canopy removal within ORV use areas. After seven years, Duever et al. (1986b) found that four graminoids were more common in ORV trails than in comparison areas. Sawgrass was less common in the trails used by off-road vehicles than in the undisturbed comparison areas.

Duever et al. (1981) and Duever et al. (1986b) also evaluated effects in “small cypress” communities. Descriptions of these areas in Duever et al. (1981) suggest that they may be similar to that of cypress prairies outlined above. These areas are closely aligned ecologically with marl prairies. Duever et al. (1981) indicated that of all five vegetative communities in the original Preserve tested with wheeled vehicles, the small cypress communities required the lowest amount of use by wheeled off-road vehicles to create “a significant impact.” Duever et al. (1986b) indicated recovery of small cypress communities was less than other communities seven years after intermediate and heavy impacts from wheeled off-road vehicles. Duever et al. (1981) found that small (less than 3 feet tall) cypress trees suffered minor damage in areas used by off-road vehicles, but that cypress trees between 3 feet and 10 feet tall had severe damage. Damage to these trees and associated mortality increased with ORV use. This indicates that cypress trees between 3 and

10 feet tall can be adversely affected in areas used by off-road vehicles, but that after limited ORV use, recovery of very small trees can occur quickly.

**Marshes** — Since the preparation of the 1991 *General Management Plan*, the classification of marshes in the Preserve has been changed to be consistent with vegetation classification throughout the south Florida region. Under the new classification of Welch et al. (1999), marshes now include many of the areas identified as prairies in 1991.

Freshwater and saline marshes can be found in the Addition. Freshwater marshes are wetland communities that are dominated by herbaceous plants and occasional shrubs. These communities are typically inundated nearly year-round and have substrates with a thick organic mantle on the surface. Marshes are usually dominated by herbaceous species, but a marsh that is dominated by grasses or sedges may be considered a graminoid marsh. Grasses usually occur in areas without standing water during some part of the year, but related graminoids may be common in areas with prolonged hydroperiods. The graminoid that is probably most common in such areas is sawgrass. Sawgrass is a sedge (Cyperaceae) that is commonly found in wetlands with various depths to limestone, often with a significant organic peat layer covering the limestone. This organic layer is usually derived from sawgrass. Other similar communities that are dominated by different grasslike plants may also be graminoid marshes and would be identified by the graminoid that is the dominant ground cover plant.

Freshwater marshes are commonly dominated by broad-leafed plants, such as pickerel weed (*Pontederia cordata*), cattail (*Typha domingensis* or *T. latifolia*), or duck potato (*Sagittaria* spp.). These wetlands have comparatively deep water (1.5–2.0 m)

during the wet season and persist as aquatic communities year-round or well into the dry season. These deeper areas provide refuge for fish during dry seasons, when few places are under water, and also tend to concentrate populations of fish and other aquatic animals as water levels decrease with dry weather. Many wading birds, such as wood storks (*Mycteria americana*) and American egrets (*Casmerodius albus*), depend on these concentrated prey populations to find sufficient food for nesting and brood rearing.

Saline marshes occur in coastal areas and are often affected by marine systems. These communities, influenced by tidal fluctuations, have higher soil salinity than inland freshwater systems. Saline marshes that are far inland may be affected by marine waters only during extreme storm tides, such as those associated with hurricanes. This produces a change in salinity very infrequently, but the effects of this change may remain with the marsh community for several years. These communities are usually populated with plants that are typical of freshwater marshes but that are able to tolerate small increases in salinity. Plants that inhabit these areas include cattail (*Typha domingensis*), pond apple (*Anona glabra*) and cord grass (*Spartina bakeri*). These areas and other communities inland from coastal systems may be dominated by fresh water almost all of the time but may still be frequently influenced by tidal changes in water level. During the dry season, decreased flow of fresh water may allow salt water to flow farther inland than during the wet season.

Nearer the coast, tidal systems are more likely to dominate, so that mixing of fresh water and salt water becomes more common. When salt water becomes diluted by fresh water, brackish water results. Communities that are dominated most of the year by brackish water are likely to be

dominated by saline marsh with occasional mangrove trees. These saline marshes are often populated by black rush (*Juncus roemerianus*) salt marsh cord grass (*Spartina* spp), or salt grass (*Distichlis spicata*). Fires sweep through salt marshes when weather conditions and fuel loads are conducive. Without fire or frost, trees would eventually replace salt marsh vegetation (Forest Service, Wade et al. 1980a).

**Suitability for ORV Use** — ORV use has been shown to alter marsh plant composition and structure. Duever et al. (1981 and 1986) described effects of ORV traffic in inundated sand marshes and peat marshes (wheeled vehicles were not tested in peat marshes). These communities appear to include much of the “marshes” category used here. These are open communities with few trees or shrubs, and ground cover is dominated by emergent herbs. Inundation is year-round or nearly year-round. Duever et al. (1981) indicated that off-road vehicles produced heavy impacts in inundated sand prairies, but less impact in noninundated sand prairies with the same amount of ORV use. Continuously inundated marl marshes were not tested with wheeled vehicles but appeared to be more affected when they were inundated than when the water table was below the ground surface. This suggests that marl marshes with extended hydroperiods may be quickly impacted by ORV use.

In marl marsh communities in the original Preserve, Duever et al. (1981) found that panic grass (*Panicum* sp.), sawgrass and muhly grass decreased with increased ORV use. Bladderwort, often a floating aquatic plant, was common in the rutted areas; this was attributed to an increased hydroperiod in the tire ruts. Sand marsh communities showed little difference in plant diversities with comparison areas after one year. After seven years, coinwort (*Centella asiatica*)

was more common in marl marsh areas used by off-road vehicles.

**Mangrove Forests.** Mangrove forests (mangrove swamps) are intertidal wetlands dominated by hardwood trees that are tolerant of coastal, saline conditions. Three mangrove trees — red mangrove (*Rhizophora mangle*), black mangrove (*Avicennia germinans*), and white mangrove (*Laguncularia racemosa*) — and buttonwood (*Conocarpus erectus*), a mangrove associate, are common in southern Florida. These trees make up a dense forest on much of the coast in southern Florida and form scattered tree islands farther inland, where surface waters become brackish.

Depending on the distance from the coast and seasonal runoff from inland freshwater systems, mangrove forest soils can vary in salinity. These changes in ground water and salt content create adverse conditions for most organisms, so that species richness in mangrove forests is usually low. Catastrophic events such as fires, frosts, hurricanes, and oil spills also limit mangrove productivity. Frosts severely prune mangroves, and hurricanes can destroy them.

The mangrove communities in the Addition are found primarily in the southern part of the narrow strip of the Addition that is east of SR 29 and adjacent to the Barron River and Everglades City. This area is currently open to motorized and nonmotorized boats.

**Suitability for ORV Use** — Mangrove forests are not suitable for wheeled vehicles. Airboats have also caused damage to mangrove trees when wind generated by propellers damages leaves and small branches of mangrove trees. Florida law prohibits destruction of mangrove trees.

**Pinelands.** Pinelands occur in areas that are higher than most wetlands, so their substrates are inundated less frequently. In the Addition, slash pine (*Pinus elliottii*) dominates these communities. Slash pine forests are woodland

communities with pine trees that are spaced several yards apart, so that an incomplete tree canopy is formed. Depending on substrate, some of these woodlands form a pine and palmetto community, where scattered pine trees form an open (incomplete) canopy with a dense shrub layer composed mostly of saw palmetto (*Serenoa repens*). The palmetto shrub layer is usually dense so that ground-cover does not become well established.

Slash pine-dominated communities that occur on limestone outcrops are called pine rockland communities. These areas also develop a palmetto shrub layer, but the palmettos are usually not as dense as in the pine and palmetto communities. This allows the establishment of other shrubs and ground cover, so that pine rocklands are often more diverse than pine and palmetto communities living on sandy substrates. Pine rockland communities often contain plants that are associated with the Atlantic coastal ridge communities.

The pine and palmetto and pine rockland communities are typically mesic communities, but frequently include extensive ecotonal (transitional) areas that are adjacent to wetlands. These ecotonal communities have brief or infrequent hydroperiods and contain elements of the adjacent wetlands. Palmettos apparently do not adapt well to hydric conditions and are not common in areas that are saturated or inundated often. Slash pines, however, tolerate some hydric conditions, so that in areas with short hydroperiods, slash pines commonly live without the saw palmetto understory. In these areas, the open pine canopy allows sunlight to penetrate, and graminoids commonly found in prairies are supported.

Several ecotonal communities can be found in pinelands. These ecotonal communities occur in areas with subtle topographic differences, so that differences in the communities may occur because of differences in soil type,

hydrology, small elevation differences, or fire history.

Pine needles, grasses, and other combustible materials accumulate relatively quickly in pinelands, and pinelands burn at frequent intervals. Pinelands are fire-dependent, and prescribed fires by NPS staff maintain the habitat viability by preventing hardwood succession. If fires are suppressed, pinelands eventually succeed to hardwood-dominated stands.

Pinelands provide habitat for the federally listed red-cockaded woodpecker. Red-cockaded woodpeckers form clusters of cavity trees within pinelands. NPS annual surveys of red-cockaded woodpecker clusters have documented no loss of pines due to ORV traffic.

**Suitability for ORV Use** — Of all the plant communities in the original Preserve tested for ORV impacts by Duever et al. (1981), pinelands were the most resistant to adverse effects from ORV use. Wetter pine communities were more heavily affected. Duever et al. (1986b) found that two of three pineland areas affected by off-road vehicles had recovered after seven years, but that the third, and wettest, pineland had not fully recovered. Amounts of ground cover did not appear to be substantially altered by ORV use. Heights of plants in areas of ORV use were decreased, but the plants recovered in one growing season.

Within the pineland understory, Duever et al. (1981) found few differences in plant communities compared with undisturbed areas after one year. However, they did note slight increases in sawgrass, coinwort, and *Hyptis* sp. Compared with undisturbed comparison sites, while panic grass and three-awn grass (*Aristida* sp.) decreased with increased ORV use. After seven years, Duever et al. (1986b) indicated that *Hypericum* sp., *Ludwigia* sp., and yellow-eyed grass (*Xyris* sp.) were more common in ORV trails than in comparison

areas, while fleabane (*Pluchea* sp.) was less common. Sawgrass was less common in the trails used by off-road vehicles than in the undisturbed comparison areas.

Duever (1986) indicated that pinelands recovered more quickly than other areas, so that these areas may be considered favorably for designated trails.

**Hardwood Hammocks.** Mesic and hydric hardwood hammocks are scattered throughout the Addition. Often appearing as islands of trees, hardwood hammock communities occur on slightly elevated areas, and the soils are generally drier than the surrounding wetlands. Hammocks are usually small areas (1 hectare or about 2.5 acres or less) that are surrounded by other communities; in the Big Cypress region, the surrounding community is typically a wetland swamp or prairie. These slightly elevated areas function as refuges for wildlife during periods of high water. Because soils remain moist most of the year, hardwood hammocks rarely burn, but they are susceptible to fire during extended droughts. Following a fire, the species composition of recolonized hammocks often changes significantly (Duever et al. 1986a).

Hammocks are usually dominated by hardwood trees with sabal palms; saw palmettos frequently occur as part of the shrub layer and often appear to be remnants of an earlier, more open successional stage. Near the coast, these hammocks are protected from frosts by the adjacent Gulf of Mexico, so that tropical hardwoods dominate these hammocks. Many of these hammocks are located on shell mounds that were constructed by the Calusa Indians. These shell mounds support a diversity of tropical hardwoods, including, gumbo limbo (*Bursera simaruba*), mastic (*Mastichodendron foetidissimum*), and poison wood (*Metopium toxiferum*).

Hammocks that occur inland are usually surrounded by freshwater wetlands; these may be swamps (wetlands dominated by trees)

or wet prairies (wetlands dominated by herbaceous ground cover). Inland hammocks are usually dominated by live oak (*Quercus virginiana*) or laurel oak trees with understories made up of cocoplum (*Chrysobalanus icaco*), snowberry (*Chiococca alba*), and beauty berry (*Callicarpa americana*). Ground cover is sparse, usually consisting of tufted grasses such as bluestem (*Andropogon virginicus*). Epiphytes are common, especially on the branches of oak trees, where resurrection fern (*Polypodium polypodioides*), many bromeliads, and several uncommon orchids grow. Many epiphytes also occur on the trunks and bootjacks (leaf bases that remain for some time on the palm trunk) of sabal palms, such as shoestring fern and golden serpent fern. Vines such as poison ivy, several grapes (*Vitis* spp.), and pepper vine (*Ampelopsis arborea*) are common canopy components. Elevated areas with sandy soils and limestone near the substrate surface often support cabbage palm (sabal palm) hammocks. These hammocks are usually not especially diverse, and have few trees other than sabal palms forming the tree canopy. Shrubs are uncommon, and ground cover is sparse. Vines and epiphytes may occur on the palm trunks, but these are also usually sparse.

**Suitability for ORV Use** — Trees that dominate these hardwood hammock communities are often large, such as oaks, sabal palms, or wild tamarind (*Lysiloma latisiliquum*). As a result, ORV riders usually avoid hardwood hammocks, although the substrate in these areas would support ORV use. Hardwood hammocks are susceptible to invasion by unwanted exotic species, especially Brazilian pepper, when their soils and tree canopies are disturbed.

Occasionally, smaller trees and shrubs in the understory may be subject to damage because they can be bent or broken by vehicles. Duever et al. (1986b) stated that abandoned trails in the original Preserve were vegetated by saltbush (*Baccharis* spp.) after seven years. Saltbush species are opportunistic in

disturbed areas. Duever et al. (1986b) speculated that the abandoned trails would eventually succeed to the native understory species, but no further assessment has been conducted to determine if this is occurring.

Hardwood hammock communities are commonly associated with archeological resources, and changes to substrates may affect cultural remnants. These communities are ordinarily small and isolated enough that they can be avoided. To reduce the risk of compromising cultural resources that may be in the hardwood hammock substrates, ORV use should be directed away from hammock communities.

**Disturbed Areas.** Disturbed areas, found throughout the Addition and intermixed within all of the above vegetation communities, are areas that have been affected by nature (fire, freeze, storms, extreme tides, etc.) or by man's activities such as logging, canal and road construction, farming and grazing, oil extraction, ORV use, fire, introducing exotic species, earth moving, altering drainage, altering the chemistry of water or soils, or facility construction. Community succession has been altered in disturbed areas. Soils in disturbed areas differ with locations and original substrates. The result is a change in the ecosystem that usually allows colonization and recruitment of ruderal (weedy) species. These weeds are often exotic plants that outcompete natives and quickly dominate the disturbed area.

### Protected Plant Species

As shown in table 12, three species of plants that reside in the Addition are listed as candidate species for federal listing as endangered or threatened. The state of Florida lists an additional 96 species that occur in the Addition as threatened or endangered, along with three more that are listed as commercially exploited. Collectively, these species warrant attention because they have had long-term

TABLE 12: LISTED PLANT SPECIES FOR BIG CYPRESS NATIONAL PRESERVE ADDITION<sup>a</sup>

Common Name	Scientific Name	Designated Status <sup>b</sup>	
		Federal	State
Paurotis palm, Everglades palm	<i>Acoelorrhaphe wrightii</i>		T
Golden leather fern	<i>Acrostichum aureum</i>		T
Brittle maidenhair	<i>Adiantum tenerum</i>		E
Sensitive joint-vetch, meadow joint-vetch	<i>Aeschynomene pratensis</i>		E
White colic-root, bracted colic-root	<i>Aletris bracteata</i>		E
Pineland-allamanda, pineland golden trumpet	<i>Angadenia berteroi</i>		T
Eared spleenwort	<i>Asplenium erosum</i>		E
Bird's-nest fern, wild birdnest fern	<i>Asplenium serratum</i>		E
Pinepink	<i>Bletia purpurea</i>		T
Fakahatchee bluethread	<i>Burmannia flava</i>		E
Manyflowered grasspink	<i>Calopogon multiflorus</i>		E
Spicewood, pale lidflower	<i>Calyptanthes pallens</i>		T
Leafless bentspur orchid	<i>Campylocentrum pachyrrhizum</i>		E
Narrow strap fern, narrow-leaved strap fern	<i>Campyloneurum angustifolium</i>		E
Tailed strap fern	<i>Campyloneurum costatum</i>		E
Powdery strap airplant	<i>Catopsis berteroniana</i>		E
Florida strap airplant	<i>Catopsis floribunda</i>		E
Southern Florida sandmat	<i>Chamaesyce pergamena</i>		T
Porter's sandmat	<i>Chamaesyce porteriana</i>		E
Satinleaf	<i>Chrysophyllum oliviforme</i>		T
Coffee colubrina, greenheart	<i>Colubrina arborescens</i>		E
Butterflybush, Curacao bush	<i>Cordia globosa</i>		E
Quailberry, Christmasberry	<i>Crossopetalum ilicifolium</i>		T
Pepperbush	<i>Croton humilis</i>		E
Florida tree fern, red-hair comb fern	<i>Ctenitis sloanei</i>		E
Blodgett's swallowwort	<i>Cynanchum blodgettii</i>		T
Cowhorn orchid, cigar orchid	<i>Cyrtopodium punctatum</i>		E
Florida prairieclover	<i>Dalea carthagenensis</i> var. <i>floridana</i>	Candidate	E
Ghost orchid, palmlolly	<i>Dendrophylax lindenii</i>		E
Caribbean crabgrass	<i>Digitaria filiformis</i> var. <i>dolichophylla</i>		T
Florida pineland crabgrass	<i>Digitaria pauciflora</i>	Candidate	E
Guiana-plum	<i>Drypetes lateriflora</i>		T
Clamshell orchid, cockleshell orchid	<i>Encyclia cochleata</i>		E
Florida butterfly orchid	<i>Encyclia tampensis</i>		CE
Dingy-flowered star orchid	<i>Epidendrum anceps</i>		E
Acuna's star orchid	<i>Epidendrum blancheanum</i>		E
Umbrella star orchid	<i>Epidendrum floridense</i>		E
Night-blooming epidendrum, night-scented orchid	<i>Epidendrum nocturnum</i>		E
Stiff-flower star orchid	<i>Epidendrum rigidum</i>		E
Sanibel Island love grass	<i>Eragrostis tracyi</i>		E
Beach verbena, coastal mock vervain	<i>Glandularia maritima</i>		E

Common Name	Scientific Name	Designated Status <sup>b</sup>	
		Federal	State
Wild cotton, upland cotton	<i>Gossypium hirsutum</i>		E
West Indian tufted airplant	<i>Guzmania monostachia</i>		E
Snowy orchid	<i>Habenaria nivea</i>		T
Needleroot airplant orchid	<i>Harrisella porrecta</i>		T
Poeppig's rosemallow	<i>Hibiscus poeppigii</i>		E
Hanging club-moss	<i>Huperzia dichotoma</i>		E
Delicate violet orchid	<i>Ionopsis utricularioides</i>		E
Rockland morningglory	<i>Ipomoea tenuissima</i>		E
Pineland clustervine	<i>Jacquemontia curtisii</i>		T
Skyblue clustervine	<i>Jacquemontia pentanthos</i>		E
West coast lantana, Sanibel shrubverbena	<i>Lantana depressa</i> var. <i>sanibelensis</i>		E
Catesby's lily, pine lily	<i>Lilium catesbaei</i>		T
Small's flax	<i>Linum carteri</i> var. <i>smallii</i>		E
Pantropical widelip orchid	<i>Liparis nervosa</i>		E
Nodding club-moss	<i>Lycopodiella cernua</i>		CE
Hidden orchid	<i>Maxillaria crassifolia</i>		E
Pineland blackanthers	<i>Melanthera parvifolia</i>		T
Climbing vine fern	<i>Microgramma heterophylla</i>		E
Twinberry, Simpson's stopper	<i>Myrcianthes fragrans</i>		T
Giant sword fern	<i>Nephrolepis biserrata</i>		T
Wild basil, wild sweet basil	<i>Ocimum campechianum</i>		E
Florida dancinglady orchid	<i>Oncidium ensatum</i>		E
Hand fern	<i>Ophioglossum palmatum</i>		E
Erect pricklypear	<i>Opuntia stricta</i>		T
Royal fern	<i>Osmunda regalis</i> var. <i>spectabilis</i>		CE
Pineland passionflower	<i>Passiflora pallens</i>		E
Comb polypody	<i>Pecluma ptilodon</i> var. <i>caespitosa</i>		E
Cypress peperomia	<i>Peperomia glabella</i>		E
Florida peperomia, baby rubberplant	<i>Peperomia obtusifolia</i>		E
Yerba linda	<i>Peperomia rotundifolia</i>		E
Southern fogfruit	<i>Phyla stoechadifolia</i>		E
Greater yellowspike orchid	<i>Polystachya concreta</i>		E
Bahama ladder brake	<i>Pteris bahamensis</i>		T
Swartz's snoutbean	<i>Rhynchosia swartzii</i>		E
Royal palm, Florida royal palm	<i>Roystonea regia</i>		E
Leafless beaked lady's-tresses	<i>Sacoila lanceolata</i>		T
Ray fern	<i>Schizaea pennula</i>		E
Florida Keys nutrush	<i>Scleria lithosperma</i>		
Everglades bully	<i>Sideroxylon relinatum</i> subsp. <i>Austrofloridense</i>		E
Mullein nightshade	<i>Solanum verbascifolium</i>		T
Everglades Keys false buttonweed	<i>Spermacoce terminalis</i>		T
Texas ladiestresses	<i>Spiranthes brevibris</i>		E
Lacelip lady's-tresses	<i>Spiranthes laciniata</i>		T
Longlip lady's-tresses	<i>Spiranthes longilabris</i>		T
Southern lady's-tresses	<i>Spiranthes torta</i>		E
West Indian mahogany	<i>Swietenia mahagoni</i>		T
Broad halbard fern	<i>Tectaria heracleifolia</i>		T
Curtiss' hoarypea	<i>Tephrosia angustissima</i> var. <i>curtissii</i>		E
Lattice-vein fern	<i>Thelypteris reticulata</i>		E

Common Name	Scientific Name	Designated Status <sup>b</sup>	
		Federal	State
Reflexed wild-pine, northern needleleaf	<i>Tillandsia balbisiana</i>		T
Stiff-leaved wild-pine, cardinal airplant	<i>Tillandsia fasciculata</i> var. <i>densispica</i>		E
Banded wild-pine, twisted airplant	<i>Tillandsia flexuosa</i>		T
Hoary wild-pine, fuzzywuzzy airplant	<i>Tillandsia pruinosa</i>		E
Giant wild-pine, giant airplant	<i>Tillandsia utriculata</i>		E
Soft-leaved wild-pine, leatherleaf airplant	<i>Tillandsia variabilis</i>		T
Chiggery grapes	<i>Tournefortia hirsutissima</i>		E
Entire-winged bristle fern	<i>Trichomanes holopterum</i>		E
Hoopvine	<i>Trichostigma octandrum</i>		E
Florida gamagrass	<i>Tripsacum floridanum</i>		T
Leafy vanilla	<i>Vanilla phaeantha</i>		E
Rain-lily, redmargin zephyrlily	<i>Zephyranthes simpsonii</i>		T

Sources: USFWS 2006; Florida Department of Agriculture, Division of Plant Industry 2006; Florida Natural Areas Inventory 2006.

a Species in this table include those that have been documented in the preserve- it does not include listed species for Collier County that are not present in the preserve.

b E = endangered                      Candidate= species is a candidate for listing as threatened or endangered  
T = threatened                      CE = commercially exploited

population declines and are vulnerable to exploitation or environmental changes. Table 12 displays the status of all 102 special status plant species that occur in the Addition.

**Exotic and Nonnative Plant Species**

Thousands of nonnative plant species have been introduced to south Florida for ornamental plantings, agriculture, and other human uses. Because of the relative youth of the south Florida landmass and the semi-tropical climate, it is theorized that the region is particularly susceptible to invasion by exotic plant species (Duever et al. 1986a). Some 297 exotic plants have become established in south Florida (Duever et al. 1986a). Many of these are reported from Big Cypress National Preserve, but most are restricted to early successional stages on disturbed sites, and only a few pose a long-term threat to native

communities. Of these, five species — melaleuca (*Melaleuca quinquenervia*), Brazilian pepper, water hyacinth (*Eichhornia crassipes*), hydrilla (*Hydrilla verticillata*), and Old World climbing fern (*Lygodium microphyllum*) — are fairly common in the Preserve and the Addition. Australian pine (*Casuarina* spp.) was identified as an exotic species of concern; however, in the last two decades it has been eradicated. Today, except for those on private property, all known Australian pine plants have been eliminated from the Preserve and the Addition. Crested floatinghart (*Nymphoides cristata*), a relatively new exotic for south Florida, was discovered in the Preserve in August 2006. Infestations are restricted to about 4 miles of canal along Tamiami Trail and two strand swamps south of the trail (NPS 2006b). Evidence suggests that this species was introduced to the Preserve through the transfer of propagules attached to a net or other fishing gear. Invasion of the

adjacent swamps likely occurred from water flowing through culverts in the area. Water lettuce (*Pistia stratiotes*) and air potato (*Dioscorea bulbifera*) are also known to be present.

Melaleuca and Brazilian pepper are capable of invading native plant communities, and control efforts have been concentrated on these species.

The exotic plant control program is carried out by the NPS contractors and maintenance and resource management staff. NPS staff are active participants in the Florida Exotic Pest Plant Council, an interagency task force organized to share technical information on the control of exotics, monitor the distribution of exotics in south Florida, and collaborate on comprehensive control strategies.

Even though exotics are spread by natural events (such as hurricanes) and animals (such as raccoons and birds), there are indications that off-road vehicles have resulted in the spread of exotic and invasive plants within the Preserve, including Brazilian pepper, melaleuca, and Old World climbing fern. Off-road vehicles transport seed in their tire treads and vehicle beds and distribute it in currently unaffected areas of the Preserve as they travel. Evidence of the spread of invasive plants along ORV trails has been documented around the Monroe Station trailhead (Pernas 1999).

**Melaleuca.** Melaleuca, a native of Australia and New Guinea, was introduced to Florida around 1910 for landscaping. Perhaps the first introduction of melaleuca in Big Cypress was at Monroe Station around 1940. Because it grows in pure stands at the expense of native plants and can occupy large areas, melaleuca is considered to be a major threat to the ecological integrity of the Preserve.

Melaleuca has successfully invaded much of south Florida because of its outstanding ability to propagate. A mature tree may

contain tens of thousands of small woody seed capsules along its branches, and each capsule contains about 250 seeds. The capsules remain closed as long as they receive moisture from the tree's vascular system. However, if the vascular system fails due to damage by fire, frost, cutting, herbicidal injury, or simply old age, the capsules will slowly dry out, open, and release hundreds of thousands of seeds. The seeds fall within a short distance of the parent tree and germinate best on open, moist soils. Germination is limited on very dry or very wet soils and under dense canopy cover. As a result, melaleuca does well in prairies and open, moist pinelands, but is slower to invade wetter communities such as cypress domes and strands.

Melaleuca is extremely fire tolerant. The spongy inner bark insulates the trunk while the papery outer bark and oil-rich leaves readily carry fire. Following a fire, melaleucas will both release seeds and resprout, and fires create excellent conditions for melaleuca seed germination and seedling survival. Hence, fire in a mature melaleuca stand can encourage the exotic to spread.

Melaleuca is controlled through two primary methods: (1) hand pulling — manually pulling the plants when they are small enough, and (2) cut stump — brushing or spraying herbicide on freshly cut stump surfaces. Both techniques are labor intensive, and trained personnel are required to handle the herbicides. Once mature, seed-bearing trees have been killed, prescribed fire or cutting may be used to control seedlings and sprouts.

The entire Addition has been inspected for the presence of melaleuca plants, and about 632,000 melaleuca stems have been treated and/or removed. Today, melaleuca is considered to be under control within the Preserve and the Addition. Future treatments of melaleuca in the Addition will focus on re-treating previously treated areas.

**Brazilian Pepper.** A native of South America, Brazilian pepper was first introduced to south Florida around 1900. It is now widespread in the region, primarily on disturbed, well-drained sites.

Brazilian pepper reproduces by seed. Seeds are produced in bright red berries that are ingested by birds and other wildlife and then spread to other areas. Ingestion appears to improve seed germination potential.

Fire has variable effects on pepper plants. Seedlings are killed by fairly frequent fires; however, in more mature stands trees may be top-killed by fires but can resprout and reoccupy a burned area. Intense fires on upland sites tend to eliminate competing vegetation and prepare good seedbed conditions for a *Schinus* invasion.

Like melaleuca, Brazilian pepper occurs in dense, pure stands, particularly in the Addition. However, unlike melaleuca, dense pepper stands are almost always confined to areas with substrate disturbance (roadsides, canal banks, abandoned homesites, or camps— typically areas in which fill has been placed to create dry land). As some upland areas mature toward hardwood hammock vegetation, Brazilian pepper will decline in importance. However, in most upland areas the natural fire cycle is likely to maintain Brazilian pepper as a component of the understory indefinitely. Fire and hydrological cycles seem to prevent Brazilian pepper from invading undisturbed prairies, marshes, and other more moist types of environments.

Brazilian pepper occurs in mesic communities nearly throughout the Preserve, especially in the Addition. It is often found on old farm fields, spoil banks, and canal berms. In 2005 NPS staff initiated large-scale treatment of Brazilian pepper in the Addition north of I-75 and west of Nobles Grade. This is an area with perhaps the greatest concentration of Brazilian pepper in the entire Preserve. Much of this area was disturbed by small-scale

agriculture and grazing, with several hunting camps and many swamp buggy trails; these changes to the landscape created significant areas for Brazilian pepper establishment. In 2005 about 780 acres were treated for dense infestation, and in 2006 about 10,058 acres of moderate to dense infestation of Brazilian pepper were treated, mostly in the area between Nobles and Bundschu grades (NPS 2006b). Collectively, nearly 11,000 acres in the Addition have been treated. Infestations were heaviest along Nobles Grade and in abandoned hunt camp sites. Treatments of infestations around Deep Lake and in the strip of land along SR 29 are planned for early 2009. The overall goal is for stopping the spread of Brazilian pepper in the entire Preserve, including the Addition, which will likely take about 10 years (NPS 2006).

**Water Hyacinth and Hydrilla.** Water hyacinth and hydrilla have invaded the Addition's canal systems and excavated ponds, where they often form dense mats. Neither plant can invade seasonally dry wetlands, and the plants appear to be restricted to permanent water in canals and ponds. For this reason no major control program is currently warranted.

**Old World Climbing Fern.** This plant is rapidly becoming a significant problem species throughout southern Florida. It apparently originated in the Palm Beach County area on the east coast of the state and has been spreading rapidly westward and southward. The first recorded treatment of Old World climbing fern in the Preserve occurred in 1998. Since then this exotic species has been found in nearly 100 sites in the Preserve. Infestations have been found throughout the Preserve, with the greatest concentration in the northeast portion of the Addition. Most of these infestations are small (<0.5 acre), although some larger patches have been found. To date all known infestations of this plant in the Addition have been treated. However, further establishment of this fern in the Addition is anticipated, and detailed reconnaissance to locate infestations will

occur annually. All of the known Old World climbing fern in the Addition, about 150 acres, has been treated. In 2006 treatments were focused on infestations in the Kissimmee Billy and Cow Bell Strands. The overall goal is to prevent incipient infestations of Old World climbing fern from becoming major eradication problems.

Another, similar exotic climbing fern (*Lygodium japonicum*) is causing similar problems with native communities, but this plant is more common to the north. Although *Lygodium japonicum* has been recorded in the Addition, it is not common.

## FIRE ECOLOGY AND MANAGEMENT

The natural vegetation communities of Big Cypress are dynamic, and boundaries of the communities shift over time. The two major influences on vegetation distribution are hydroperiods and fires; other significant factors are frost and hurricane damage, although they are somewhat less important because they occur infrequently. Of these influences, only fire can be used as a practical management application in natural areas.

The importance of fire in the natural environment of south Florida is well documented (Forest Service, Wade et al. 1980a; NPS 1953; Davis 1943). All natural communities in the region are affected by fire, and many not only survive periodic burning but are ultimately dependent on fire for their perpetuation. Many plants in fire-dependent communities, such as prairies and pinelands, are highly flammable, and fires spread rapidly in these communities. Ignition sources are plentiful. South Florida has the highest incidence of lightning of any region in the nation, and there is also a long history of human-caused fire (Forest Service, Wade et al. 1980a). Lightning-caused fires can occur year-round, but are more typical during latter part of the dry season just before the summer rains begin. Human-caused fires can also occur

any time but tend to be more frequent in the dry winter months. Human-caused fires have probably been an influence on the regional vegetation for several thousand years (Duever et al. 1986a). Frequent ignition and high flammability, particularly in combination with annual dry seasons, create an extraordinarily high fire frequency, and fires in south Florida tend to be large.

The effects of fires in Big Cypress are extremely complex and depend on factors such as the season, intensity, extent, and duration of burning and the susceptibility and responsiveness of vegetation to fire damage. The flammability of vegetation types varies through the annual wet and dry seasons and from year to year. For example, drier, more upland types such as pinelands and some prairies are susceptible to fire earlier in the year than most wet prairies and marshlands, which dry out as the season progresses. However, hardwood hammocks, mixed-hardwood swamps, and cypress strands are rarely dry enough to burn except during extended droughts.

Roughly 90% of the Addition consists of plant communities (cypress and mixed hardwood swamps, marl prairies and marshes, and pinelands) that require periodic fire for perpetuation (Burch 2003). In such communities, surface fires tend to eliminate competing vegetation, stimulate sprouting or seed production, create seedbed conditions, and release nutrients. Without cyclic fire, fire-tolerant species decrease in reproduction as a site is invaded and eventually dominated by fire-intolerant plants. Natural fire intervals range from as frequent as every 3 to 5 years in prairies to as long as every 50 to 100 years in mixed hardwood swamps (Burch 2003).

Although periodic surface fires tend to maintain certain communities, extreme fire conditions can dramatically alter plant, and consequently animal, distribution. When the fire cycle is retarded, organic materials

accumulate and create hazardous fuel levels that can threaten even fire-tolerant species. Prolonged droughts or human-caused drainage can dry out the organic soils of many plant communities and, when coupled with hazardous fuel accumulations, can result in intense fires that consume organic soil materials. Peat fires, as such fires are called, can literally burn the soil out from under established vegetation, radically changing the plant composition. Peat fires tend to lower the surface level of the burned area, thereby extending the hydroperiod and affecting the replacement vegetation. The pond in the middle of a cypress dome, for instance, may be enlarged by a peat fire. In an extreme example, a hardwood hammock on deep organic soil may be completely burned and replaced by an open pond.

It would not be possible to exclude fire from the Addition, nor would it be desirable to do so. It is the job of resource managers not simply to stop fires, but rather to attempt to control where, when, and how intensely they burn.

Recent fire activity in the Addition has affected many of its vegetation communities. During May and June 2007 a lightning-caused fire burned about 64,000 acres east of SR 29 on both sides of I-75. Two fires that burned on the north side of I-75 came together and created 24 miles of fire line (from mile markers 52 to 76).

The NPS fire management program covers the Addition and is guided by the *Fire Management Plan* (NPS 2005). The NPS staff uses an integrated program of wildland fire suppression and prescribed fire. The *Fire Management Plan* is being amended to include the management of naturally ignited wildland fires to accomplish specific, pre-stated resource management objectives in predefined geographic areas outlined in the *Fire Management Plan*. The NPS prescribed fire management program at Big Cypress is the largest in the national park system in terms of the amount of

burning accomplished — about 40,000 acres annually to reduce accumulated fuels in plant communities. This program has about 20 full-time employees. NPS fire management staff work closely with property owners in the area as well as the state's Division of Forestry because state restrictions often constrain fire operations.

Management-ignited fires (prescribed fires) have been used in the Addition to reduce hazardous fuel accumulations around property and in historically high arson areas, to improve pastures on grazing allotments, to maintain habitat for the Cape Sable seaside sparrow and red-cockaded woodpecker, to aid in the removal of exotic plants, and to research the effects of fire on prairie vegetation. Burning is also used to reduce the debris from demolished structures — but only at sites that are tolerant of prescribed burning. All prescribed fires are conducted in compliance with state and federal fire management regulations.

## WATER RESOURCES

### Hydrologic Cycle

The Big Cypress Swamp is a recognized physiographic province in southwestern Florida. It is a source of recharge for the shallow aquifers of south Florida and is important to the integrity of the water resources in the western part of Everglades National Park. The hydrological features of the swamp were recognized by Congress when it established Big Cypress National Preserve and the Addition.

The original Preserve is essentially a rain-driven hydrologic unit, and for the most part it is not dependent on adjacent land for water flow. However, the Addition is more prominently influenced by upstream inputs from external drainages (Map 11: Hydrology of the Addition).

Like the original Preserve, the Addition is flooded with a shallow sheet of surface water starting shortly after the onset of the rainy season (usually in June) and ending in the winter dry season after surface waters recede. Rainfall averages 54 inches per year, but it has ranged from 35 inches to 80 inches per year. Summer rains are usually short, intense, and frequent. Winter rains are a result of frontal systems, and they last longer and have less intensity. Tropical systems, including hurricanes, occur most frequently in September and October and can sometimes bring significant and torrential rainfall.

During the rainy season, shallow depressions fill with water. Because of the poor drainage, water stands on the land until it evaporates, infiltrates to the underlying aquifer, or slowly drains off through sloughs or strands. Thus, at the peak of the rainy season as much as 90% of the Addition is inundated to depths ranging from a few inches to more than 3 feet. When the dry season begins, the water level starts to recede. The recession normally continues into May, when perhaps only 10% of the Addition is covered by water in ponds, cypress domes, and sloughs. The water regimen of the area largely determines the patterns in which temperate and tropical vegetative communities and their related wildlife species occur.

### Surface Water Flows

The Addition lies 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.

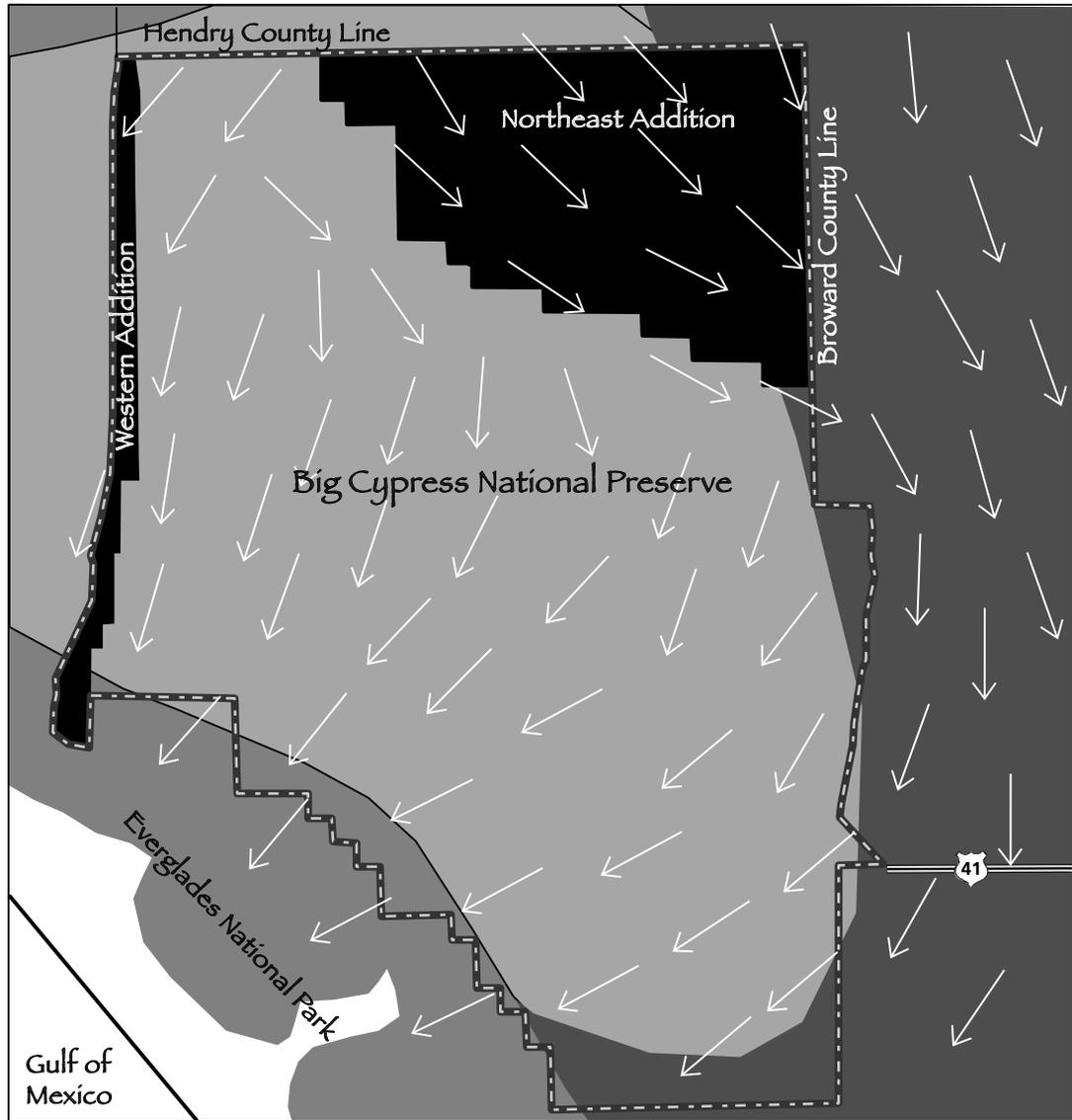
The Addition is exceptionally flat, with a typical gradient of only 5 to 10 inches per mile. Surface water hydrology of the Addition is typically characterized as a "sheetflow" flooding regime. During the wet season, the landscape becomes covered with a shallow,

continuous expanse of water that flows slowly toward the coast. Water movement is almost imperceptible in the interior of the original Preserve, where the terrain slopes an average of less than a foot per mile. However, flows are easily observable where the expanse of sheetflow is constricted to pass under a roadway or is channeled into a canal. Typically, marsh, prairie, and cypress areas will have water depths of 1 to 3 feet, while pinelands and hammock habitats will have little or no water.

After surface flows have ceased, water losses continue through evapotranspiration and groundwater seepage. The Addition typically has an almost full drydown condition during the late spring, before the onset of summer rainfall. During drydown condition, standing water is retained only in the deepest depressions and canals.

Flows tend to follow bedrock undulations, which are generally oriented in a northeast-southwesterly direction and range in relief from approximately 1 foot to as much as 10 feet. These low areas control surface water flows because the water table is below the crests of the undulations most of the time.

Surface flows in the Addition are influenced by upstream management practices and internal barriers to flow. Major physical alterations of the landscape and associated water management practices have greatly modified the volume, timing, distribution, and quality of surface water in south Florida. Since the 1880s, development was assisted by large-scale drainage of wetlands, canal and levee building, road construction, agriculture, residential and commercial development, and operation of pumps and flood gates. Today, many portions of the watershed are drier or wetter for longer periods than before such development and have poorer water quality related to agricultural and urban runoff.



0 5 10 Miles



## Legend

- Addition Lands
- Big Cypress Swamp
- Everglades
- General direction of surface-water flow

Map II

# Hydrology of the Addition

## Big Cypress National Preserve – Addition General Management Plan

United States Department of the Interior • National Park Service  
DSC • March 2009 • 176/20083



Investigators have documented that surface water in the Big Cypress vicinity preferentially flows in channels rather than in adjacent wetlands (Duever et al. 1981; Pernas et al. 1995). However, Duever et al. (1986a) also observed that topographic irregularities interrupted excessive drainage. Channelization is of particular concern at the southern boundary of the original Preserve and the Addition where fresh water and salt water mix and where changes in salinity can change the vegetation composition.

A recent review of historical water-level information by NPS staff showed an increase in the duration of surface water inundation in the 1990s relative to the two previous decades (Sobczak and Pernas 2000). It is thought that the wetter condition in the 1990s was caused by increased rainfall amounts, but upstream water releases, gate operations in adjacent areas, and features within the Preserve that block and channelize flow also contributed to the condition. Because the relatively dry conditions that prevailed in the 1970s and 1980s also were influenced by water management practices, there is uncertainty regarding future hydrologic conditions, both in terms of the weather patterns and the *Comprehensive Everglades Restoration Plan* (U.S. Army Corps of Engineers 1999).

Major physical and operational alterations that will directly impact the Addition during the next 50 years include removal of part or all of the L-28 canal and levee, partial modification of the L-28 tieback, alteration of flows at the northern boundary of the Addition, and changes in the operational rules for regulating flows in adjacent and upstream areas. As shown in Map 11: Hydrology of the Addition, the L-28 canal system is directly east of the Addition boundary and interrupts the generally northeast to southwest flow of water across the Addition. Water management practices from upstream citrus expansion may influence high-water conditions along the northeast portion of the Addition, but the extent of this impact (if any) is unclear.

### Surface Water Flows and ORV Use.

Flattened vegetation and tire tracks at roadside entry points are generally the extent of ORV effects seen by most observers. However, aerial views of the Addition show a vast network of ORV trails and travel corridors. This network of tire ruts and ridges could be influencing the volume, timing, and distribution of surface water flows.

The extent, occurrence, and severity of effects that off-road vehicles have had on surface water flows of the Addition are largely unknown. However, ORV ruts, which can be 2 or more feet deep, can channel water and potentially alter natural water flow patterns and timing. Two studies have documented greater water flow rates within ORV ruts than in adjacent undisturbed areas. Duever et al. (1981) found that over wet and dry seasons, water flows accelerated from two to four times in trails oriented parallel to the direction of water flows. Flows in some trails continued after water had ceased flowing in surrounding areas, possibly leading to a shortened natural hydroperiod in a localized area. Pernas et al. (1995) found that surface water flow always followed airboat trails, regardless of the trail orientation. Within the study area, these flow rates were accelerated approximately five times faster within the airboat trails than in adjacent undisturbed areas.

Duever et al. (1986a) hypothesized that trails that were extensively rutted and oriented parallel to flow could drain surface water from an adjacent wetland, particularly in low-lying areas. However, they also observed that topographic irregularities interrupted excessive drainage effects, so that impacts tended to be localized.

### Groundwater

The Addition is underlain by an extensive, shallow, surficial aquifer, which serves as the main source of fresh water in Collier County. The aquifer lies in a porous limestone

formation that is approximately 50-100 feet thick on the Addition's western boundary and generally diminishes in thickness to the east. Throughout much of the Addition, the limestone of this shallow, unconfined aquifer is within 10 feet of the surface. Groundwater travels relatively quickly through the formation and is 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). During the rainy season, groundwater levels are high. By April, the usual end of the dry season, water levels normally reach their annual lows.

### Water Quality

The water in Big Cypress is relatively unpolluted. The fresh surface waters of Big Cypress National Preserve are 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 it is intended to protect existing, high-quality waters. The Big Cypress Swamp is also designated as an Area of Critical State Concern by Florida state statute (Chapter 380.05). This designation provides the state's Division of Community Planning with oversight on local development projects and comprehensive planning within the designated area (Collier County).

Concentrations of nitrogen, phosphorus, total organic carbon, and persistent pesticides, which often serve as indicators of pollution, are generally similar to concentrations in nearby, relatively uninhabited areas, and concentrations are considerably less than those of nearby urbanized areas. Water quality changes occur seasonally and diurnally in Big Cypress and are related to the natural hydro-

logic and biologic regimes. The seasonal recession of water levels triggers physical, chemical, and biological changes in water quality. During low water, diurnal fluctuations in dissolved oxygen are greatest as a result of the high concentration of organisms in the remaining water. During the day plants produce excess oxygen by photosynthesis. At night dissolved oxygen decreases as photosynthesis ceases and respiration demands are met. Fish kills sometimes occur during periods of low dissolved oxygen; they have been observed in the spring in the Tamiami Canal about 10 miles west of Forty-Mile Bend, and often they spread both east and west for several miles.

The low-nutrient, high-quality water in the Addition 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 NPS development, operation of boats and vehicles within the original Preserve, and oil and gas leakage in the Preserve. Today, water quality in some locations is dramatically different than before 1900. Surface water entering the Addition 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).

The National Park Service established a long-term water monitoring program for measuring surface water stage and quality in the original Preserve in 1988. Water quality samples currently are collected every other month at 20 stations located throughout the original Preserve and the Addition. The objective of this water monitoring program is to provide a long-term record for assessing ambient water quality conditions and contamination threats. The South Florida Water Management District (SFWMD) maintains water-quality

monitoring programs in lands upstream and adjacent to the Addition. The most important parameters of interest for tracking long-term water quality conditions include total phosphorus, nitrate, sulfate, and pesticides.

**Water Quality and ORV Use.** The use of off-road vehicles in the original Preserve generates visible, localized turbidity in the upper portion of the water column. This effect is most pronounced in areas where ruts are deepest and vegetation has thinned. However, a study by Duever et al. (1986b) determined that the effects of ORV use on water quality were negligible, localized, and produced no threat to regional water quality. Localized impacts included hydroperiod alteration, temperature variation, introduction of sediment into the water, chemical pollution, and salinity changes. The turbidity that resulted from ORV operation was found to decrease sunlight penetration, thereby decreasing plant productivity.

According to Beardsley (1995), extensive vegetation impacts from ORV use may inhibit nutrient uptake, causing greater levels of nutrients to remain in the water. Beardsley also stated that loss of vegetation cover reduces water filtration and removes frictional forces that reduce retention of water in the wetland. In some cases, subtle modification to water quality can impact other biological, vegetative, and wildlife components of the environment, and the existence of many localized impacts can translate into regional-scale and long-term impacts if the processes that cause them occur regularly and are permanent. Regional water quality effects would be most likely during times of heavy ORV use and when ORV trails are heavily rutted and oriented in the direction of sheetflow.

Water quality is not a primary parameter used to evaluate ORV impacts because ORV impacts on waters tend to be localized and ephemeral. However, areas of high ORV use show persistent alteration of the local

vegetative community that is likely related to disturbance of soil structure and chemistry.

## Wetlands

The Addition has been mapped by the U.S. Fish and Wildlife Service (USFWS) as part of the *National Wetlands Inventory*. The majority of Addition lands are classified as wetlands; exceptions are scattered hardwood hammocks, some pinelands, and artificially filled areas. Twenty-seven different types of wetlands occur in the Addition, with the majority of them being seasonal wetlands. Cowardin classifications present in the Addition include periphyton communities, marshes, sloughs, prairies, open cypress domes, lakes, lake shorelines, and drainage canals/ditches. Most of the wetland area is seasonal, except for the lacustrine and riverine areas. The lacustrine, littoral, and riverine systems make up a much smaller area, but have more diverse classifications because many of these bodies of water and associated biological systems result from excavation of substrates.

## Floodplains

The southwestern corner of the original Preserve, including Ochopee, was mapped for floodplains by the Federal Emergency Management Agency (FEMA). This area is located along U.S. 41, east of the Western Addition. According to FEMA, the headquarters and residential area at Ochopee are within the 100-year floodplain. A 100-year storm or hurricane storm surge could flood the Ochopee area to a depth of 8 feet above mean sea level. There are no areas within the Preserve in the coastal high hazard area, and no areas are subject to flash flooding (NPS 1991). No additional data are available that are specific to the Addition.

### Estuarine Resources

The estuarine habitats of the Addition are concentrated in the coastal interface zone south of Everglades City. They are influenced by freshwater inflows and result in waters of mixed salinity that provide unique and highly productive wildlife habitat.

## WILDLIFE

### Protected Wildlife Species

A total of 30 animal species in the Addition receive some level of special protection or are recognized as rare species by the state of Florida or the federal government. Most of these species are limited to south Florida, and they are endangered as a result of habitat reduction caused by water management projects, urbanization, and agricultural expansion.

Nine of the 30 species mentioned above are listed as either federally endangered or threatened and reside in the preserve — 8 of those 9 are known to be present in the Addition. The state lists 14 species as species of special concern. Collectively, these species warrant attention because they have experienced long-term population declines and are vulnerable to exploitation or environmental changes. Table 13 displays the status of all 30 special status wildlife species that are known to occur in the Addition.

Descriptions of those federally listed species that will be analyzed in detail in “Chapter 4, Environmental Consequences” are provided below.

**Florida Panther.** The Florida panther (*Puma concolor coryi*) was listed as endangered under the federal Endangered Species Act in 1967. Critical habitat for the Florida panther has not been designated by the U.S. Fish and Wildlife Service. Lands in the Addition contain suitable habitat for the Florida panther.

Florida panthers once lived throughout most of the southeastern United States, but intensive hunting of these animals as a pest species and the conversion of wildlands to agriculture have severely reduced the population. Today, the only confirmed breeding population is in south Florida. The population is centered in and around Big Cypress, including Everglades National Park, Fakahatchee Strand Preserve State Park, the Florida Panther National Wildlife Refuge, and privately owned lands north of the preserve in Collier and Hendry counties. Panther populations have been steadily increasing in recent years. In 2000, the estimated population was 62 individuals, with a population density of one panther per 31,923 acres (112,919 hectares) (McBride 2000). In 2003 the population was estimated at 83 panthers (117 minus 21 mortalities) (FFWCC 2008). The 2008 population estimate was 84 panthers (104 minus 20 mortalities) (FFWCC 2008).

In general, panther population centers appear to indicate a preference toward large, remote tracts with adequate prey, cover, and reduced levels of human disturbance. A study conducted by Kautz et al. (2006) confirmed that forest patches comprised an important component of Florida panther habitat in south Florida. According to the Kautz study, the three most frequently used habitat types

TABLE 13: LISTED WILDLIFE SPECIES FOR BIG CYPRESS NATIONAL PRESERVE<sup>a</sup>

Common Name	Scientific Name	Designated Status <sup>b</sup>	
		Federal	State
<b>Mammals</b>			
Everglades mink	<i>Mustela vison evergladensis</i>		T
Florida panther	<i>Puma concolor coryi</i>	E	E
Mountain lion	<i>Puma concolor</i>		S/A
Big Cypress fox squirrel	<i>Sciurus niger avicennia</i>		T
West Indian manatee	<i>Trichechus manatus</i>	E	E
Florida black bear	<i>Ursus americanus floridanus</i>		T
<b>Birds</b>			
Cape Sable seaside sparrow	<i>Ammodramus maritimus mirabilis</i>	E	E
Limpkin	<i>Aramus guarauna</i>		SSC
White-crowned pigeon	<i>Columba leucocephala</i>		T
Little blue heron	<i>Egretta caerulea</i>		SSC
Reddish egret	<i>Egretta rufescens</i>		SSC
Snowy egret	<i>Egretta thula</i>		SSC
Tricolored heron	<i>Egretta tricolor</i>		SSC
White ibis	<i>Eudocimus albus</i>		SSC
Peregrine falcon	<i>Falco peregrinus</i>		E
Florida sandhill crane	<i>Grus canadensis pratensis</i>		T
American oystercatcher	<i>Haematopus palliatus</i>		SSC
Bald eagle	<i>Haliaeetus leucocephalus</i>		T
Wood stork	<i>Mycteria americana</i>	E	E
Osprey	<i>Pandion haliaetus</i>		SSC
Brown pelican	<i>Pelecanus occidentalis</i>		SSC
Red-cockaded woodpecker	<i>Picoides borealis</i>	E	SSC
Roseate spoonbill	<i>Platalea ajaja</i>		SSC
Black skimmer	<i>Rhynchops niger</i>		SSC
Everglades snail kite	<i>Rostrhamus sociabilis plumbeus</i>	E	E
Least tern	<i>Sterna antillarum</i>		T
<b>Reptiles</b>			
American alligator	<i>Alligator mississippiensis</i>	T(S/A)	SSC
American crocodile	<i>Crocodylus acutus</i>	E	E
Eastern indigo snake	<i>Drymarchon corais couperi</i>	T	T
<b>Mollusks</b>			
Florida tree snail	<i>Liguus fasciatus</i>		SSC

SOURCES: USFWS 2006; Florida Fish and Wildlife Conservation Commission 2006c; Florida Natural Areas Inventory 2006.

a Species in this table include those that have been documented in the Preserve; it does not include listed species for Collier County that are not present in the Preserve. Not all species listed in this table have been documented in the Addition.

b E = Endangered                      S/A = Similarity of appearance to a threatened or endangered species  
T = Threatened                      SSC= Species of special concern (no regulatory authority)

found within panther home ranges included upland hardwood forest, hardwood swamp, and pinelands, respectively. The hammocks are important foraging areas, and the pine flatwoods, with a dense understory, are important for denning and resting. Panthers prefer to move through vegetated areas, and rarely move through open areas except at night. It is important to maintain vegetated corridors between habitats to allow for panther movement.

Only preliminary data are available on Florida panther reproduction. Existing data indicate that breeding may occur throughout the year, with a peak during winter and spring, a gestation period of around 90 to 95 days, litter sizes of one to four kittens, and a breeding cycle of two years for females successfully raising young to dispersal, which occurs around 18 to 24 months (USFWS 2005d). According to NPS staff, dispersal of young in the Preserve typically occurs around 15 to 18 months. Most panther births occur between March and July, and the den sites are used for two months after birth.

The panther's preferred prey is white-tailed deer (*Odocoileus virginianus*). 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.

The Florida Panther Habitat Preservation Plan (Logan et al. 1993) identified about 926,000 acres of habitat considered essential to maintaining a minimum viable population of panthers in south Florida. About 582,000 of these acres are within Big Cypress National Preserve, representing approximately 63% of the essential habitat.

Radio-tracking data and surveys of panther sign (e.g., tracks, droppings, and other physical evidence) conducted by the National Park Service and the Florida Fish and Wildlife

Conservation Commission (FFWCC) indicate two population centers in the Big Cypress area. One includes the Fakahatchee Strand/northern Big Cypress swamp area (including the Deep Lake and Bear Island units of the original Preserve, the Addition lands, Fakahatchee Strand State Preserve, the Florida Panther National Wildlife Refuge, and private lands to the north), and the other center includes the eastern half of the original Preserve (including all or portions of the Corn Dance, Loop, and Stairsteps units). Evidence of panthers has been occasionally found in other areas of the original Preserve and the Addition, but these areas appear to be the most regularly inhabited.

The panther populations exist relatively close to each other, but there are some striking differences in the condition of the panthers. In 1985, panthers in the Bear Island unit and adjoining private lands north of I-75 were more abundant, heavier, and healthier than their counterparts south of I-75 (Roelke et al. 1985). In fact, one male panther weighed by researchers gained 20 pounds when he moved to the north side of I-75 from Fakahatchee Strand. From 1982 to 1985 panther sign declined noticeably in Fakahatchee Strand and the Corn Dance unit of the original Preserve, but sign did not decline in the Bear Island unit or on adjacent private lands. The condition of the current population is not well documented, but it is believed to be better than what it was in 1985. During the past 25 years, radio telemetry data on collared panthers indicates that 1–3 collared panthers have been using the Addition lands each year. These data represent collared panthers only, and it is fair to presume that more panthers than those with collars are using the area.

Recruitment — the number of young panthers surviving to adulthood — is also higher in the Bear Island area. Possible reasons for the better condition of panthers north of I-75 are that (1) the area may contain a better mix of vegetation types supporting deer, (2) that range management for cattle grazing in the

area may support more deer, and (3) that low hunting pressure on private lands may provide a refuge for both deer and panthers.

The automobile is the most frequent direct cause of panther deaths. Between 1981 and 1986 there were 12 documented panther deaths or injuries in south Florida, and half were road kills. Of these, four panthers were struck by cars on Florida 84 (now I-75) between mile-markers 16 and 18; one was hit on SR 29 near Copeland; and one was hit on U.S. 41 near Turner River Road. Because of the threat to panthers from automobiles, the state installed special underpasses while constructing I-75 across Big Cypress in order to provide for safer panther movements. Road kills are still frequent despite the mitigation measures that were put into place to avoid conflict with vehicles — in 2007, 14 panthers were killed in the first six months of the year (Schulze 2007). Fifteen panthers were killed on roads in 2007 (FFWCC 2008). Additionally, there were 10 highway mortalities in 2008 (FFWCC 2008). The number of panthers dying from disease or parasites is unknown. More recent data indicates that intra-specific aggression (panthers killing panthers) is also a factor in panther mortality rates.

In 1995, eight female mountain lions were released into the Florida panther population, including four introduced into the Big Cypress, to offset the negative effects of inbreeding documented in panthers. The mountain lion, therefore, is federally listed, based on its “similarity of appearance” to the panther.

Several government agencies and advisory groups are involved in panther management and research in south Florida and Big Cypress. Under the Endangered Species Act, the U.S. Fish and Wildlife Service (USFWS) has oversight responsibility to review the actions of other agencies in relation to federally protected species and to establish species recovery programs. The National Park Service has the primary responsibility for protecting

the Florida panther (as well as other listed species) on lands under its jurisdiction. The Florida Fish and Wildlife Conservation Commission is responsible for implementing the USFWS panther recovery plan, and the National Park Service and the commission cooperate for overall wildlife management in Big Cypress.

The survival and recovery of the Florida panther is dependent on : (1) protection and enhancement of the extant population, associated habitats, and prey resources; (2) improving genetic health and population viability; and (3) reestablishment of at least two additional populations within the panther’s historic range (USFWS 1999). Accordingly, the agencies involved in panther management in south Florida have agreed that implementing the following management actions will improve panther recruitment:

- Reduce hunting pressure on panther prey species, especially deer and hogs.
- Improve habitat by using prescribed burns and habitat manipulation to increase deer browse.
- Regulate ORV use and other human activities more closely because of potential disturbance to panther habitat.
- Consider reintroducing panthers bred in captivity or translocating other Florida panthers to improve the genetic viability of the wild population.
- Continue and expand research on panther distribution, behavior, and health and on prey species status.

These actions are consistent with the “Florida Panther Revised Recovery Plan” (USFWS 1987a). In 2008 the panther recovery plan was updated and released by the U.S. Fish and Wildlife Service.

As mentioned earlier, both the National Park Service and the Florida Fish and Wildlife Conservation Commission are involved in panther research in Big Cypress. NPS efforts

have concentrated on the distribution of panthers on NPS lands in the original Preserve south of I-75 and east of SR 29 and in Everglades National Park. The panther recovery program, under the auspices of the game commission and supported by the U.S. Fish and Wildlife Service, has focused on panther home ranges and movement patterns, physical condition and health, and breeding in captivity. In addition, the game commission has also been involved in studies of the condition and health of deer in Big Cypress as the panthers' main prey.

The Florida Fish and Wildlife Conservation Commission and the National Park Service have taken steps to reduce hunting pressure in Big Cypress and to enforce speed limits to reduce panther road kills. Hunting regulations have since been implemented, partially out of concern for panther protection. Several FFWCC commission enforcement personnel have been trained in the use of radar equipment and have been involved in speed limit enforcement on I-75 and U.S. 41.

The discovery of mercury contamination in some Florida panthers is a relatively new concern. In 1989 a dead panther was found in the East Everglades. A tissue analysis revealed that the dead animal had extremely high levels of mercury and may have died from mercury poisoning. Further blood and tissue analysis of live Florida panthers, as well as fish and raccoons in the region, showed a pattern of elevated mercury contamination. Release of mercury from organic soils into surface waters is the apparent source of the toxins. Mercury bioaccumulates through the aquatic food chain into fish and then raccoons. All panthers with higher mercury levels primarily preyed on raccoons, rather than deer or hogs, which were scarcer in the panthers' home range. As a result of these studies, the Florida Panther Interagency Committee recommends that agencies manage habitat and public use to increase deer and, where appropriate, hogs or other non-contaminated prey. The intent is to shift panther predation away from contaminated

prey species (Florida Panther Interagency Committee 1989).

Panthers are typically shy, secretive animals that normally avoid human interaction. Interactions with humans can affect panther behavior. A study was conducted between 1994 and 1998 by Janis and Clark to study the effects of hunting on panthers (*The Effects of Recreational Deer and Hog Hunting on the Behavior of Florida Panthers*, 1999). It centered on the panther population north of I-75, including the Bear Island Unit in the original Preserve. The U.S. Fish and Wildlife Service's "Biological Opinion" for the 2000 *Final Recreational ORV Management Plan* states the following on page 562 of the plan:

Janis and Clark (1999) surmise that the increase in the distance of panther locations from trails is "biologically minor" and probably related to prey behavior; i.e. white-tailed deer moving deeper into the forest to avoid ORV users. The decrease in panther use of the Bear Island Unit is balanced by an increase in use of private lands north of BICY [Big Cypress National Preserve] as "refugia." The authors assert that this pattern would be of serious concern if panther habitat on private lands were lost.

**West Indian Manatee.** The West Indian manatee (*Trichechus manatus*) was listed as federally endangered under the Endangered Species Act in 1967. Critical habitat for the West Indian manatee was designated by the U.S. Fish and Wildlife Service in 1976 (41 FR 41914), and corrected and augmented in 1977 (42 FR 47840-47845). As published in the *Federal Register* (50 CFR Part 17.95), critical habitat, as it applies to the Addition, is defined as

*all U.S territorial waters adjoining the coast and islands and all connected bays, estuaries, and rivers from Gordon's Pass, near Naples, Collier County, southward to and including Whitewater Bay, Monroe County.*

No specific primary or secondary constituent elements were included in the designation. Critical habitat for the manatee identifies specific areas occupied by the manatee that have those physical or biological features that are essential to the conservation of the manatee and/or may require special management considerations.

Interpretations of the critical habitat criteria contained in the *Federal Register* have led biologists to conclude that critical habitat in Big Cypress National Preserve is generally limited to open water creeks, canals, and estuarine areas south of U.S. 41. Within the Addition, critical habitat includes near-shore mangrove estuaries and creeks, as well as the canals along U.S. 41 and SR 29. Occupied critical habitat in the SR 29 canal (aka Barron River Canal) extends to the north beyond U.S. 41 as far as the first water control structure.

The West Indian manatee is one of the largest coastal mammals in North America. The West Indian manatee is an aquatic mammal with grey to grey-brown, thick, tough skin that is sparsely covered with small, thick hairs and is sometimes covered with barnacles and algae. The rounded body of the manatee has no hind limbs, but it has paddle-like forelimbs or flippers with three to four nails present on the dorsal surface of each flipper. The body tapers to a flattened tail.

This unusual marine mammal with its massive, seal-like body has been able to adapt well to its marine environment. Exact estimates of the historic manatee population are uncertain, but overhunting during the 1700s to 1900s is believed to be responsible for reducing the manatee population to only a few relict groups (Hartman 1979). Manatees migrate seasonally to adapt to changing water temperatures. West Indian manatees roam in fresh, brackish, and marine waters throughout Florida, the Greater Antilles, Central America, and South America. Waters colder than 20 degrees Celsius increase the manatees' susceptibility to coldstress and cold-induced mortality.

Because of this temperature restriction, manatees seek out warm water refuges to help reduce energetic maintenance costs. The West Indian manatee is one of the most endangered marine mammals in coastal waters of the United States.

The manatee occurs throughout the southeastern United States. The only year-round populations of manatees occur throughout the coastal and inland waterways of peninsular Florida and Georgia (Hartman 1974). During the summer, manatees may range as far north along the East Coast of the U.S. as Rhode Island, west to Texas, and, rarely, east to the Bahamas (USFWS 1996, Lefebvre et al. 1989). There are reports of occasional manatee sightings from Louisiana, southeastern Texas, and the Rio Grande River mouth (Gunter 1941, Lowery 1974).

Manatees frequently migrate throughout the waterways in South Florida. The South Florida Ecosystem region is home to the most resident manatee populations and transient migrants in Florida. In South Florida, manatees are most prominent year-round in the following areas: Indian River, Biscayne Bay, Everglades and Ten Thousand Island area, Estero Bay and Caloosahatchee River area, and Charlotte Harbor area. Some of the largest winter aggregations (50 or more manatees) occur in south and central Florida (USFWS 1996). See Map 12: West Indian Manatee Habitat, Western Addition.

Manatees occur in both fresh- and saltwater habitats within tropical and subtropical regions. They depend on areas with access to natural springs or manmade warm water refugia and access to areas with vascular plants and freshwater sources (Humphrey 1992). Several factors contribute to the distribution of manatees in Florida. Between October and April, Florida manatees concentrate in areas of warmer water. When water temperatures drop below 21 to 22 degrees Celsius, they migrate to South Florida or form large aggregations in natural springs

and industrial outfalls. Severe cold fronts have been known to kill manatees when the animals did not have access to warm water refuges.

During warmer months they appear to choose areas based on food supply, water depth, and proximity to fresh water. Manatees may not need fresh water, but they are frequently observed drinking fresh water from sewage outfalls and culverts.

The manatee occupies a prominent position in 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%–9% of its body weight (44 to 99 pounds or 20 to 45 kilograms /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 (4 feet 11 inches to usually less than 19 feet 8 inches or 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).

Although there are no accurate estimates of manatee population size, the state Department of Environmental Protection aerial surveys determined that there were at least 2,639 manatees in Florida's waters in 1996, and a minimum of 1,709 in 1997. The synoptic (general) aerial survey for 2007 reported 2,817 manatees in Florida waters, and 3,807 manatees in 2009 (Fish and Wildlife Research Institute 2009). Although this has been the highest estimate of manatees since the surveys were started, the results of these surveys may vary because of such factors as sampling methodology, manatee behavior, and weather conditions.

The National Park Service, U.S. Fish and Wildlife Service, and the U.S. Geologic Survey are collaborators in manatee research and management in the Big Cypress. Winter aerial surveys have been conducted during the past five years; however they have not been systematic surveys. Aerial surveys have not been very successful in observing manatees in the mangrove area between the Preserve headquarters and Everglades City. However, surveys are conducted in the canals near NPS headquarters and Wooten's Airboat Tours in Ochopee. Everglades National Park and the U.S. Fish and Wildlife Service have also counted manatees in the Addition between headquarters and Everglades City during their surveys. These data confirm that the SR 29 strip of the Addition is used by manatees.

Human activities have significantly affected manatees by eliminating or modifying suitable habitat, altering migratory access routes, increasing mortality, and decreasing abundance, all of which can affect manatee reproduction, recruitment, distribution, and behavior. The greatest current threat to manatees is the high rate of manatee mortalities caused by watercraft or propeller collisions. In addition to direct collisions with boats, secondary effects from boating activity include such stresses as disruption of normal breeding behavior, disruption of cow-calf bonding, interference with migration routes and patterns, and the loss of feeding areas. The second most significant threat to manatees is the loss and degradation of habitat, due primarily to direct damage by aquatic recreational and commercial boating activity, coastal construction, and pollution from sewage discharge and stormwater runoff (Marine Mammal Commission 1992, Smith 1993). Other human-related threats include manatee death or injury from flood-control structures and navigational locks, entanglement in fishing line, entrapment in culverts, and poaching. These other threats accounted for 162 known mortalities between 1974 and 1993.

Map 12

# West Indian Manatee Habitat

## Western Addition Big Cypress National Preserve General Management Plan

National Park Service  
United States Department of the Interior  
DSC • February 2009 • 176/20084

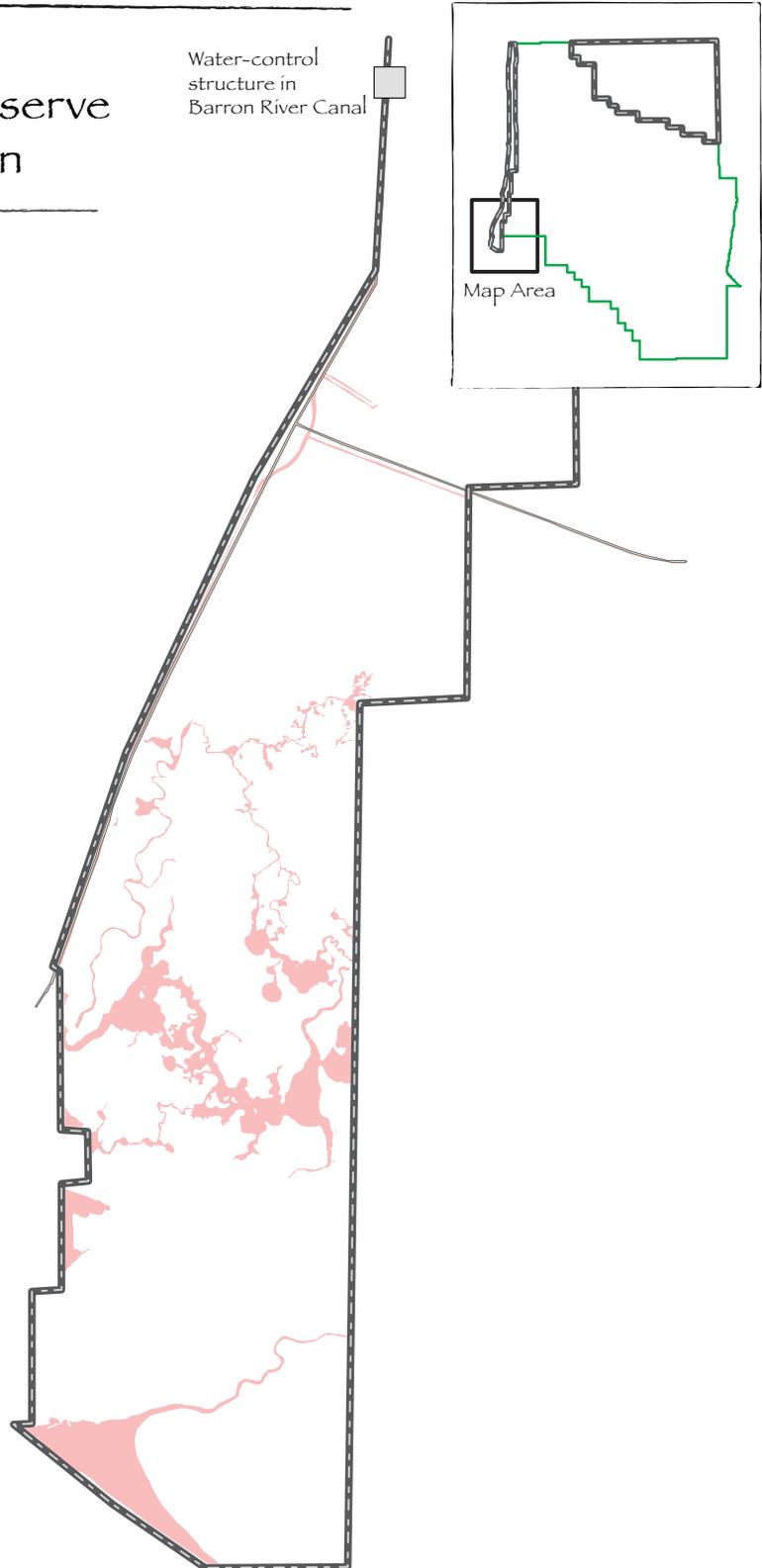
### Legend

-  Addition Boundary
-  Addition Manatee Habitat

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The U.S. Fish and Wildlife Service's recovery plan for the manatee established four objectives: (1) identify and minimize causes of manatee disturbance, injury, and mortality, (2) protect essential manatee habitat, (3) determine and monitor the status of manatee populations and essential habitat, and (4) coordinate recovery activities, monitor and evaluate progress, and update and/or revise the recovery plan (USFWS 1996).

**Red-cockaded Woodpecker.** The red-cockaded woodpecker (*Picoides borealis*) was listed as federally endangered under the Endangered Species Act in 1970. Critical habitat for the red-cockaded woodpecker has not been designated by the U.S. Fish and Wildlife Service. Lands in the Addition contain suitable habitat for the red-cockaded woodpecker.

The red-cockaded woodpecker is one of 22 species of woodpeckers native to North America. Adult red-cockaded woodpeckers are approximately 7 to 8 inches (18 to 20 centimeters) in length and have a wingspan that ranges between 1 foot 1 inch to 1 foot 3 inches (35 to 38 centimeters). The red-cockaded woodpecker is easily distinguished by its large, conspicuous white cheek patches, black cap and neck, and black-and-white barred back and wings (Jackson 1994).

The red-cockaded woodpecker's historic range encompassed the southeastern U.S. from eastern Texas and Oklahoma to New Jersey, and the bird was characterized as abundant in 19th-century literature. Throughout the 20th century, however, the species distribution within its historic range has become fragmented, and its total population numbers have decreased drastically due to the destruction of its habitat. The woodpecker is still widely distributed in the southeastern United States, but the few remaining colonies (a particular group of woodpeckers that use a set of cavity trees) are confined to scattered refuges.

The population in the Preserve is the southernmost and perhaps the largest in south Florida (NPS, 1981). The red-cockaded woodpecker can only survive in mature pine stands, usually 60 years old or more, that are infected with red-heart disease, a fungus that weakens the interior "heartwood" of a pine. This allows the birds to excavate cavities for roosting and nesting. The red-cockaded woodpecker typically nests between April and August in tree cavities located 20 to 50 feet above the ground. In the Preserve, nesting is usually over by mid-June (Schulze 2007).

The pine trees must be widely spaced and preferably have an open understory. Such stands are uneconomical from a forest products perspective, and most mature pinelands in the Southeast have been converted to plantations of young pines for the pulp and lumber industries, thus removing most woodpecker habitat (Lennartz et al. 1983) and causing population decline.

Beyond direct removal of mature pinelands, the woodpecker may also decline if remaining mature pinelands are not properly managed. The open understory is commonly maintained by periodic fire. However, if fires are too frequent, then the pine reproduction necessary to perpetuate the stand may be suppressed; if fires are not frequent enough, the understory may become too dense to maintain the colony, or the fuel build-up may cause an intense fire that could destroy cavity trees (NPS 1981).

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. In prime habitat the forage area for the red-cockaded woodpecker surrounds the colony and consists of pine forests. But in Big Cypress, where pine forests are patchy, the forage area is large and includes prairies, swamps, and other vegetation

communities. Recent studies show that forage areas in south Florida average more than 360 acres rather than 200 acres typical for most of the woodpecker's range (Nesbitt et al. 1983).

The red-cockaded woodpecker appears to be fairly tolerant of human activities as long as the colony is maintained. For instance, several active colonies in the original Preserve are near ORV trails, oil pads, and backcountry camps. There appears to be a limit, however, on the amount or types of activities that woodpeckers will tolerate; in other parts of the South, nesting failures have been attributed to noise from loud radio music and house construction, continuous chainsaw operation, and heavy interstate traffic (Jackson 1983).

In the 1990s there were 30–40 active red-cockaded woodpecker colonies in the original Preserve (NPS 1990c, NPS 2000). Currently, there are between 70 and 80 active colonies (Schulze 2007). A sample of the known colony sites is monitored each year during the breeding season by NPS staff to determine the status of the colonies.

There are no known colonies in the Addition, although red-cockaded woodpeckers have historically colonized the Addition. There are a few colonies near the southern boundary of the northeast Addition. The habitat in the Addition, especially in the Northeast Addition, is suitable for woodpeckers. Recent management activities in this area have improved the quality of woodpecker habitat. These areas could be recolonized by the red-cockaded woodpecker in the future.

Management of the red-cockaded woodpecker in the original Preserve currently consists of prescribed burning, or allowing prescribed natural fire in mature pine stands known to support colonies, and restricting oil and gas activity to avoid disturbing these colonies. NPS staff from the Resource Management and Fire programs meet annually to determine prescribed fire needs. Oil and gas activity is prohibited near a colony to provide an undisturbed forage area around the colony.

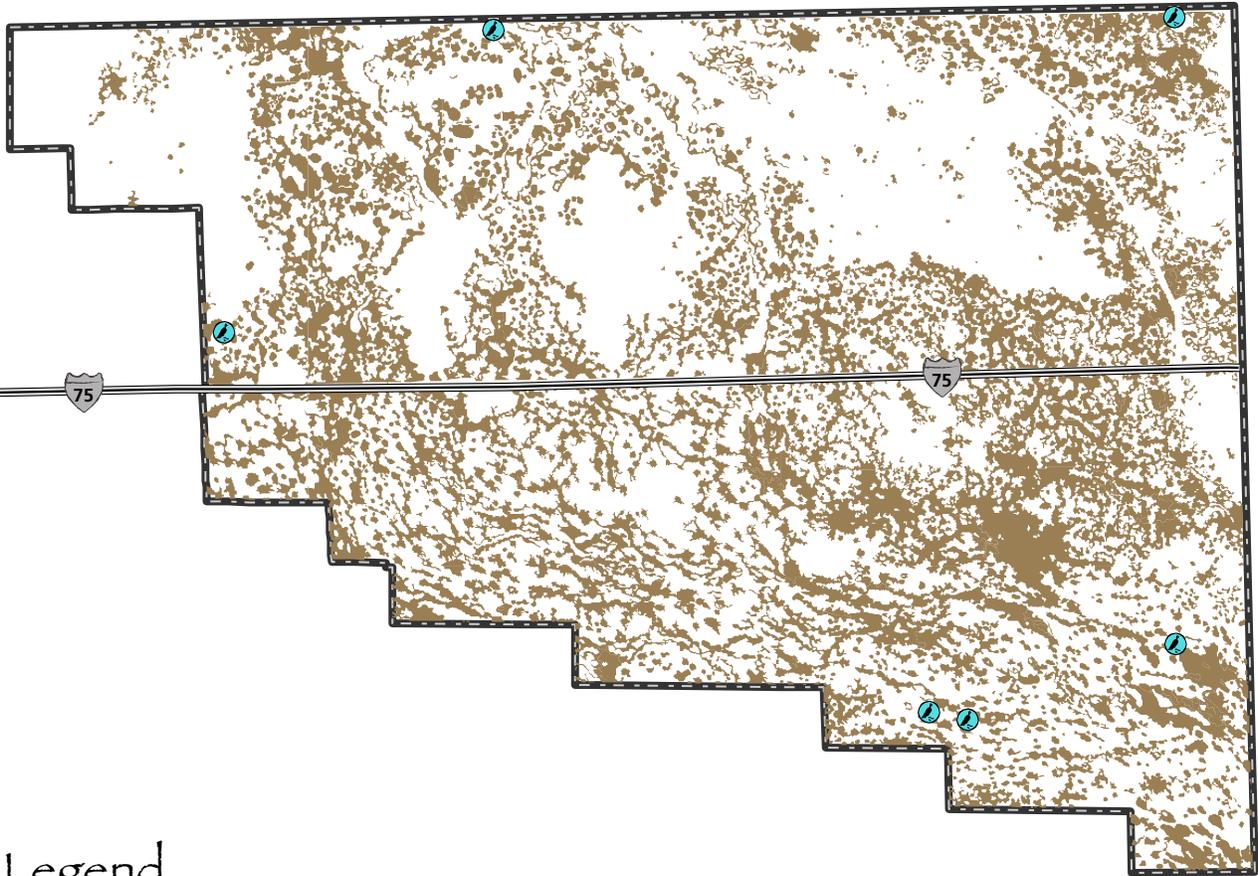
Management actions for this species within the Preserve include mechanical removal of fuel loads under cavity trees and reduction in midstory vegetation through prescribed fire. Annual work includes determining cluster status, observing nesting activity, making nesting cavities in trees, and banding nestlings.

Habitat fragmentation and/or loss are the primary threats to this species. Other range-wide threats to the red-cockaded woodpecker include cluster abandonment due to encroachment of mid-story vegetation. Genetic isolation may be a problem with the woodpecker throughout its range. Even though genetic problems have not been documented within the Preserve, the widely scattered habitat may preclude adequate genetic mixing. Environmental events such as wildfires, hurricanes, and inundation by water for extended periods have also affected pinelands that host woodpeckers.

There has been no documentation of the loss of trees used by the red-cockaded woodpecker due to compaction or injury along ORV trails. Abandonment of clusters due to disturbance by off-road vehicles also has not been observed.

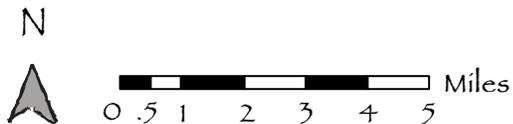
**Wood Stork.** The wood stork (*Mycteria americana*) was listed as federally endangered under the Endangered Species Act in 1984. Critical habitat for the wood stork has not been designated by the U.S. Fish and Wildlife Service. Lands within the Addition contain potential rookery habitat for the wood stork (Maps 13 and 14: Potential Wood Stork Rookery Habitat, Northeast and Western Addition). A large portion of the northeastern portion of the Addition contains the habitat parameters required to support nesting.

The wood stork is a large, long-legged wading bird, with a body length (head to tail) of 2 feet 9 inches to 3 feet 3 inches (85 to 115 centimeters) and a wingspan of 4 feet 11 inches to 5 feet 5 inches (150 to 165 centimeters). Their plumage is white, except for iridescent black



## Legend

-  Addition Boundary
-  Cypress Strands and Domes
-  Known Rookeries



Map 13

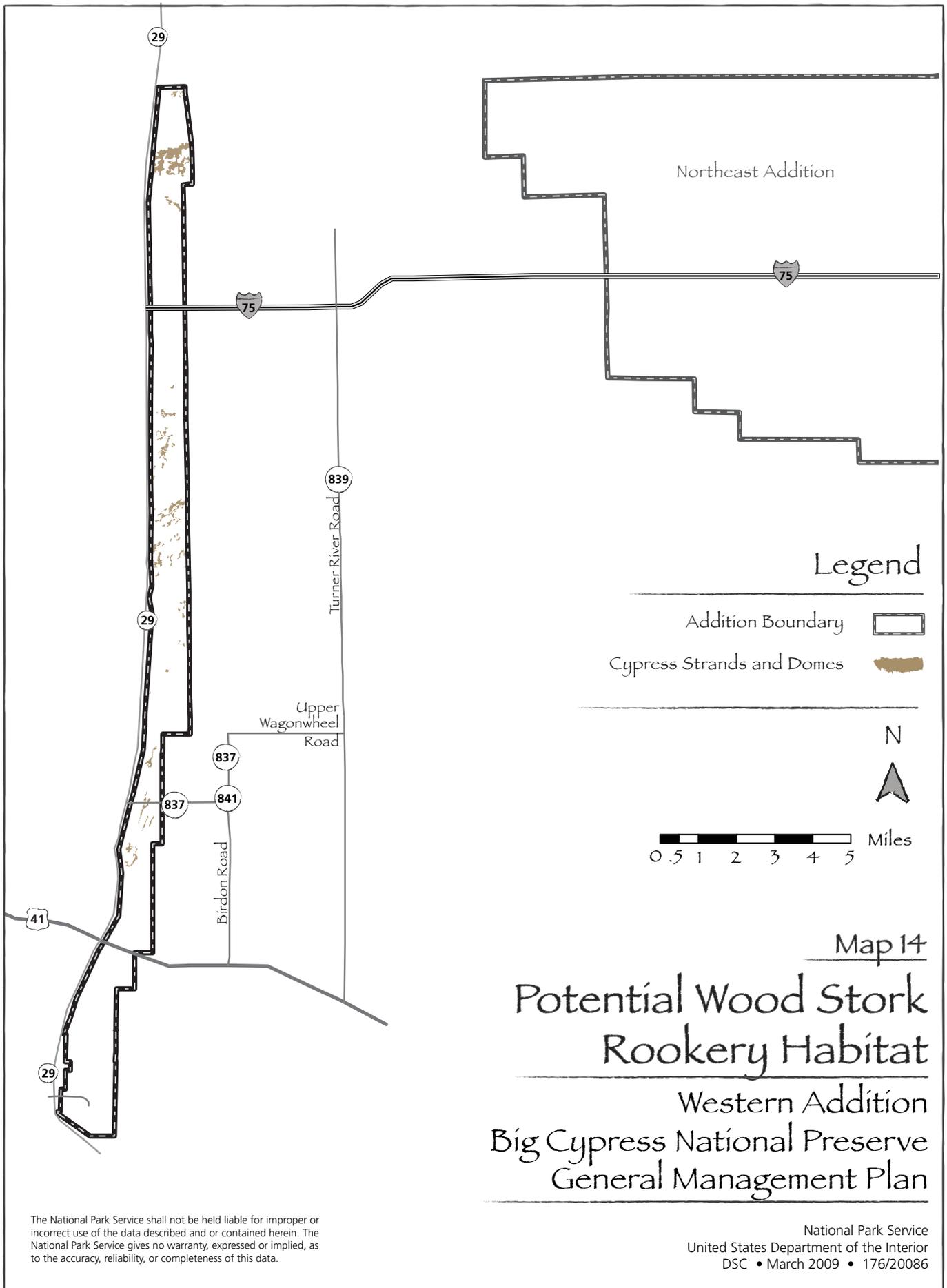
# Potential Wood Stork Rookery Habitat

Northeast Addition  
Big Cypress National Preserve  
General Management Plan

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primary and secondary feathers and a short black tail. On adult wood storks, the rough scaly skin of the head and neck is unfeathered and blackish in color. Their legs are dark with dull pink toes. The bill color is blackish.

Wood storks are birds of fresh water and brackish wetlands, primarily nesting in cypress or mangrove swamps. In the United States, wood storks historically nested in all coastal states between Texas and South Carolina (Wayne 1910, Bent 1926, Howell 1932, Oberholser 1938, Dusi and Dusi 1968, Cone and Hall 1970, Oberholser and Kincaid 1974). Currently, wood storks breed in Florida, Georgia, and coastal South Carolina. Wood storks usually construct their nests in medium to tall trees that are usually standing in water or in trees that are on dry land if the land is a small island surrounded by water. Their nests are large rigid structures usually found in the forks of large branches or limbs. Storks may add guano to the nest to stabilize the twigs (Rodgers et al. 1988). The nest may be constructed in branches that are only 3 feet 3+ inches (a meter) above the water or in the tops of tall trees.

The nesting season of wood storks varies geographically, but in Florida egg laying begins in October, and fledging of young birds occurs in February or March. The U.S. 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. According to the *South Florida Multi-Species Recovery Plan*, under pre-drainage conditions wood storks formed colonies between November and January (December in most years regardless of annual rainfall and water level conditions). In response to deteriorating habitat conditions in South Florida, wood storks in the Everglades and Big Cypress basins have

delayed the initiation of nesting to February or March in most years since the 1970s. This shift in timing is believed to be responsible for the increased frequency of nest failures and colony abandonment.

Wood storks feed in freshwater marshes, narrow tidal creeks, or flooded tidal pools, primarily on fish between 7.8 inches and 9.8 inches (2 and 25 centimeters) in length. Particularly attractive feeding sites are depressions in marshes or swamps where fish become concentrated during periods of falling water levels. Feeding areas in south Florida have decreased by about 35% since 1900 because of human alteration of wetlands. Additionally, levees, canals, and floodgates have greatly changed natural water regimes in south Florida.

The wood stork forages annually in Big Cypress when water levels provide concentrations of fish. Documented nesting in the Big Cypress was rare until 1996 when 45 colonies were reported (Jansen and Brooks 1996). The previous two consecutive years of high water and subsequent buildup of the prey base apparently provided ideal conditions in which to raise young. Wood stork nests have been found only sporadically in the Big Cypress since 1996. Observations since that time have not been systematic and have generally been conducted in conjunction with overflights and aerial surveys for the Florida panther. Historic wood stork nest sites have been randomly surveyed by NPS staff during the last 10 years, with no documented reoccupation of nest sites occurring in the Addition.

Preservation and/or restoration of natural hydrologic processes is critical to the survival of the wood stork, as it depends on open water to support its nesting, roosting, and foraging sites.

## Major Game Species

Of the 13 game species in Big Cypress, white-tailed deer, wild turkey, and European feral hogs require special management consideration because of their importance to both recreational hunters and the endangered Florida panther. Hunting is currently prohibited in the Addition; however, it is anticipated that hunting will be permitted once the *General Management Plan* is completed and approved. Addition lands are expected to become part of the adjacent Big Cypress State Wildlife Management Area. As in the original Preserve, hunting will be regulated according to the requirements, seasons, and bag limits established by the Florida Fish and Wildlife Conservation Commission. NPS staff would manage the hunts in the Addition, with assistance from the commission, and both NPS and commission staff will have the ability to enforce state hunting regulations. The current status of these three game species and their habitat is described below.

**White-tailed Deer.** The white-tailed deer (*Odocoileus virginianus*) is the most important game species in the Preserve and the Addition. In addition to being a popular large game animal, white-tailed deer are a prey species for the endangered Florida panther. The 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 exotic plants such as melaleuca, would likely affect deer populations, and, consequently, the panther population.

Generally, deer browse in south Florida is poor because of low fertility and low palatability (Florida Game and Fresh Water Fish Commission [FGFWFC], 1959). In the later stages of plant succession woody plants and graminoids, which tend to be high in lignin and low in nutrition, occupy a site. Consequently, deer browse declines as the vegetation

matures. The best deer browse occurs after disturbances that encourage new growth, because young shoots are relatively high in nutritional value and much more palatable. Recent fires in the Addition will likely improve deer browse and habitat in the near-term.

Although areas within the Preserve and the Addition host resident Florida panthers, the effect of panther predation on deer herds is unknown. McBride (1985) suggests a comparison with western cougar predation on mule deer.

Ackerman (1982) found that a cougar in Utah killed a mule deer about every 9.5 days, which equates to 39 mule deer per year per cougar. Although it is difficult to directly compare kill rates by cougars in Utah with Florida panthers, the scale of predation (e.g., tens of deer per year per panther) may be appropriate where deer are abundant. If this level of predation on deer is a valid assumption, then Florida panthers and hunters may be competing for the same deer. Studies of Florida panther stomach and fecal contents show wild hogs, rabbits, armadillos, and other small game are also preyed upon, but it is not clear if these prey are preferred or if panthers are forced to prey on smaller game because deer are lacking. If deer are the preferred prey, then predation probably exerts a significant influence on the deer population.

The Florida Fish and Wildlife Conservation Commission began collecting data on the deer herd in the original Preserve in 1984 to estimate the population size and assess the health and condition of the deer. Since the 1991 *General Management Plan* was completed, the deer population in many areas of the original Preserve has increased. Factors influencing this increase include area closures, favorable environmental

conditions, and changes in hunting regulations. Data collected from aerial surveys and counts have limitations and do not allow for accurate estimates of herd size.

Legal hunting does not seem to be a threat to deer populations in the Preserve, but the cumulative effect of legal and illegal hunting and of panther predation is unclear. The U.S. Fish and Wildlife Service expressed concern in the early 1990s that even legal hunting may be adversely affecting the panther through disturbance.

Annual surveys of white-tailed deer in the Addition have been conducted by the Florida Fish and Wildlife Conservation Commission since 2005 to gather baseline data that can be used to make hunting management decisions for the Addition once it is opened to public hunting. The surveys measure the abundance and distribution of white-tailed deer in the Addition. Two types of surveys were conducted in 2006: aerial surveys for recruitment data and land cruise surveys (night and morning) for population estimation. In general, deer observations were highest north of I-75. The survey results were highly variable, but in general habitat for white-tailed deer is considered to be of higher quality north of I-75 (Mihalco 2007). In 2008 the deer herd in the Northeast Addition north and south of I-75 was estimated to be 133 and 54, respectively (Joe Bozzo, District Biologist with the Big Cypress Field Office of the Florida Fish and Wildlife Conservation Commission, pers. comm. 12/10/08). Typically, up to 33% of the game population can be harvested annually and remain sustainable.

**Wild Turkey.** Wild turkeys are an important prey resource for the Florida panther and are one of the principal

game animals for hunting in the area. Wild turkeys are common in the region. Turkey density tends to fluctuate widely from year to year due to environmental conditions (Powell 1965, Frye 1954). Turkey poult mortality is very high if heavy rains occur during April or May when young birds are susceptible to disease and drowning, but populations usually bounce back if conditions are favorable during the next breeding season (Powell 1965).

Turkey surveys in the Addition were initiated in 2006 by the Florida Fish and Wildlife Conservation Commission to gather baseline data that can be used to make hunting management decisions for the Addition. Eight sites (all of them north of I-75) were surveyed using digital remote cameras. Habitat north of I-75 is considered to be better than that in the south, supporting a greater number of turkeys. Approximately 230,000 acres were sampled with the placement of the eight cameras. A total of 518 turkeys were documented at four of the eight sites. Statistically, this yields a minimum population estimate of 14 birds (two adult gobblers, three juvenile gobblers, and nine hens) (FFWCC 2006).

**Feral Hogs.** Feral hogs (*Sus scrofa*) are second to deer in importance as game animals. European feral hogs were first introduced to Florida by Spanish explorers in the 16<sup>th</sup> century. In more recent years feral hogs have been managed by the state as a game animal and have been stocked in many areas of south Florida, including Big Cypress as late as 1975, to improve hunting. Illegal stocking of feral hogs in Big Cypress may also occur.

Mast-producing hardwood hammocks are probably the preferred habitat for hogs, followed by pinelands (because of

their short hydroperiod), and during the dry season mixed-hardwood swamps (Schortemeyer et al. 1985). Belden et al. (1985) found that hogs tend to move into wetter vegetation types as the dry season progresses. As with deer, cypress prairies and prairies are probably the least productive vegetation for hogs (Schortemeyer, pers. comm. 1986).

Wild hogs are known for their ability to rapidly reproduce. The U.S. Fish and Wildlife Service reports that in the Merritt Island National Wildlife Refuge near Cape Canaveral, hogs may produce 1.5 litters per year, with an average of 2.3 piglets at weaning (Hight, personal communication 1986). These numbers could be higher for subtropical south Florida; however, the summer wet season may be a limiting factor for hog populations. Schortemeyer has observed hogs freely moving through 1 foot of water or less, but when water is deeper than 16 inches, their movement appears to be greatly restricted, confining the animals to higher ground and limiting available space and food (Schortemeyer et al. 1985). Conversely, a prolonged winter drought appears to reduce hog reproduction and increase hog movements and may cause direct mortality through dehydration (Schortemeyer, personal communication 1986). Given these limits, the hog population in the Big Cypress may be constrained from large or rapid increases by environmental conditions. Data in the 1991 *General Management Plan* indicated that feral hog populations are very susceptible to hunting pressure.

In addition to being a popular game animal, feral hogs are a prey species for Florida panthers. An analysis of panther feces collected in the preserve showed that 15% of the samples contained hog remains (FGFWFC, Belden 1984). The report cautioned, however, that the

sample may have contained both panther and bobcat scats, which would probably lower the importance of hog remains in the analysis.

Some concerns have been raised about the impact of hogs as an exotic species on natural and cultural resources in the preserve. Hogs are known to uproot extensive areas in hardwood hammocks, and this activity could pose a threat to native plants, *Liguus* tree snail eggs, and archeological resources. Rooting could encourage exotic plants by providing disturbed areas necessary for establishment. However, it has also been suggested that rooting exposes grubs and other foods for turkey, quail, and additional native wildlife and encourages browse plants for deer. Rooting also occurs during the dry season in marshes.

Other hog-related problems include diseases carried by hogs, possible competition between hogs and native wildlife, possible adverse effects on wild turkey nesting, and competition with deer for the annual mast crop (under-water shoots on trees) (Beckwith 1965); however, negative impacts from competition have not been quantified or confirmed. Hogs are known to be carriers of brucellosis, a disease that infects humans and could infect the Florida panther.

The current population of feral hogs in the area has declined in recent years and is currently very low. Data from the 2006 hunt conducted in the original Preserve indicated only four animals were taken by hunters, one during muzzle loading season and three during archery season. The reason(s) why hog numbers are so low is not well understood; however, it is suspected that increased hunting pressure by panthers may be a factor.

## Exotic and Nonnative Wildlife Species

Exotic species impact natural systems through unchecked predation. In many cases, exotic wildlife have no natural predators and can displace native species through competition. More than 100 exotic animal species have been introduced into south Florida (Duever et al. 1986a). Sixty of these are believed to be breeding populations. At least 22 exotic species have been collected in the Preserve, 18 of which are known to be breeding populations. European feral hogs have probably the greatest impact of any exotics on native species. Other exotic mammals have limited distribution in the Addition, and apparently none has a significant influence on native species. Other important exotics include the armadillo, several fish (walking catfish, black acara, spotted tilapia, and oscar), several insects (fire ants and lovebugs), and snakes.

The increasing number of exotic snakes found in south Florida has been causing concern to biologists. Five Burmese pythons were discovered in Big Cypress in 2006, up from three in 2005 (*Naples Daily News* 2007). The Burmese python is native to India and southeast Asia and has flourished in the subtropical climate of South Florida.

In nearby Everglades National Park, more than 624 southeast Asian snakes have been found since 2000. In 2006 and 2007, more than 418 snakes were captured and/or removed from the Everglades. Populations of exotic snakes are known to be increasing in south Florida in recent years.

## Completed and Ongoing Studies and Inventories Related to Natural Resources

The following studies/plans, some of which were done for the original Preserve, may be relevant to the Addition.

- trail stabilization — The National Park Service has gained knowledge about trail stabilization techniques through experience and experimentation that would negate the need to conduct a research project/study (as recommended in the 2000 ORV plan) to answer questions about how to best stabilize trails. Field tests conducted on Concho Billie, Oasis, and Monument Trails have demonstrated successful treatments.
- topographic mapping — Some mapping of the original Preserve has been completed via *Comprehensive Everglades Restoration Plan* efforts.
- an inventory of reptiles and amphibians — This inventory has been completed.
- a small mammal inventory — This inventory is in progress and is in its second year.
- a fish inventory — This inventory has been completed.
- a vascular plant inventory — This inventory has been completed.
- water resources monitoring — Although an original research project has not been conducted regarding surface flow, water quality impacts, or wildlife effects, the Preserve has established permanent water quality and water stage monitoring stations in the Addition that could alert Preserve staff to changing conditions resulting from ORV use and other land uses as well.
- wildlife monitoring — Monitoring of wood storks and Florida panthers has been conducted annually since the mid 1990s.
- a game species inventory — The Florida Fish and Wildlife Conservation Commission is also conducting a game species inventory of the Addition that focuses on deer and turkeys.

## WILDERNESS RESOURCES AND VALUES

Wilderness resources and values are the attributes of an area that are physically present — they make up the wilderness character of an area.

### WILDERNESS RESOURCES IN THE REGION

There are three designated wilderness areas in the south Florida region:

- the Marjory Stoneman Douglas Wilderness (1,296,500 acres in Everglades National Park— the largest wilderness area in the state) managed by the National Park Service in Collier, Miami-Dade, and Monroe Counties
- the J.N. “Ding” Darling Wilderness (2,619 acres) managed by the U.S. Fish and Wildlife Service on Sanibel Island — Lee County
- the Florida Keys Wilderness (6,197 acres) managed by the U.S. Fish and Wildlife Service in the Florida Keys in Monroe County.

There is no designated wilderness in Big Cypress National Preserve.

### WILDERNESS RESOURCES IN THE ADDITION

There is currently no designated wilderness in the Addition; however, there are expansive areas that contain wilderness characteristics. Summarizing the Wilderness Act of 1964, wilderness resources and values are generally present if an area is untrammeled, undeveloped, natural, and has outstanding opportunities for solitude or primitive and unconfined types of recreation. General descriptions of the Addition’s wilderness resources and values are presented below

according to these categories, followed by a more detailed description of the wilderness characteristics present in specific areas of the Addition.

#### Untrammeled

An area is considered “untrammeled” if its natural processes are essentially unhindered and free from modern human manipulation or control. Large portions of the Addition have never been significantly altered by human activities, and their natural processes continue to function in an essentially unhindered manner. This is especially true of the Mullet Slough and Kissimmee Billy Strand areas. Although portions of the Addition have been altered in the past by farming, grazing, road building, and other activities, some of these areas have since reverted to natural vegetative and wildlife communities and are now largely free of human manipulation or control.

#### Undeveloped

Although much of the natural landscape of the Addition has been modified over time by human activity, there are expansive areas that retain their primeval character and where the “imprint of man’s work is substantially unnoticeable.”

#### Natural

Natural systems in the Addition are affected by unnatural processes such as the alteration of water systems and other human-induced impacts. Much of the Addition is impacted by the presence of exotic, nonnative plants, although the effect on a visitor’s experience and perception of naturalness varies. Despite these effects, and particularly when compared

to surrounding areas, the Addition contains a high degree of naturalness.

### **Opportunities for Solitude**

The remote character of the Addition provides outstanding opportunities for solitude. No visitor facilities and services are present in the Addition, so visitation is relatively low and limited to self-guided activities such as hiking, biking, and bird-watching. The Addition is currently open mainly to foot and bike travel — it has never been legally open to public hunting and motorized use. Opportunities for solitude are compromised in popular areas, such as at access points, along maintained grades, and near private camps.

### **Opportunities for Primitive and Unconfined Types of Recreation**

The Addition's remote setting provides a backcountry environment that allows for the pursuit of many self-reliant recreational opportunities. Visitors can experience a sense of freedom and rugged individualism through a variety of recreational activities. The Addition provides outstanding opportunities for hiking on- and off-trail, scenic viewing, wildlife watching, fishing, camping, and exploration. Canoeing and kayaking is also possible in certain areas of the Addition.

### **Other Wilderness Values**

The Addition is also important for scenic, educational, and ecological resources and values. These values allow visitors to learn about and experience the contrasting scenery of the Addition's various plant communities, archeological resources, and water-dependant natural systems. All of these resources and values contribute to and enhance the wilderness character of the area.

## **AREA-SPECIFIC DESCRIPTIONS**

### **Northeast Addition, North of I-75**

This area is more fragmented than the area south of I-75, but it still contains a number of natural areas, best represented by Kissimmee Billy Strand. Kissimmee Billy Strand is mostly pristine, although it is bounded by old roads and grades. However, aside from these man-made improvements, the strand is generally wild and free of trails. Natural processes predominate in the south and western portions of the northeast Addition, whereas the northern and eastern portions contain numerous camps, trails, and other permanent improvements. The L-28 Interceptor Canal and the oil/gas pipeline right-of-way are areas that have been substantially manipulated.

Areas east of Nobles Grade contain some evidence of past human disturbance; however, most of the area has healed considerably since 1996 (when acquired by the National Park Service) and is now considered wild and untrammled. Some remnant trails are present, but they have recovered significantly and today are substantially unnoticeable. A few smaller areas contain distinguishable remnants of human works, but they will likely be restored by natural processes over time and will become contributing elements to the wilderness character of this area.

The most frequently visited areas, where encounters with other visitors can be expected, are the mile marker 63 rest area on I-75, which provides access to the Florida National Scenic Trail, and the L-28 Interceptor Canal. Private camps also exist in the northeast Addition, and thus opportunities for solitude are diminished in these areas due to frequent access by private landowners.

### **Northeast Addition, South of I-75**

Most of the northeast Addition south of I-75 is natural and largely free from the influences of man. This area is best represented by Mullet Slough, the largest pristine area within the Addition. Here, water quality is high, trails and roads are mostly nonexistent, and the slough's remoteness has allowed native communities to persist. Natural processes are uninhibited south of I-75, with the exception of the camps and development that exist in the east near the L-28 Interceptor Canal. In the southwestern portion there are signs of disturbance from previous oil and gas operations, but these are limited mostly to remnant roads and trails that have recovered significantly during the last 10 years. Today, they are mostly unnoticeable, and the area appears natural.

### **Western Addition**

Most of the western Addition is natural and largely free from the influences of man. The exceptions are those areas that surround improved private properties, roads, and former agricultural sites. Lands east of the western Addition are owned by the National Park Service and are managed in a wilderness-compatible fashion, which contributes to the naturalness and ecological integrity of lands in the western Addition. In general, this area is wild and natural processes are mostly uninterrupted.

Opportunities for solitude in the western Addition are reduced due to the presence of developed areas along the highway corridors, such as near Miles City, Copeland, Carnestown, and Everglades City, and near popular areas like Bear Island Grade.

## CULTURAL RESOURCES

### OVERVIEW

Big Cypress National Preserve and the Addition are in the Glades region (an area defined by hardwood and pinewood hammocks, sawgrass, and dwarf cypress interspersed with shallow freshwater marshes and prairies) of south Florida. The limited vegetation of this region is a result of thin soils underlain by limestone bedrock. This region also includes the Everglades and portions of the Atlantic coast, the Ten Thousand Islands, and the Florida Keys. Human habitation of the Glades region can be traced back to the late Pleistocene or Lithic era. Paleo-Indian populations migrating throughout North America probably arrived in south Florida sometime before 13,000 years ago. Florida's environment was substantially different during this period. Its land area was approximately twice the state's current size, and the climate was significantly cooler and drier. The story of human activity in Florida during this period is not well understood, due in part to the fact that much of the area occupied by humans was inundated by rising sea levels that occurred with the retreat of the continental ice sheets that began around 12,000 to 13,000 years ago. This change in global glaciations signaled the end of the Pleistocene era.

The prehistoric periods of human culture represented by sites in south Florida include (1) the Paleo-Indian, (2) the Archaic period, which spanned roughly 8,000 BC to 500 BC, and (3) the Glades Tradition, which extends into the historic period, spanning 500 BC to 1760 AD. The historic periods of human culture begin with the initial Spanish contact in 1513 and continue through the 20<sup>th</sup> century and the creation of Big Cypress National Preserve.

There are fewer than 100 Paleo-Indian archeological sites in Florida, and none

located within the boundary of Big Cypress National Preserve or in the Addition. In all likelihood, most sites associated with the Paleo-Indians of this era are submerged beneath the state's coastal waters. However, at least one area within the Addition, Deep Lake, has the potential for association with this prehistoric period.

The Archaic period that followed the Pleistocene is divided into three distinct divisions; early, middle, and late. The Archaic cultures of south Florida are distinguished by progressively more diversified hunting, fishing, and gathering; the creation of more permanent settlements, increasingly sophisticated tools, trade networks, and in the late Archaic the appearance of pottery. A few Archaic period sites have been identified within Big Cypress National Preserve. None have yet been discovered in the Addition, but additional survey work remains to be done.

The Glades period or Glades tradition succeeded the Archaic period and incorporates both the end of the prehistoric period in south Florida and the first historic documentation of indigenous culture in south Florida. The Glades tradition witnessed the introduction of decorated pottery and woodworking as well as the introduction of European trade goods such as metal implements and trade beads. Spanish explorers documented the extant tribal cultures, which included the Calusa, Tekesta, and Key Indians.

The Spanish established forts and settlements along the Florida coast, raided the tribes for slaves, and sought to convert the indigenous peoples to Christianity. The Spanish managed to retain some control of Florida despite repeated incursions by the English and French. Following the end of the Seven Years' War in 1763, Spain ceded Florida to Great Britain. At the end of the American Revolution in 1783, the British returned

Florida to Spain. The Spanish maintained at least nominal control of Florida while the British and the Americans tried to assert control over the region. The United States officially acquired Florida in 1821. American expansion into Florida led to the establishment of ports and towns, the introduction of the plantation system, and a policy of Indian removal, which in turn triggered prolonged and intense conflict with the Seminoles.

The Seminoles trace their origins back to bands of the Creek confederacy that had migrated into Florida in the 18<sup>th</sup> century to escape Indian removal. Escaped black slaves from the colonies and then the United States found refuge among the Seminoles. Continued conflict over American expansion and repeated attempts to remove the Seminoles from Florida led to a series of three wars fought between 1817 and 1858. Many Seminoles were killed during the fighting or removed to Indian Territory in present-day Oklahoma. Others sought refuge in the Everglades and Big Cypress swamp. The Seminoles managed to maintain a presence even as Americans ultimately asserted control over the rest of Florida.

American dominance in Florida was defined in large part by the ascent of southern “cracker culture.” This distinctly southern cultural group shaped the history of Florida in the 19<sup>th</sup> century and the transition to the 20<sup>th</sup> century. The pace of modern development in Florida greatly accelerated in the 20<sup>th</sup> century. Farming, ranching, logging, oil and gas exploration, and land development opened areas that earlier European contact had left relatively undisturbed. The completion of the Tamiami Trail road in 1928 connected the Atlantic and Gulf coasts at the cities of Miami and Tampa and opened the interior to motor touring and eventually other forms of recreation. The Big Cypress area has for generations been home to a wide range of recreational activities, such as hunting, fishing, trapping, boating, and hiking. The establishment of Big Cypress National Preserve in 1974

recognized the importance of these activities to the inherent values of the Preserve.

Despite changes in use, development, and access, the Seminoles maintained a presence in the Big Cypress. Under the authority of the Indian Reorganization Act, a number of Seminoles officially organized as the Seminole Tribe of Florida in 1957. Other Seminoles incorporated and formed the Miccosukee Tribe of Indians of Florida in 1962. The establishing legislation for Big Cypress National Preserve recognizes special access rights for both tribes for “usual and customary use and occupancy . . . within the Preserve, including hunting, fishing, and trapping on a subsistence basis and traditional tribal ceremonials.”

## ARCHEOLOGICAL SITES

Fifty-seven archeological sites have been identified in the Addition. These resources are associated with the Archaic and Glades periods in the Preserve’s cultural chronology. Most of these sites are earth middens, which are refuse piles commonly made up of cultural artifacts, and faunal remains. The remaining sites are classified as surface scatters (1), two sand mounds, a sand burial mound, a village site, and a home site. In field surveys conducted in the Addition, researchers from the NPS Southeast Archeological Center have made preliminary determinations about the chronology of these sites.

Of the 57 sites, 10 have been determined to be prehistoric; 23 are determined to be Native American sites; and 22 are associated with the Glades cultural period. Five sites span a range of historic periods and contain artifacts representing Native American and Seminole cultures. The chronological periods of two sites at Deep Lake are unknown. More precise determinations of the chronological periods of the sites in the Addition will require additional research.

## **Deep Lake**

Although no archeological work has yet been conducted within Deep Lake, the potential for scientific archeological resources within the watery environs of the lake is great. Classic sinkholes like this are rare in south Florida. Only four others like it are known in south Florida, and two of these are exceptionally significant archeological sites. Archeological evidence from two other south Florida limestone sinkholes indicates that they served as watering holes during much of the Paleo-Indian and Archaic periods. Archeologists have recovered evidence of Paleo-Indian and Archaic-period use of these water sources from the submerged ledges of the sinkhole. The artifacts recovered were radiocarbon dated to between 8,000 BC, and 11,500 BC. It is clear from the presence of human remains at the site and the radiocarbon dated artifacts that water levels were well below present levels at approximately 11,000 BC. It is likely that the limestone sinkholes, including Deep Lake, served as much needed sources of freshwater to south Florida's inhabitants when it was a scarce commodity elsewhere. Researchers speculate that Deep Lake may also retain resources dating from the earliest periods of human occupation in south Florida

and is therefore viewed as having enormous archeological potential.

## **ETHNOGRAPHIC RESOURCES**

Ethnographic resources are a site, structure, object, landscape, or natural resource feature assigned traditional legendary, religious, subsistence, or other significance in the cultural system of a group traditionally associated with it. Traditionally associated peoples are defined as contemporary neighbors or ethnic or occupational groups that have been associated with a park unit for two or more generations (40 years) and whose interests in the park unit began prior to the park unit's establishment. The Seminole and Miccosukee tribes are both recognized in the enabling legislation as peoples traditionally associated with Big Cypress National Preserve.

Some resources within the Addition have traditional associations with the Seminole and Miccosukee tribes. Information relating to these ethnographic resources will be collected through collaborative research between the National Park Service and designated tribal representatives.

## VISITOR USE AND EXPERIENCE

### OVERVIEW

#### South Florida

South Florida offers a variety of recreational activities ranging from developed recreation to primitive and unconfined, natural recreational pursuits. Before the 1920s, South Florida was relatively wild and undeveloped. Beginning in the 1920s, many newcomers began recreating and moving to South Florida to enjoy the warm, semitropical environment and the pristine, sandy beaches. Most of the population and human development in South Florida is now within 15 to 20 miles of the coastline, and the area has become extensively developed. Since the 1920s, the population in Florida has continued to rapidly grow, and today Florida is the fourth most populous state in the United States, with a total population of 17.8 million residents. Owing largely to the unique semitropical environment, the diverse range of recreational opportunities and reputed character, Florida continues to experience intense and concentrated visitation by vacationers every year. Because of the increasing population and visitation, the demand for additional and new recreational opportunities also continues to be a major factor.

The seven southernmost Florida counties — Broward, Collier, Hendry, Lee, Miami-Dade, Monroe, and Palm Beach Counties — measure 10,104 square miles, accounting for 18.7% of Florida's land mass, yet contain 36% of Florida's total population, totaling 6,416,981 (U.S. Census Bureau, 2005). Within this land mass, Big Cypress National Preserve and Everglades National Park, both administered by the National Park Service, account for 3,483 square miles, or 34.4% of the land within the southernmost portion of this seven-county area. These NPS-administered lands represent the largest contiguous area of relatively undeveloped land in the entire

southeastern United States, which is immediately adjacent to one of the highest population concentrations in the country.

Although the traditional developed and semi-developed recreational activities involving South Florida beaches remain the dominant attraction to vacationers, many of the wilder, interior recreational experiences are gaining interest by residents and visitors. Also, the U.S. Census Bureau estimates that the population within this seven-county area is expected to grow to 9,292,316 by the year 2030, an increase of 2.9 million persons. It is likely that demands for recreational opportunities will also increase as the population grows.

#### The Addition

There are no developed facilities in the Addition to support visitor use, and Interstate 75 is a limited access highway. Visitor use in the Addition is currently limited to hiking, biking on Nobles and Bear Island grades, fishing, backcountry camping, nonmotorized boating in the main portion of the Addition, and motorized boating in the canals and estuarine area near Everglades City. No data specific to visitor use of the Addition is available. The Addition will remain closed to hunting and motorized recreational access until a final management decision is reached and a "Record of Decision" is signed and published in the *Federal Register*.

ORV trails have been mapped and assessed as part of this process to identify sustainable trails for visitors seeking ORV access opportunities. Also as part of this document, a wilderness study is being conducted to identify suitable lands for proposal as designated wilderness within the Addition for visitors seeking opportunities for solitude or primitive and unconfined types of recreation within the backcountry.

### The Original Preserve

This *General Management Plan* is for the Big Cypress Addition. The following description of the original Preserve is given to provide a relative comparison between the Addition and the original Preserve. The potential demand for recreational opportunities in the Addition is likely to be very similar to that occurring within the original Preserve. (see table 14).

The original Preserve is a large, wet, relatively flat and undeveloped land named for the extensive expanses of cypress trees. Big Cypress National Preserve consists of great stands of cypress forest swamps, marl wet prairies, marshes, and shallow freshwater sloughs. These natural resources offer visitors relatively natural, primitive and unconfined types of visitor experiences compared to the popular developed beach and resort experiences common in South Florida. The primary visitors to Big Cypress during the 1970s and 1980s were hunters, ORV users, and owners of improved properties (privately owned in-holdings) (Big Cypress *General Management Plan* 1991). Since the 1990s, hiking, canoeing, wildlife viewing, bird-watching, photography, bicycling, camping, picnicking, and general sightseeing have all emerged as substantial visitor use activities in addition to the previously mentioned activities. Because of the general lack of developed visitor facilities, the Preserve does not typically have visitation by the general public compared to most units managed by the National Park Service. Because of the primitive nature of the Preserve, visitation typically requires careful planning, fortitude, and self-reliance. The number of visitors seeking opportunities for solitude or primitive and unconfined types of recreation within the backcountry has increased within the Preserve as a whole. Visitation to Big Cypress National Preserve has gradually increased over the past 15 years as the American public has become more informed about the recreational opportunities available.

TABLE 14: PRESERVE VISITATION BY YEAR

Year	Total Recreation Visits
1989	81,157
1990	127,790
1991	159,172
1992	212,682
1993	234,830
1994	294,307
1995	365,463
1996	424,920
1997	462,553
1998	474,895
1999	503,110
2000	505,062
2001	409,771
2002	449,481
2003	400,902
2004	385,194
2005*	768,687
2006	825,857
2007	822,864

\* A change was made in data collection methodology.

SOURCE: NPS Public Use Statistics Office, 2008

To support these emerging visitor uses within the original Preserve, interpretive activities are offered to visitors in the Oasis, Concho Billie, Bear Island, and Turner River areas where ORV trails are sometimes used as access into the Preserve. Guided bicycle trips, canoe tours, environmental education programs, and activities, as well as swamp walks and hikes up the Florida Trail, are offered each winter season from mid-December through early April.

ORV users assign considerable importance to the opportunities provided by their ORVs to access and explore the Preserve’s back-country. Considerable work is performed by NPS staff to construct and maintain ORV access points, ORV trails, and campsites within the original Preserve every year.

To enhance recreational opportunities, improvements are gradually being made to

campgrounds, access points, and picnic areas. Safety and visitor amenity improvements associated with the U.S. 41 project have increased visitor opportunities by providing easy walking on boardwalks, interpretive and educational panels, and safe parking in designated areas adjacent to the main highway.

Day use visitor facilities currently available in the original Preserve include the Oasis Visitor Center, two picnic areas at the Kirby Storter Roadside Park and the H.P. Williams Roadside Park, a canoe landing, and an interpretive trail on Loop Road. Overnight visitor use facilities include two developed campgrounds at Monument Lake and Midway, and six primitive campgrounds located at Bear Island, Burns Lake, Pinecrest, Mitchell's Landing, Pink Jeep, and Gator Head. Future projects will add interpretive trails, a welcome center, and improved parking in many areas.

## RECREATIONAL OPPORTUNITIES

The primary recreational activities within the original Preserve include the following:

- frontcountry driving, sightseeing, and visitor centers
- walking and hiking
- bird-watching and wildlife viewing
- paddling
- motorboating
- camping
- bicycling
- ORV riding
- hunting, fishing, and frogging
- opportunities to experience peace and quiet in a natural environment

These primary activities are described below in greater detail. Although other recreational activities may occur, these listed activities account for the dominant types of use. Within the Addition, current recreational opportunities are limited to walking and hiking, bird-watching and wildlife viewing, paddling,

limited motorboating, camping, and opportunities to experience peace and quiet in a natural environment. Because of the similarity of resources in the Addition and the original Preserve, descriptions of activities within the original Preserve have been included for purposes of comparison. All of these activities have been proposed for the Addition, including those that do not currently occur there.

### Frontcountry Driving, Sightseeing, and Visitor Centers

Several major highways transect or run adjacent to the Big Cypress National Preserve Addition. Interstate 75, also known as Alligator Alley, crosses the northern portion of the Preserve for approximately 30 miles, about 19 of which are within the Addition and are currently used almost solely as a nonrecreationally based travel corridor. Although this highway is the primary transit route between Fort Lauderdale and Naples, it does offer views into the undeveloped land in Big Cypress.

U.S. 41, also known as the Tamiami Trail, is a paved highway that crosses the southern portion of the Preserve for about 36 miles, 1 mile of which is in the Addition. Preserve headquarters and the Oasis Visitor Center are on U.S. 41 in the original Preserve. The Oasis Visitor Center offers interpretive displays, printed materials and books for sale, and an alligator viewing platform. Currently, no visitor centers exist in the Addition.

State Road (SR) 29 is a paved highway that runs north/south between Immokalee and Everglades City and is adjacent to the western border of the Big Cypress National Preserve Addition for approximately 29 miles. Wildlife underpasses have been and are being constructed under Interstate 75 and SR 29 to protect animals and drivers, specifically the Florida panther, from being killed in automobile accidents.

A graded dirt administrative road known as Bear Island Grade exists in the northwestern corner of the Addition and provides access into the Bear Island Unit from SR 29. Other graded roads in the Addition include Bundschu Grade and Nobles Grade, each extending approximately 4 miles into the Addition, north of Interstate 75, although neither of these routes is maintained. Numerous unimproved jeep and ORV trails exist in the Addition and are fully described in the trails section of this chapter.

Unpaved, graded, gravel-based roads in the original Preserve include the approximately 24-mile Loop Road (south of U.S. 41), the approximately 23-mile Turner River Road, the 10-mile Birdon Road, the almost 3-mile Wagonwheel Road that crosses the Addition for almost 1 mile, and the 3-mile access road to the Burns Lake site. Other than the main paved highways, the three unpaved roads listed previously, and several rights-of-way to private in-holdings, no public access roads exist within the Big Cypress National Preserve Addition.

### **Walking and Hiking**

Walking is the primary method of accessing places in the Addition. Although there are no designated trails or pathways and no facilities in the Addition, existing, nonmaintained roads or trails serve as primary access routes for visitors. Cross-country travel in the Addition is difficult due to the heavily forested and swampy environment, but this is the only method of accessing the deep backcountry.

Within the original Preserve, the Florida Trail received national designation in 1983. The trail is currently incomplete but is planned to extend approximately 1,300 miles from Big Cypress National Preserve to Gulf Islands National Seashore in Florida's western panhandle. The trail, which is the only designated hiking trail longer than 2.5 miles in the original Preserve, provides backcountry

hiking experiences to visitors. Section 1 of this trail (Oasis to the original Preserve boundary) was established by the Florida Trail Association in the early 1970s. Section 1 begins at the visitor center trailhead and now extends about 35 miles to a rest area along Interstate 75. A temporary trail informally follows Nobles Grade, a nonmaintained road north of Interstate 75, up to the Preserve boundary. The official location and designation of this section of the trail in the Addition is pending the completion of this *General Management Plan*.

### **Bird-watching and Wildlife Viewing**

The size and relatively pristine condition of the Addition offers a wide variety of bird-watching and wildlife viewing opportunities. Most bird-watching and wildlife viewing activities in the Addition consist of individual ventures, as well as formal and informal organized group outings. Within the original Preserve, formal wildlife observation platforms are located at the H.P. Williams Picnic Area, Kirby Storter, and at the Oasis Visitor Center. Bird-watching opportunities are even greater in the original Preserve because of the larger acreage and greater accessibility along roads, developed trails, boardwalks, and in both frontcountry and backcountry areas. Within the Big Cypress Addition, wildlife viewing and bird-watching opportunities are relatively primitive in nature and self-directed because no infrastructure has been provided.

### **Paddling**

Most paddling opportunities in the Addition are in the vicinity of Everglades City and Plantation Island. Within the original Preserve, most paddling opportunities are south of U.S. 41 where accessible water routes provide deep enough water. Within the original Preserve, the Turner River Canoe Trail and the Halfway Creek Canoe Trail provide the opportunity for nonmotorized

paddling experiences. Other areas are open to all boats. In the Addition, the lakes and streams adjacent to Everglades City and Plantation Island are open to paddlers and provide a coastal marsh and mangrove experience.

### **Motorboating**

Motorboating in the original Preserve and in the Addition is generally restricted to the deeper water estuarine environments south of U.S. 41 outside of Everglades City. Motorized vessels are regulated by the Florida Fish and Wildlife Conservation Commission, who serves as the state boating law administrator, and by the U.S. Coast Guard navigation rules. At a minimum, to operate a motorboat within Big Cypress National Preserve, a Florida certificate of registration and validation decal must be onboard, the boat registration number must be affixed to both sides of the bow, and the boat must be equipped with U.S. Coast Guard approved personal flotation devices.

Motorboat use in the Addition is generally restricted to smaller vessels because of the shallow waters and tight turning radiuses in the creeks and open waters. As a result, the most common vessels are class A boats, less than 16 feet in length, and class I boats, 16 feet to less than 26 feet. Occasionally, class II boats, 26 feet to less than 40 feet overall length, operate in the Addition, but because of the relatively confined conditions, use by this boat class is less frequent and generally restricted to the more open, deeper water locations. The most common boat types in use are traditional single hull or pontoon boats powered by outboard motors. In some deeper, more open creeks, larger 40-60 passenger jet

driven boats are occasionally operated. Use by airboats is prohibited in the Addition. Airboats, which for the National Park Service are classified as off-road vehicles, are defined as shallow draft boats, most frequently with flat bottomed aluminum hulls, that are propelled by large air fans or airplane propellers mounted to the stern. All commercial boat operations are currently prohibited within the Addition.

### **Camping**

**Backcountry Camping.** Backcountry camping is the only type of camping allowed in the Addition, and such camping is subject to Preserve backcountry camping regulations. The Park Service maintains regularly updated and published backcountry regulations.

**Developed Campgrounds.** No developed campgrounds currently exist in Addition. In the original Preserve, two developed campgrounds (Monument Lake and Midway), and six primitive campgrounds (Bear Island, Burns Lake, Pinecrest, Mitchell's Landing, Pink Jeep, and Gator Head) exist.

### **Bicycling**

Bicycling in the Addition is currently allowed on Nobles and Bear Island grades. In the original Preserve, bicycling occurs along many of the gravel roads and on several of the ORV trails. Because of the rough condition of many of the ORV trails in the original Preserve regarding the relatively large deep ruts and standing water, these trails are oftentimes not conducive to bicycle use.

TABLE 15: SUMMARY OF OVERNIGHT VISITS BY YEAR AT THE NATIONAL PRESERVE

Year	Total Visits	Tent Campers	RV Campers	Back-country Campers	Total Overnight Stays
1989	81,157	2,591	5,847	1,117	9,555
1990	127,790	2,938	12,919	2,532	18,389
1991	159,172	2,897	15,714	5,267	23,878
1992	212,682	1,295	16,112	7,824	25,231
1993	234,830	2,659	18,450	18,786	39,895
1994	294,307	1,803	10,682	11,123	23,608
1995	365,463	2,702	12,034	8,701	23,437
1996	424,920	3,529	10,886	12,959	27,374
1997	462,553	3,518	9,929	12,836	26,283
1998	474,895	2,503	7,096	15,093	24,692
1999	503,110	3,031	13,270	10,158	26,459
2000	505,062	6,210	15,179	12,294	33,683
2001	409,771	6,626	15,582	14,326	36,534
2002	449,481	4,684	12,126	13,063	29,873
2003	400,902	3,272	10,330	12,292	25,894
2004	385,194	2,936	6,671	11,715	21,322
*2005	768,687	10,661	31,000	9,798	51,459
2006	825,857	3,706	12,422	11,814	27,942
2007	822,864	3,845	13,240	18,783	35,868
2008	813,790	3,524	10,383	11,679	25,586

\* A change was made in data collection methodology

**Off-Road Vehicle (ORV) Use**

ORV use by the general public is currently prohibited within the Addition, although some of the alternatives in this document propose ORV use in the Addition.

The use of off-road vehicles is a popular recreational activity in the original Preserve, and great interest has been expressed for allowing this activity to occur in the Addition. Enabling legislation states that ORV access will be limited and regulated in the Preserve. In the original Preserve, several types of off-road vehicles are used to access the swampy backcountry. These include street-legal four-wheel-drive vehicles (4 x 4s), light-weight all-terrain cycles (ATCs), swamp buggies, and airboats. Recreational activities that can involve the use of off-road vehicles in the Preserve include hunting, fishing, trapping,

camp access, bird-watching, general exploring, and recreational driving.

Within the Addition, no data on ORV numbers could be located for the years prior to 1988, when this land was privately owned. Within the original Preserve, no data on ORV numbers could be located for years prior to 1980, when the National Park Service implemented a mandatory registration for all ORVs operated in the Preserve. Within the original Preserve, NPS ORV permit data since 1980 are presented in table 16. Tracked vehicles were banned in 1988 based on research that showed they produced more adverse impacts than other ORV types (Duever et al. 1981).

Within the original Preserve, ORV permit numbers have ranged from 633 in 1995 to 2,271 in 1999, 1,702 in 2006, and 2,000 in 2008. Fluctuations in the number of ORV permits

issued each year primarily reflect water levels within the Preserve, with fewer registered vehicles in the wetter years (e.g., 1995) when portions of the Preserve were closed to hunting.

In the original Preserve, ORV use is heaviest during the fall, winter, and spring hunting seasons. The greatest use is on opening weekends of hunting seasons and holidays. Accurate data on ORV-related visitation are

**TABLE 16: NUMBERS OF ORVs REGISTERED FOR USE IN BIG CYPRESS NATIONAL PRESERVE, 1980 TO 2008**

Year	ATV	Swamp Buggy	Street Legal	Airboat	Totals
1980	361	180	176	130	871 <sup>a</sup>
1981	1,154	508	347	195	2,252 <sup>a</sup>
1982	1,042	162	464	166	1,853 <sup>a</sup>
1983	1,012	174	404	133	1,737 <sup>a</sup>
1984	1,020	155	410	115	1,706 <sup>a</sup>
1985	300	143	345	96	891 <sup>a</sup>
1986	300	586	165	238	1,324 <sup>a</sup>
1987	456	794	348	328	1,980 <sup>a</sup>
1988	507	810	393	371	2,082
1989	512	756	398	323	1,989
1990	580	733	334	261	1,908
1991	812	773	315	274	2,174
1992	872	773	314	296	2,255
1993	842	735	270	331	2,178
1994	584	559	193	250	1,586
1995	303	135	108	87	633
1996	682	586	205	234	1,707
1997	967	625	202	277	2,071
1998	1,053	667	219	255	2,194
1999	1,131	670	220	250	2,271
2000 <sup>b</sup>					
2001 <sup>c</sup>					
2002	437	192	90	76	1,754
2003	528	222	121	87	1,699
2004	574	241	107	73	1,652
2005	743	487	146	77	1,444
2006	615	416	111	67	1,702 <sup>d</sup>
2007	972	491	185	83	1,753
2008	1,097	572	221	110	2,000

- a. Includes counts for tracked vehicles until this vehicle type was banned in 1988.
- b. *Recreational ORV Management Plan* finalized for original Preserve, and data is not immediately available.
- c. Data is not immediately available.
- d. 2006: Because of missing information in the database, the total is higher than the number of vehicles.

unavailable, although several efforts have been made to gather such information. Duever et al. (1986a) attributed the substantial increase in ORV trails visible in aerial photographs from 1953 to 1973 to increased recreational ORV use, primarily associated with hunting. They further estimated that approximately 2,540 to 4,000 ORV-related hunters may be present in the original Preserve at peak use times (weekends) during the hunting season. A 1970 study estimated 40,000 person-days of use per year in the entire Big Cypress region.

**ORV Trail Mapping.** ORV trails in the Addition are currently closed to public recreational ORV use and have had limited use in years preceding federal ownership and management. Intensive trail mapping has been conducted as part of a general inventory of Addition trails. Between 2005 and 2007, NPS staff carefully studied existing maps, aerial photography, and verbal accounts of Addition trails to determine where sustainable trails were located. Identified routes were then field verified to confirm existence and rate condition of the trail and evaluate if the trail was sustainable for public use. Although many miles of tracks exist in the Addition, the key was to determine the trails that could be included in a designated trail system and be sustained in a manner that would not degrade Preserve resources. This effort resulted in identifying sustainable trails, meaning trails capable of withstanding repeated use without irreparable resource damage. The criteria for evaluating sustainability included the following:

- the degree of improvement to the ground surface
- soil and substrate type identified by vegetation type
- trail width
- degree of previous disturbance such as rutting of trail surface
- apparent relative level of past use
- presence of water on trail

This effort attempted to map all known existing trails. Approximately 253 miles of trails were assessed (see Map 7: Conceptual ORV Trails on page 101). Of the 253 miles assessed, approximately 140 miles were determined to be sustainable ORV trails.

Although not completely absent of ORV traffic, the Addition offers the National Park Service an opportunity to study the Big Cypress landscape largely in the absence of active ORV traffic. This circumstance presents a relative baseline for which to compare the effects of ORV traffic in the original Preserve to conditions in the Addition where off-road vehicles are not permitted. Off-road vehicles have largely been absent from the Addition since 1988, and prior to 1988 use was relatively low and confined to certain trails.

**Characteristics of Off-Road Vehicles.** The following paragraphs describe the typical types of off-road vehicles that would be expected to be used (and regulated) in the Addition.

**Street Legal 4 x 4s** — Street-legal, four-wheel-drive off-road vehicles and trucks that are commercially manufactured and sold are very restricted in the extent of their access within the original Preserve. These vehicles require the driest driving conditions and rarely venture very far into the Preserve's backcountry. As a group, this ORV type is the heaviest, with a mean weight of 4,431 pounds (based on 1996/97 permit data from the Preserve). On average, they comprise approximately 10% of the ORV permits registered with the National Park Service, although this varies from year to year.

**All-Terrain Cycles (ATCs)** — Small, commercially manufactured motorized all-terrain cycles are 50 inches or less in width, have a dry weight of 900 pounds or less, are designed to travel on three or more low pressure tires, have a seat designed to be straddled by the operator, and use a

handlebar steering control. These cycles tend to be restricted to drier terrain, as they lack the clearance required for deeper water and mud. They are also limited in their ability to carry camping gear and supplies on extended overnight back-country trips. They are typically less expensive to purchase and maintain, easier to transport, and can penetrate wooded areas more easily than other ORV types. These vehicles are the smallest and lightest off-road vehicles used in the Preserve; current four-wheel drive models range in weight from 400 to 600 pounds. On average, all-terrain cycles comprise about 50% of the Big Cypress National Preserve ORV permits.

**Swamp Buggies** — Swamp buggies include a wide variety of custom-designed and –built vehicles. These vehicles have a wide range of configurations based on the frames, engines, number of axles, and wheel sizes used. Their weights range up to 7,160 pounds, with an average of 3,629 pounds. These vehicles are less restricted in their access than street-legal vehicles and all-terrain cycles, and they can carry several individuals and supplies deep into the backcountry on extended trips. Swamp buggies tend to be more expensive to build and maintain, less reliable, and require substantially larger trailers to transport to and from the area than other ORV types. These vehicles are not street legal. Swamp buggies annually comprise approximately 30% of the ORV permits.

**Other Vehicle Types** — Currently, the above-listed vehicle types are the only types of wheeled off-road vehicles approved and permitted for use in the Preserve. As emerging technologies produce new types of off-road vehicles that do not specifically match the above three descriptions, the National Park Service will consider these new types of vehicles for inclusion in the ORV program

as part of an adaptive management aspect of the *Recreational ORV Management Plan*.

Use patterns in the original Preserve management zones are directly influenced by terrain characteristics. Airboats can most easily negotiate the marshes and wet prairies south of U.S. 41 and the Loop Road. Wheeled vehicles are used more frequently in shallow marl soils, sandy soils, and the drier upland areas north of U.S. 41 where permitted in the original Preserve. Swamp buggies are less restricted, although in forested areas they are constrained by the width of the corridor through the trees, the size of the vehicle, and tire size. All-terrain cycles are less confined to trails and can move faster but cannot traverse the marl or mucky soils as well as the swamp buggies. Street legal four-wheel-drive vehicles require mostly dry conditions and infrequently travel very far into the Preserve backcountry.

**Characteristics of ORV Users and Visitation.** The Big Cypress National Preserve 2000 *Final Recreational ORV Management Plan* gives specific information and statistics related to ORV use in the Preserve. A description is provided here regarding general characteristics of ORV use at Big Cypress.

Off-road vehicles have customarily been used for hunting-related activities, although participation in a wide variety of nonhunting recreational activities has been observed more frequently during the past decade. ORV riding is usually considered a social activity. The use of off-road vehicles is central to many visitors' enjoyment of the Preserve. Seeing wildlife, the ability to reach a favorite destination, sharing activities with friends and family, and reaching a favorite hunting spot are the primary reasons cited for using off-road vehicles. Although users are deeply attached to certain places, such as hunting camps or favored hunting spots, they also assign considerable importance to the opportunity provided by their vehicles to roam and explore the Preserve's backcountry.

Many recreational outings are reported to produce long-lasting benefits and valued experiences. An analysis of information from focus group discussions suggests that Preserve ORV users are similar to ORV users in other parts of the country. Specifically, they

- travel in groups
- prefer little managerial intervention
- see themselves as skilled risk takers and identify with others like themselves
- say the ORV experience is a way to release stress, revitalize spirits, and gain a sense of purpose
- want to protect the natural environment
- enjoy opportunities for social bonding
- value the ORV as a means to achieve solitude and immersion in nature

Based on information from a larger survey of ORV permit holders, many of the most significant benefits depend on their specific activities and/or on specific places. The connections between users, activities, and places must be taken into consideration when selecting ORV management actions.

### **Hunting, Fishing, and Frogging**

The original Preserve has been designated by the state as a wildlife management area, and the National Park Service permits hunting, frogging, and fishing by the public in accordance with state laws and regulations. Hunting is currently prohibited within the Addition. Fishing is permitted within the Addition subject to applicable laws and regulations.

The National Park Service and the Florida Fish and Wildlife Conservation Commission have concurrent jurisdiction for enforcing game and fish laws in the Preserve. Although the National Park Service has authority to manage wildlife within the Preserve, the Park Service has assigned the management of

hunting to the commission. The commission consults with the National Park Service before issuing regulations that affect hunting and fishing within Big Cypress National Preserve. Likewise, the National Park Service consults with the commission before establishing any temporary or permanent closures or public use limits.

Hunting is a popular recreational activity in the original Preserve. Hunting seasons run from September through April. Deer, turkey, and feral hogs are the principal species hunted. The primary weapons include rifles, shotguns, bows, and muzzle-loading guns. Bird dogs and waterfowl retrievers are the only dogs permitted for hunting. Although many hunters use off-road vehicles to get to hunting areas, many other hunters access the original Preserve on foot.

The *General Management Plan / Final Environmental Impact Statement* (NPS 1991) describes the types of hunting, different hunting opportunities, general regulations, and permit program. The Florida Fish and Wildlife Conservation Commission publishes updated regulations specific to the Big Cypress Wildlife Management Area related to open seasons, game types, quotas, weaponry, and other pertinent regulations annually.

To hunt in the original Preserve, hunters are required to purchase Florida state hunting licenses and wildlife management area stamps. Should hunting regulations be established within the Addition and hunting activities be allowed, state hunting licenses and wildlife management area stamps would also be required in the Addition.

Big Cypress National Preserve is home to the endangered Florida panther. Because the Florida panther is listed as a federal endangered species, hunting regulations in the Preserve are relatively restrictive due to the associated direct and indirect disturbance of the panther by hunting activities, and because

white-tailed deer and feral hogs are important prey for the panther.

The Florida Fish and Wildlife Conservation Commission regularly publishes regulations for the following activities:

- deer hunting
- turkey hunting
- hog hunting
- migratory bird hunting
- small game hunting
- frogging
- fishing

## NATURAL SOUND PRESERVATION

### Soundscape

The Addition's soundscape is comprised of both natural ambient sounds and a variety of human-created sounds. The natural soundscape exists in the absence of human-created sound and is considered a resource. This resource is an aggregate of all natural sounds that occur in the Addition. Examples of sounds found in the natural soundscape include sounds produced by birds, frogs, and insects to define territories or attract mates; sounds created by animals to detect and avoid predators or other danger; and sounds produced by physical processes such as wind in the trees, rain falling, or thunder.

The National Park Service will preserve, to the greatest extent possible, the natural quiet and natural sounds associated with physical and biological resources and will restore to the natural condition wherever possible those soundscapes that have become degraded by unnatural sounds (noise). Human-caused sounds at Big Cypress National Preserve are largely created by motorized vehicles and mechanical equipment. Some examples include vehicles; motorized watercraft; heavy equipment; construction activity; oil and gas development; aircraft; and electronic devices.

The magnitude of noise is usually described by its sound pressure. Human-caused sounds in the Addition are currently limited to highway noise and aircraft overflights since ORV use is currently not permitted in the Addition and no oil and gas activity currently exists. Since the range of sound pressure varies greatly, a logarithmic scale is used to relate sound pressures to some common reference level, usually described in decibels (dB). See table 17 for examples of sound levels.

Ambient sound has been described as the continuous background sound environment. The range in ambient soundscapes can vary considerably among locations or by time in a single location. Ambient sound levels in the original Preserve generally range between 24 dBA and 40 dBA (dBA refers to the "A" frequency weighted decibel scale), depending on the contribution of noise by insects. Acoustic monitoring was conducted in the original Preserve in the summer of 2008 by the John A. Volpe National Transportation Systems Center (Volpe). These data are currently being evaluated.

Noise is generally defined as unwanted sound. Sound can become noise due to factors such as loudness, pitch, and duration or when it occurs at unwanted times, comes from an unwanted source or sources, interrupts or interferes with a desired activity, or is perceived to be a disturbance. With respect to Preserve visitors, what constitutes unacceptable noise will depend on visitor sensitivities and expectations.

When evaluated against the natural soundscape, all human sound is considered noise. This does not, however, mean that all human sounds are inappropriate or unacceptable. In the context of Big Cypress National Preserve, noise evaluations must consider management guidance such as enabling legislation and Preserve purpose, management zoning,

**TABLE 17: SOUND LEVELS FOR COMMONLY EXPERIENCED SITUATIONS**

Reference Sound	A-weighted Decibels Level
Whispering at 5 feet	20
Quiet residential area	40
Distant bird calls	45
Wind through trees	///
Normal conversation at 5 feet	60
Helicopter landing at 200 feet	80
Steam train whistle at 100 feet	90-100
Jet aircraft takeoff at 500 feet	100

Sources: League for the Hard of Hearing, 2005; NPS 1995a:139; Appendix H MASE EA

resource sensitivity, impacts from the activity, and desired future conditions for resources and visitor experiences.

There are no absolute standards that define unacceptable levels, duration, or qualities of environmental noise. The Forest Service (1980b) has established subjective audibility guidelines to assess noise impacts for various recreational opportunities. These guidelines are included in table 18, and they relate recreational opportunities to the corresponding acceptable level above ambient sound levels. The U.S. Department of Energy suggests that there is a “strong likelihood of individual complaints” when the intruding noise is greater than 10 dB above ambient sound levels.

But, typical forest background noise levels are around 40 dBA, and 50 dBA in campgrounds, small towns, or quiet suburban communities (EPA 1980).

**Noise from Off Highway Vehicles**

The increased popularity and widespread use of off-road vehicles on federal lands in the 1960s and early 1970s prompted the development of a unified federal policy for such use (*GAO/RCED-95-209 Off Highway Vehicle Use on Federal Lands*). Executive Order 11644 was issued in February 1972

**TABLE 18: ACCEPTABLE LEVELS ABOVE AMBIENT SOUND LEVELS FOR VARIOUS RECREATIONAL OPPORTUNITIES**

Recreational Opportunity	Acceptable dB Level
appropriate for primitive recreational area; intruding noise not detectable	0
appropriate for trail camps; will not wake most sleepers; intruding noise normally not detectable	5
appropriate for undeveloped roadside camps and those accessible by four-wheel drive and all-terrain vehicles	10
appropriate for roadside camps accessible by highway vehicles	20
appropriate for highly developed campgrounds in a quiet, suburban neighborhood	40

Source: U.S. Forest Service 1980b

*to establish policies and provide for procedures that will ensure that the use of off-road vehicles on public lands will be controlled and directed so as to protect the resources of those lands, to promote the safety of all users on those lands, and to minimize conflicts among the various uses of those lands.*

Executive Order 11989 was issued in May 1977 and contained three amendments to EO 11644. Although these amendments lifted restrictions on the use of military and emergency vehicles on public lands during emergencies, they otherwise strengthened protection of the lands by authorizing agency heads to (1) close areas or trails to off-road vehicles causing considerable adverse effects and (2) designate lands as closed to off-road vehicles unless the lands are specifically designated as open to them. (*GAO/RCED-95-209 Off Highway Vehicle Use on Federal Lands*) Off-road vehicles and motorized watercraft such as motor boats all produce noise that may adversely affect the Addition soundscape and visitor experiences. Noise levels emitted from off-road vehicles and motorized watercraft vary depending on many factors such as engine size, type of motor, vehicle type, speed, gearing ratio, and many other factors.

The Noise Control Act of 1972 provides authority for the U.S. Environmental Protection Agency (EPA) to establish limits and regulations pertaining to acceptable sound levels and to develop procedures by which vehicle sound is measured. Regulations for boating and water use activities established by the National Park Service prohibit vessels from operating at more than 82 decibels measured at 82 feet from the vessel (36 CFR 3.7).

### **Influence of Off-road Vehicles on the Addition Soundscape**

ORV use in backcountry areas with relatively low, natural ambient sound levels is generally considered undesirable by those engaged in

non-ORV activities such as hiking, camping, and bird-watching. ORV use does affect the natural soundscape and the impact is best described using the “audibility” criterion. The criterion level for audibility is the sound level at which an ORV can be discerned from the background by the listener or the minimum level at which it is detectable. “Audibility distances” can be calculated for various types of vehicles in recreation areas with low ambient natural sound levels. Audibility distances for ORV noise are on the order of 0.5-2 miles, but may differ given changes in background and human noise levels and type of ORV used.

### **Influence of Other Human Noise Sources on the Addition Soundscape**

Natural sounds generally predominate throughout the Addition. There can be human-caused noise in the backcountry, such as sounds related to NPS management activities, recreation activities, and potentially oil and gas drilling operations. Most human-caused sounds are usually confined to developed areas along major roads and are mobile and temporary in nature.

Activities in adjacent lands and airspace may also affect the Addition’s natural soundscape. Commercial, private sector, military, and NPS aircraft all impact natural soundscapes. Highway traffic on roads that cross the Addition is an additional source of noise that affects the natural soundscape.

**Oil and Gas Development Noise.** Preserve soundscapes can be affected by oil and gas development, including geophysical operations, drilling, production, abandonment, and reclamation and may affect the soundscape in the Addition in the future. But, oil and gas activity does not currently exist in the Addition. Detailed information for noise impacts associated with these activities is described in the report “Oil and Gas Technology and Associated Environmental Effects” prepared

by Tetra Tech, Inc. for the National Park Service in 1987.

Noise levels associated with drilling operations in Big Cypress National Preserve were documented by Vibra-Tech South Corporation in 1986. The study was conducted for Exxon Company in December 1985 during typical rotary drilling operations and conductor casing drive hammer operations at the Collier 2B4 well. Noise levels were recorded at varying distances from the operation, ranging from 10 feet to 12,000 feet. During conductor casing drive hammer operations, decibel levels were highest within 10 feet of the drilling rig (93 dBA) and lowest (40 dBA or less) at distances of 10,000 feet or greater from the rig. During rotary drilling operations, 85 dBA was recorded 10 feet from the rig and 40 dBA or less was recorded 9,200 feet from the drilling operation. It is important to note that the noise level recording equipment used in this study had a minimum detection limit of 40 dBA. Using 40 dB as a maximum ambient level, noise from rotary drilling operations can be detected up to 8,500 feet (1.61 miles) from a rig, and noise generated from a conductor casing drive hammer operation can be detected up to 9,200 feet (1.74 miles) from a rig in the preserve. By applying the U. S. Forest Service's acceptable level of 10 dB above ambient sound, which if exceeded would likely result in public complaints, the threshold distance for rotary drilling operations is at least 2,400 feet (0.45 mile) and nearly 8,500 feet (1.61 miles) for conductor casing drive hammer operations.

**Aircraft Noise.** Natural soundscapes throughout the Addition are affected by aircraft noise from a variety of overflight sources. These include high-altitude, commercial jet traffic; military activity; general aviation; NPS administrative operations, such as resource management, prescribed fire activities, emergency response and facility maintenance; municipal and commercial air traffic from surrounding counties; and the air flight training operating out of the Dade-

Collier Training and Transition Airport known locally as the Jetport. The National Park Service resource management and prescribed fire activities are the predominate source of aircraft noise. In addition, another source of aircraft noise is from the 1,260 annual air tour flights over the Preserve.

In order to minimize aircraft noise, The Federal Aviation Administration (FAA) recommends a minimum altitude of 2000 feet. The FAA also limits and regulates noise levels generated by aircraft as authorized under 14 CFR Part 36, "Noise Standards: Aircraft Type and Airworthiness Certification." To be certified for operation within the United States, all aircraft must meet established noise limits based on aircraft type, speed capabilities, operational category (commercial, agricultural, etc.), and age of aircraft. Propeller-driven aircraft, jet aircraft, and helicopters are all included.

Helicopter use is of particular interest within the Addition because this type of aircraft is often used to access the backcountry. The acoustical impact of a helicopter is a function of the size and the type of engine used as well as the movement of the rotor blades through the atmosphere as they produce lift. Turbine-powered helicopters are generally quieter than piston powered helicopters with muffled engine exhausts. Turbine-powered helicopters produce sounds often no louder than familiar surface transportation vehicles.

**Highway Noise.** Interstate 75 provides the main interstate access route between Fort Lauderdale/Miami and Tampa Bay. This highway creates a considerable impact on the natural soundscape in the northern portion of the Addition as a result of the nearly constant traffic. To a lesser degree, Highways 29 and 41 also impact the natural soundscape within the Addition. The level of highway traffic noise depends on (1) the volume of the traffic, (2) the speed of the traffic, and (3) the number of trucks in the flow of the traffic. Generally, the loudness of traffic noise is increased by

heavier traffic volumes, higher speeds, and greater numbers of trucks. Vehicle noise is a combination of the noises produced by the engine, exhaust, and tires. The loudness of traffic noise can also be increased by defective mufflers or other faulty equipment on vehicles. As a person moves away from a highway, traffic noise levels are reduced by distance, terrain, vegetation, and natural and man-made obstacles (FHWA 1995). A 61-meter (about 200-foot) width of dense vegetation, for example, can reduce noise by 10 decibels, which cuts the loudness of traffic noise in half (FHWA 1995).

### **Visitor Responses to Noise**

An overwhelming majority of public comments to date have indicated that the use of

off-road vehicles in the Addition would create impacts to natural resources and to opportunities for visitors to experience solitude. Although ORV riders enjoy being able to easily access the deep backcountry of the original Preserve, the use of these vehicles impacts the natural soundscape and solitude that many non-ORV users seek. Although most hunters at Big Cypress use some form of off-road vehicle to access prime hunting areas, many hunters have expressed their displeasure with off-road vehicles in disturbing wildlife and their personal recreational experience. Other visitors have commented on the noise disturbance created by Interstate 75, which can be heard thousands of feet into the interior of the Addition.

## SOCIOECONOMIC ENVIRONMENT

### OVERVIEW

Collier County is the primary geographic unit for analysis of the socioeconomic impacts. When data permit, specific impacts on Everglades City, the Big Cypress Seminole Indian Reservation, and the Miccosukee Indian Reservation will also be discussed in this section.

Collier County is in southwest Florida's Gulf Coast, about 150 miles south of Tampa and 100 miles west of Fort Lauderdale. Its principal city is Naples. The county's land area is 2,025 square miles, and the Preserve encompasses most of the eastern half of the county. Much of the county's population lives in unincorporated areas along the Gulf Coast near Naples. Many Preserve employees live in the Naples area because the Preserve headquarters is about 35 miles southeast along U.S. 41.

The two other incorporated cities in Collier County are Marco Island and Everglades City. Marco Island is south of Naples, around 30 miles from Preserve headquarters. Everglades City is the closest incorporated area to the Preserve, less than 10 miles from headquarters. A discussion of demographic and economic data for Everglades City is included in this section because the city caters to visitors to both Everglades National Park and Big Cypress National Preserve. Public services and infrastructure in the Everglades City area include the following:

- fire protection — Ochopee Fire Control District
- police protection — Collier County Sheriff

- health care — several hospitals and clinics are in Naples and Marco Island
- educational infrastructure — Everglades City School (K–12, approximately 150 students)

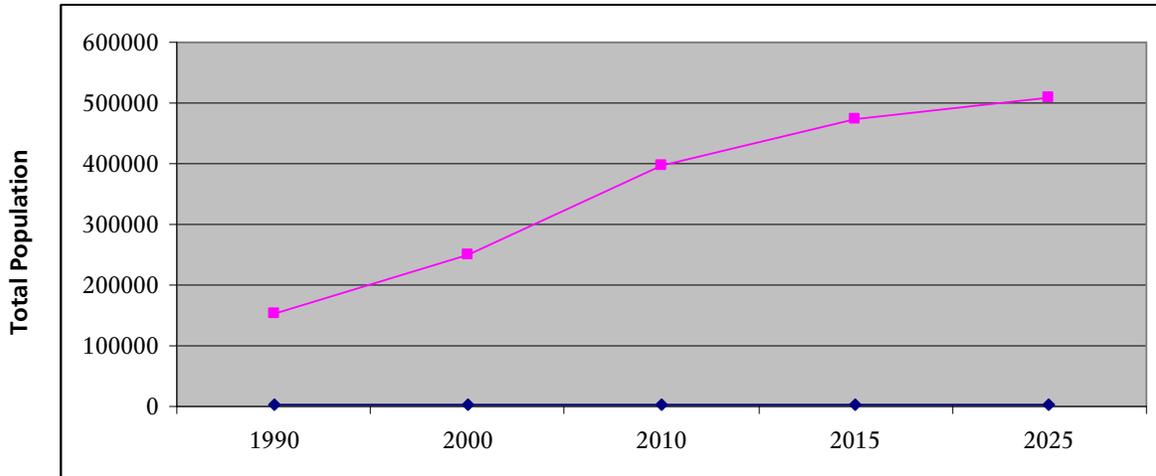
The Big Cypress Seminole Indian Reservation borders the Northeast Addition to the north, and the Miccosukee Indian Reservation borders the Northeast Addition on the east. There is very little census data on the Miccosukee Reservation.

### DEMOGRAPHICS

#### Collier County

**Population.** The U.S. Census Bureau (*Census*) reports that the population of Collier County in 1990 was 152,099, rising to 251,377 in 2000 and estimated to be 314,649 in 2006. The compound annual growth rate of Collier County's population from 1990 to 2006 was 4.6%, with a 65.3% increase in total population during this period — or about 100,000 people.

According to *Census* 2000 data and the University of Florida's Bureau of Economic and Business Research (BEBR) projections from 2000, the population of Collier County is expected to continue growing rapidly. The bureau projects that population will increase to 397,434 in 2010, 474,192 in 2015, and 507,388 in 2025 (see figure 2). Based on these estimates, the average annual growth rate from 2006 to 2025 is expected to average 2.5%.



Source: 2000 U.S. Census Bureau and Bureau of Economic and Business Research

**FIGURE 2: TOTAL POPULATION: COLLIER COUNTY**

**Age Distribution of Population.** Table 19 displays the breakdown of Collier County’s population by age group based on 2000 and 2006 *Census* data. The data reveal that from 2000 to 2006 the four fastest growing age groups were the 85-year and older, 75-84 year, 9-year and under, and 20-34 year categories. These population age groups grew at average annual rates of 10.9%, 6.0%, 5.6%, and 5.5%, respectively during this period. The slowest growing age groups between 2000 and 2006 were the 65-74 year, 55-64 year, and 35-44 year categories, which grew at rates of .8%, 2.1%, and 3.0%, respectively.

The table reveals that the Collier County population is fairly evenly distributed with most age categories representing around 9% to 12% of the total population.

**Everglades City**

**Population:** According to the *Census*, the population of Everglades City was 321 in 1990 and 479 in 2000, for an average annual growth rate of 4.1%. Recent Everglades City population projections were provided by

**TABLE 19: AGE DISTRIBUTION IN COLLIER COUNTY**

Age Category	2000	2006	Compound Annual Growth Rate (CAGR)	% of 2006 Population
9 years and under	27,885	37,507	5.6%	11.9%
10-19 years	27,059	32,474	3.1%	10.3%
20-34 years	39,970	55,051	5.5%	17.5%
35-44 years	33,458	39,845	3.0%	12.7%
45-54 years	29,515	36,920	3.8%	11.7%
55-64 years	31,977	36,199	2.1%	11.5%
65-74 years	35,088	36,736	.8%	11.7%
75-84 years	21,060	29,917	6.0%	9.5%
85 years and over	5,365	10,000	10.9%	3.2%

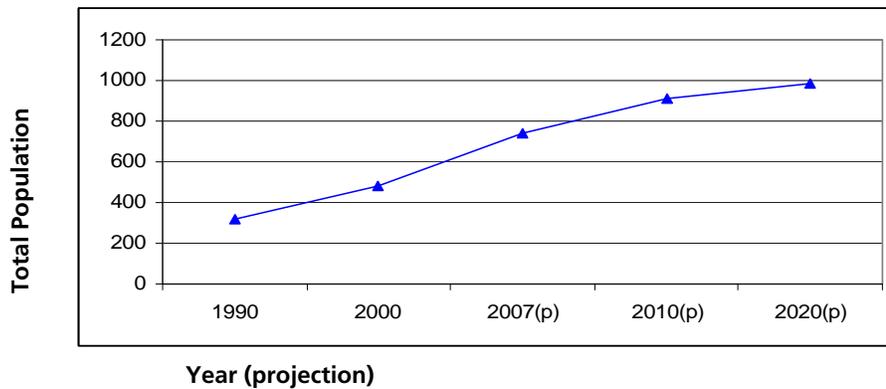
Source: U.S. Census Bureau

Collier County’s Comprehensive Planning Department. According to department forecasts, the population was estimated to be 741 in 2007 and reach 982 in the year 2020. This translates into an average annual growth rate of 2.2% over the period 2007 to 2020. This rate is in line with the 2006 to 2025 estimated population growth rate for Collier County of 2.5% (see figure 3).

**Age Distribution of Population.** As indicated in table 20, more than 60% of the population in Everglades City is over the age of 44. Only 12.9% of the population is under the age of 20, while persons 20-44 represent about 22.1% of the total population.

**Big Cypress Seminole Reservation**

**Population:** The *Census* reported that in 2000, the total population of the Big Cypress Seminole Indian Reservation was 142. This estimate is used as a basis for population growth rate calculations by the Bureau of Economic and Business Research. This bureau and Collier County Comprehensive Planning Department estimated a reservation population of 201 in 2004 and expect slow growth in the future. The most recently reported population projections for Big Cypress Indian Reservation, as calculated by this bureau, indicate that in 2010 there will be an estimated total population of 209, increasing to 222 in 2020. The estimated average annual growth



Source: U.S. Census Bureau and Collier County Comprehensive Planning Department

FIGURE 3: TOTAL POPULATION: EVERGLADES CITY

TABLE 20: AGE DISTRIBUTION OF EVERGLADES CITY POPULATION

Age Category	2000	% of 2000 Population
9 years and under	26	5.4%
10-19 years	36	7.5%
20-34 years	55	11.5%
35-44 years	51	10.6%
45-54 years	66	13.8%
55-64 years	80	16.7%
65-74 years	110	23.0%
75-84 years	34	7.1%
85 years and over	21	4.4%

Source: U.S. Census Bureau, 2000

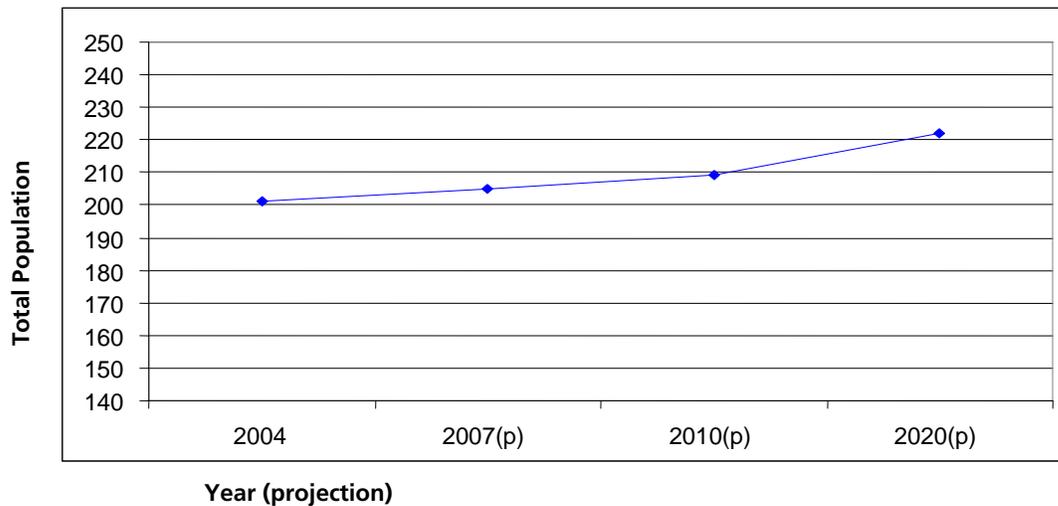
rate of the reservation during the period 2007 to 2020 is estimated to be 0.61% (see figure 4).

**Age Distribution of Population.** Based on *Census 2000* data, 75.3% of the population of the Big Cypress Seminole Reservation is under the age of 44 (see table 21). Within this age range, the largest population is in the 9 years and under category, followed by the 20 to 34 age category. These two age categories represent 46.4% of the total population.

## ECONOMY AND EMPLOYMENT

### Collier County

**Employment.** According to *Census* estimates, in 2006, Collier County’s labor force consisted of 144,905 workers. Of these workers, 140,184 were employed and 4,721 were unemployed, for an unemployment rate of 3.9%. Figure 5 compares the unemployment rates of Collier County and the state of Florida from 1990 to 2006. The figure reveals that unemployment rates steadily declined in Collier County during the period 1992 to 2000 — from a high



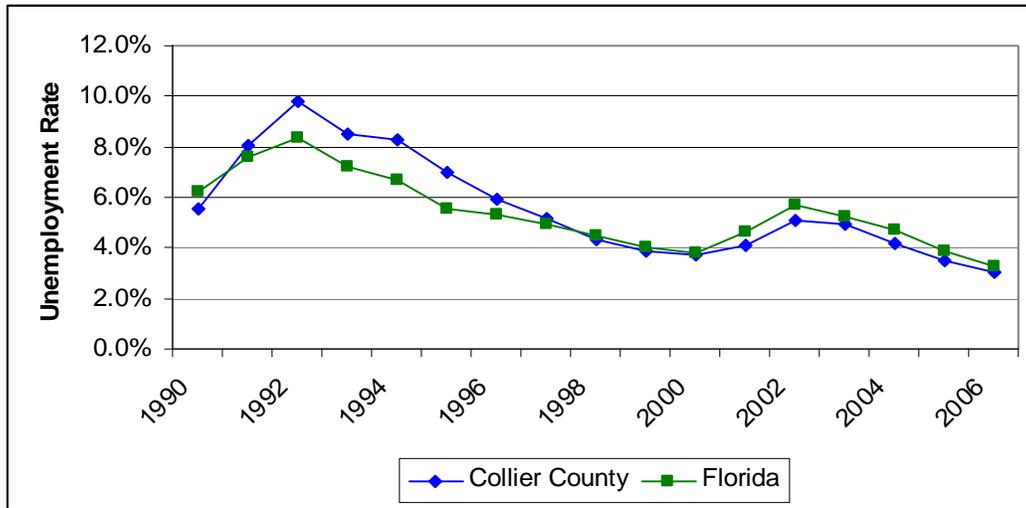
Source: U.S. Census Bureau 2000 and Collier County Comprehensive Planning Department

**FIGURE 4: TOTAL POPULATION: BIG CYPRESS SEMINOLE INDIAN RESERVATION**

**TABLE 21: AGE DISTRIBUTION OF BIG CYPRESS INDIAN RESERVATION**

Age Category	2000	% of 2000 Population
9 years and under	35	24.6%
10-19 years	22	15.5%
20-34 years	31	21.8%
35-44 years	19	13.4%
45-54 years	12	8.5%
55-64 years	9	6.3%
65-74 years	4	2.8%
75-84 years	8	5.6%
85 years and over	2	1.4%

Source: U.S. Census Bureau, 2000



Source: U.S. Bureau of Labor Statistics

FIGURE 5: UNEMPLOYMENT RATE: STATE OF FLORIDA AND COLLIER COUNTY

of nearly 10% to about 4% in 2000. Unemployment increased in 2001 and 2002 during a period of national recession, but fell consistently every year after 2002 and reached a 16-year low of 3.0% in 2006.

Table 22 reveals that the construction industry employed the largest share of Collier County workers in 2006, accounting for 19.5% of the workforce. The educational/ healthcare/social assistance, retail trade, and the arts/ entertainment/recreation/ accommodation/ food service industries also employed a relatively large share of workers in 2006, at 13.9%, 13.6, and 11.8% of the Collier County workforce respectively. Together, these four industries employed about 58.7% of the Collier County workforce, or 82,329 workers. From 1990 to 2006 the arts/entertainment/ recreation/accommodation/ food service industry had the most rapid employment growth, increasing at an average annual rate of 13.5%. Employment in the construction and educational/healthcare/ social assistance industries grew relatively rapidly during this

period, increasing at an average rate of 7.6% and 6% per year, respectively. Overall employment grew by an average annual rate of 4.6% in Collier County during the period 1990 to 2006, with the total number of employed workers increasing from around 68,449 in 1990 to 140,184 in 2006.

With respect to work location and travel to work, the 2000 *Census* data reveals that the total number of workers who commuted to work was 126,328. Of this amount, 98,913 people drove alone in a car, truck, or van and 13,505 people carpooled. About 1,245 workers used public transportation, 3,330 people walked to work, 4,103 people used other means of transportation, and 5,232 people worked from their homes. The mean travel time to work was 24.0 minutes, indicating that most employees lived far enough away from their work location to have to use some form of motorized transportation.

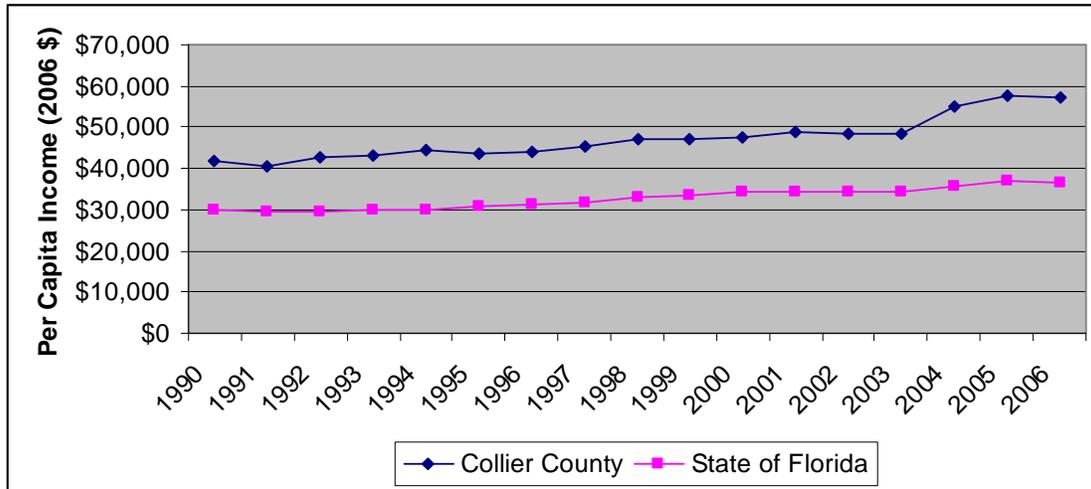
TABLE 22: EMPLOYMENT BY INDUSTRY: COLLIER COUNTY

	Employees (1990)	Employees (2006)	% of 2006 Employees	Compound Annual Growth Rate (1990-2006)
Wholesale trade	1,960	3,991	2.8%	4.5%
Information	n/a	1,768	1.3%	n/a
Agriculture, forestry, fishing, hunting, and mining	5,431	2,861	2.0%	-3.9%
Manufacturing	3,342	3,709	2.6%	0.7%
Public administration	2,545	5,615	4.0%	5.1%
Transportation, warehousing, and utilities	3,600	3,952	2.8%	.6%
Other services (except public administration)	4,811	7,958	5.7%	3.2%
Finance, insurance, real estate and rental and leasing	7,219	12,716	9.1%	3.6%
Professional, scientific, management, administrative, and waste management services	7,584	15,285	10.9%	4.5%
Retail trade	13,630	18,997	13.6%	2.1%
Arts, entertainment, recreation, accommodation, and food services	2,201	16,603	11.8%	13.5%
Educational services, health care, and social assistance	7,609	19,428	13.9%	6.0%
Construction	8,517	27,301	19.5%	7.6%
<b>Total</b>	<b>68,449</b>	<b>140,184</b>	<b>100.0%</b>	<b>4.6%</b>

Source: U.S. Census Bureau, *Census* 1990, and 2006

**Personal Income.** According to the U.S. Bureau of Economic Analysis, in 2006 Collier County had a per capita personal income of \$57,446, significantly higher than the statewide average of \$36,720. Figure 6 displays trends in per capita personal income in Collier County compared to the state during the period 1990 to 2006 in constant 2006 dollars (net of inflation). The figure reveals that per capita personal income at the county and state

level have trended together during this 15-year period, yet Collier County per capita personal income has remained consistently higher, at around \$13,500 above state per capita personal income levels. In real terms, per capita personal income has increased in Collier County at an average annual rate of 2.0% over the period, compared to 1.3% for the state of Florida.



SOURCE: U.S. Bureau of Economic Analysis (BEA)

FIGURE 6: PER CAPITA PERSONAL INCOME (CONSTANT \$2006): FLORIDA AND COLLIER COUNTY

**Composition of Collier County Economy.** Table 23 displays the approximate economic output for each industry category in Collier County in 2004. The table reveals that the largest economic sectors are the financial/insurance, construction, accommodation/recreation, and professional service industries, which together produce 54.6% of all goods and services in Collier County. The service sector comprises about 52.4% of the Collier County economy, while goods-producing industries and wholesale/retail trade represent about 24.8% and 11.4% of total economic

output respectively. The state, local, and federal government together represent about 4.7% of the total economic output in the county. The table shows that in 2004 the total economic output for Collier County was \$17.1 billion, of which approximately \$8.9 billion represented the value of services performed, \$4.2 billion reflected goods produced, \$1.9 billion reflected wholesale and retail sales, and \$802 million represented goods and services provided by federal, state, and local governments.

TABLE 23: ESTIMATED ECONOMIC OUTPUT BY SECTOR IN COLLIER COUNTY, 2004

Sector	2004 Output	% of Total
Information	\$435,108,000	2.5%
Transportation and warehousing, and utilities	\$485,707,000	2.8%
Agriculture, forestry, fishing and hunting, and mining	\$525,501,000	3.1%
Wholesale trade	\$539,910,000	3.2%
Manufacturing	\$553,130,000	3.2%
Other services, except public administration	\$591,153,000	3.5%
Public administration	\$802,074,000	4.7%
Owner-occupied dwellings	\$1,149,480,000	6.7%
Educational services, health care, and social assistance	\$1,273,309,000	7.5%
Retail trade	\$1,395,235,000	8.2%
Professional, scientific, and management, and administrative and waste management services	\$1,709,351,000	10.0%
Arts, entertainment, recreation, accommodation, and food services	\$1,714,814,000	10.0%
Construction	\$2,686,321,000	15.7%
Finance and insurance, real estate, and rental and leasing	\$3,221,944,000	18.9%
<b>TOTAL OUTPUT</b>	<b>\$17,083,037,000</b>	<b>100.0%</b>

Source: Minnesota IMPLAN Group (MIG), 2004 Collier County Data Set

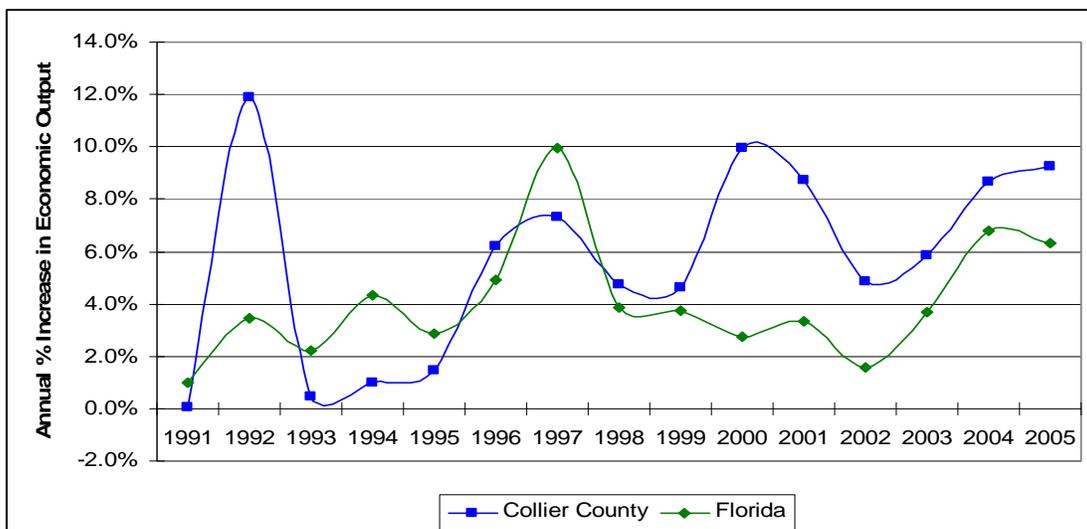
Economic output in Collier County increased by an average annual rate of 5.6% over the period 1990 to 2005, compared to 4.0% for Florida as a whole. More recently, during the period 2000 to 2005, economic growth in Collier County increased at an average annual rate of approximately 7.5%. Whereas economic growth has remained relatively constant over time for Florida, around 4%, an increase in the economic growth rate from 5.6% to 7.5% suggests an acceleration and expansion of economic growth in Collier County (as specified from a study conducted by the National Ocean Economics Program).

During the period 2000 to 2005, the county typically produced between 1.5% and 1.8% of the total Florida gross state product (GSP), which represents the total value of all goods and services produced in Florida in a given year. During this same period, Collier County typically ranked 15<sup>th</sup> out of 67 counties in Florida in terms of the amount of production of goods and services. Figure 7 displays the annual change in economic output for Florida and Collier County during the period 1990 to 2005. The figure reveals that, as expected, changes in economic output in Collier County have generally tracked with economic growth trends observed at the state level. However,

percentage changes in annual economic output have been consistently greater in Collier County relative to Florida beginning in 1998 and continuing to 2005. Following the economic downturn in 2001–2002, economic output rebounded and expanded in Collier County during the period 2003 to 2005. In 2005, growth slowed in Collier County and actually declined slightly in Florida. Despite the recent slowdown in growth in 2005, the long-term trend in economic growth for Collier County suggests that growth and economic expansion will continue into the future.

### Everglades City

**Employment.** Of the 479 residents in Everglades City in the year 2000, 424 were over the age of 16 and only 200 were part of the civilian labor force, based on data provided by the *Census*. In 2000, 197 workers were employed in Everglades City. The city had a very low unemployment rate in 2000 of 1.5%. As demographic data from the *Census* suggests, a large portion of the city's population are older residents who are likely retired, which



Source: National Ocean Economics Program

FIGURE 7: ANNUAL CHANGE IN ECONOMIC OUTPUT: FLORIDA AND COLLIER COUNTY (\$2005)

explains why the labor force is relatively small compared to the population. From 1990 to 2000 employment increased by 11.9%, or by an average annual rate of 1.1%. However, the number of persons not part of the labor force nearly tripled during this period, increasing at an average rate of 11.3% per year. This indicates that Everglades City is likely becoming a community increasingly composed of retirees.

In terms of mode of travel to and from work, 118 employees traveled alone in a car, truck, or van, and 33 carpooled. Around 33 workers either walked or used other means of transportation, and the remaining 11 individuals worked from their homes.

Table 24 indicates that a significant portion of the Everglades City workforce is employed in the arts/entertainment/recreation/ accommodation and food services industries, together representing 29.4% of the workforce in 2000. Agricultural/mining and transportation/ utilities industries also employ a relatively large number of workers in Everglades City,

representing a combined total of about 30% of the workforce.

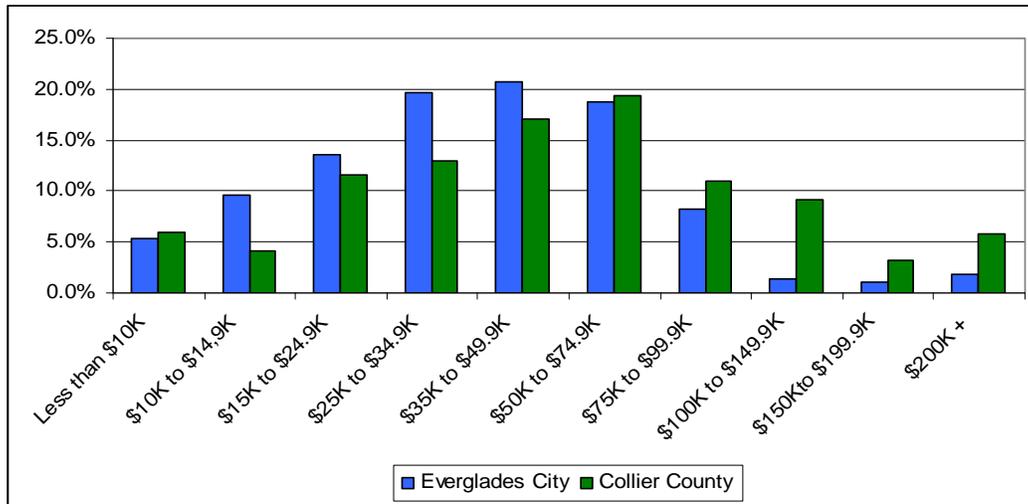
**Personal and Household Income in Everglades City.** According to the 1990 and 2000 *Censuses*, per capita income in Everglades City was \$16,394 in 1990 and \$20,535 in 2000, for an average annual increase of 2.2%. Figure 8 displays the percentage of total households in Everglades City by income bracket in comparison to Collier County, based on *Census 2000* data.

In comparing Everglades City to Collier County, *Census* data shows that Everglades City's average household income is skewed slightly more towards the lower household income brackets. The median household income for Everglades City was \$36,667, which was significantly lower than the Collier County median income of \$48,289. As for the per capita income comparisons in 2000, the data reflects the same conclusion. Per capita income in Everglades City was \$20,535 — considerably lower than per capita income in

TABLE 24: EMPLOYMENT BY INDUSTRY IN EVERGLADES CITY

	Employees (1990)	Employees (2000)	% of 2000 Employees	CAGR (1990-2005)
Manufacturing	5	0	0.0%	-100.0%
Information	n/a	0	0.0%	n/a
Professional, scientific, management, administrative, and waste management services	10	3	1.5%	-11.3%
Construction	9	5	2.5%	-5.7%
Wholesale trade	6	6	3.0%	0.0%
Other services, except public administration	34	7	3.6%	-14.6%
Finance, insurance, real estate, and rental and leasing	5	8	4.1%	4.8%
Educational, health and social services	18	14	7.1%	-2.5%
Retail trade	27	19	9.6%	-3.5%
Public administration	16	19	9.6%	1.7%
Agriculture, forestry, fishing and hunting, and mining	10	29	14.7%	11.2%
Transportation and warehousing, and utilities	28	29	14.7%	0.4%
Arts, entertainment, recreation, accommodation, and food services	8	58	29.4%	21.9%
<b>Total</b>	<b>176</b>	<b>197</b>	<b>100%</b>	<b>1.1%</b>

Source: U.S. Census Bureau, 1990 and 2000



Source: U.S. Census Bureau, 2000

FIGURE 8: HOUSEHOLDS BY INCOME BRACKETS: COLLIER COUNTY AND EVERGLADES CITY, 2000

Collier County, at an estimated \$31,195. *Census* data for Everglades City beyond the year 2000 are currently unavailable.

**Composition of Everglades City Economy.** Output by industry sector for Everglades City was estimated based on the ratio of the number of employees in Everglades City to that of Collier County. Table 25 displays estimates of economic output by sector.

Economic output in Everglades City in 2004 was estimated at \$19.6 million. The table reveals that the largest economic sector in Everglades City is the arts, entertainment, recreation, accommodation, and food services sector, which together produced an estimated \$5.8 million in 2004.

The total economic output of Everglades City in 2004 represented approximately 0.11% of total 2004 county economic output.

TABLE 25: ESTIMATED ECONOMIC OUTPUT BY SECTOR IN EVERGLADES CITY

Sector	2004 Output	% of Total Output
Manufacturing	\$0	0.0%
Information	\$0	0.0%
Professional, scientific, management, administrative, and waste management services	\$298,600	1.5%
Construction	\$497,600	2.5%
Wholesale trade	\$597,200	3.0%
Other services (except public administration)	\$696,700	3.6%
Finance, insurance, real estate, and rental and leasing	\$796,200	4.1%
Educational, health and social services	\$1,393,400	7.1%
Retail trade	\$1,891,000	9.6%
Public administration	\$1,891,000	9.6%
Agriculture, forestry, fishing and hunting, and mining	\$2,886,300	14.7%
Transportation and warehousing, and utilities	\$2,886,300	14.7%
Arts, entertainment, recreation, accommodation, & food services	\$5,772,700	29.4%
<b>TOTAL OUTPUT</b>	<b>\$19,607,000</b>	<b>100.0%</b>

Source: Minnesota IMPLAN Group (MIG), 2004 Collier County Data Set; 2000 *Census*

## VISITOR USE AND ECONOMIC IMPACT

### Visitation Data

Table 26 presents NPS data on recreational visits to the Preserve during the 1997 to 2007 period.

TABLE 26: RECREATION VISITS, 1997–2007

Year	Recreation Visits
1997	462,553
1998	474,895
1999	503,110
2000	505,062
2001	409,771
2002	449,481
2003	400,902
2004	385,194
2005	768,687
2006	825,857
2007	822,864
2008	813,790

SOURCE: NPS Public Use Statistics Office

The table shows that the number of recreation visits to the Preserve was generally in the 400,000 to 500,000 range during 1997 to 2004. In 2005 the Preserve changed its counting methods, adding visitor counts from the Oasis Visitor Center parking lot and vehicle counts from the east and west ends of the Loop Road. This change contributed to the higher visitation figures in 2005–2008.

### Visitor Activities

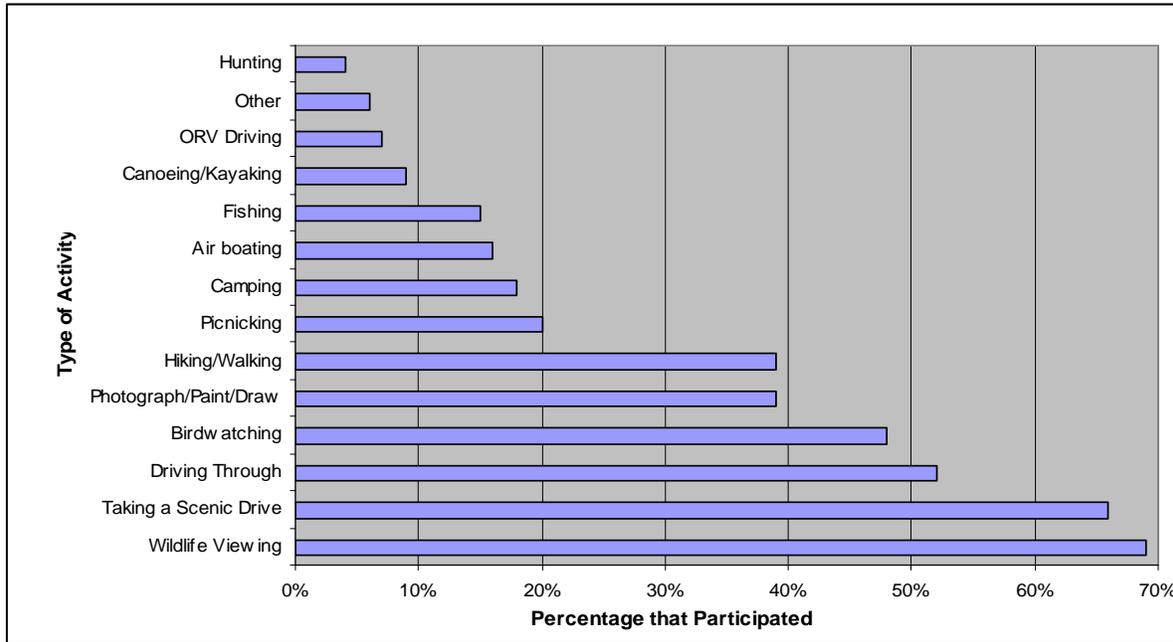
The Visitor Services Project and Cooperative Park Studies Unit of the University of Idaho conducted a general visitor survey for Big Cypress National Preserve in 2007. The park studies unit gathered a large sample of randomly selected visitor groups (N= 634) and requested that the visitors complete questionnaires in order to analyze Preserve visitation and use patterns. The survey indicated that the most common visitor group activities were viewing wildlife (69%), taking a scenic drive

(66%) driving through the Preserve to reach another destination (52%), and bird-watching (48%). Hiking and photography/painting/drawing were also popular activities, at 39%. A smaller portion of visitors participated in more traditional forms of outdoor recreation, including picnicking (20%), camping (18%), airboating (18%), and fishing (15%). Only 9% of the visitors surveyed planned to canoe or kayak, and only 4% planned to hunt. About 7% of visitors interviewed had plans to drive off road vehicles within the Preserve. Around 6% of visitors participated in “other” types of activities, which may include biking and horseback riding. The percentages reported exceed 100% because visitors can participate in more than one of these activities. Figure 9 depicts the activities participated in by Preserve visitors.

**Response Concerning the Addition.** Visitors surveyed were also asked their opinions and preferences concerning the Big Cypress Addition. Of the visitor groups interviewed, 52% noted that they would be likely to visit the Addition on the next trip, with 36% not sure about visiting, and 13% not likely to visit. Also, 30% reported that they would be more likely to visit the Addition if there was an outfitter or guide available, with 37% not being sure and 34% not likely.

In terms of activities that visitors would like available in the Addition, hiking, camping, wildlife viewing, fishing, canoeing, bird-watching, biking, and hiking were the most frequently mentioned.

**ORV and Camp User Survey.** In addition to the visitor study, the University of Idaho conducted a survey for Preserve ORV and camp users in 2007. In total, 520 questionnaires were successfully sent to a random sample of registered ORV holders or camp owners, generating 240 respondents (a 46.2% response rate). Of the total respondents, 57% had visited the Preserve five or more times in the past 12 months, which corresponds to the fact that 95% of respondents live in Florida



Source: Park Studies Unit, University of Idaho, Spring 2007 Report

**FIGURE 9: GENERAL VISITOR ACTIVITIES AND USE, 2007**

(and thus have relatively easy access to the Preserve). In terms of average group size, 30% were in groups of five or more, 40% were in groups of three or four, and 30% were in groups of one or two.

In terms of length of stay, 38% spent less than one day at the Preserve during their last visit, with 62% staying more than one day.

Of the 38% that stayed less than one day, 54% stayed seven or more hours, 23% stayed five or six hours, 12% stayed three or four hours, and 11% stayed one or two hours. Of the 62% that stayed more than one day, 32% stayed three days, 31% stayed two days, 22% stayed four or five days, and 16% stayed six days or more. As a whole, 56% of respondents stayed overnight away from home in the area, with 44% returning home.

As shown in figure 10, activities most frequently participated in during respondents last visit to the Preserve were ORV driving (72%), camping (49%), hunting (45%),

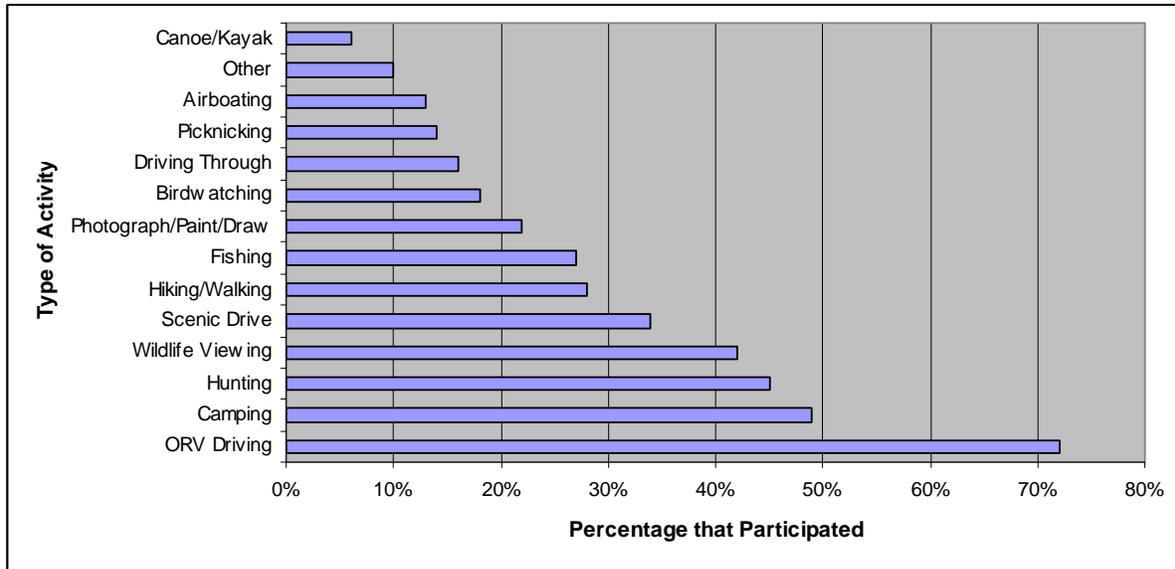
wildlife viewing (42%), and taking a scenic drive.

For most respondents (92%), the Preserve was the primary destination on their most recent trip.

#### Visitor Group Size and Length of Stay

According to the results of the 2007 visitor study, approximately 76% of all Preserve visitors spent less than a day at the Preserve, and 71% of those spent less than four hours at the Preserve. For the 24% that stayed more than one day in the Preserve, 30% spent seven or more days. The average length of stay for all visitors (for those staying less than one day and those staying more than one day) was 1.6 days. The average length of stay for those staying more than one day at the Preserve was 4.3 days.

The study further shows that 48% of respondents were in groups of two or more,



SOURCE: Park Studies Unit, University of Idaho, Spring 2007 Report

FIGURE 10: 2007 ORV PERMIT HOLDER AND CAMP OWNER ACTIVITY AND USE

44% were in groups of four or more, and just 8% were visiting the Preserve alone. The average group size for respondents was 2.8 people.

visiting the area to see other attractions, 19% to visit friends and/or relatives, 2% for business; and 21% for other reasons.

### Visitor Spending and Trip Purpose

Based on the 2007 visitor survey, average visitor group expenditures were \$1,073, with a median expenditure of \$370. The average total expenditure per person was \$484.

As shown in table 27, visitors — as a total of overall spending — spent the most on noncamping overnight accommodations outside the Preserve (36%), restaurants and bars (18%), and groceries and take-out food (11%). Visitors as a whole spent the least amount of money on donations to the Preserve (1%), commercial airboat tours, and on commercial guided tours to the backcountry (2%).

Of total nonlocal visitors, only 22% of respondents noted that they were in the area for the primary purpose of visiting the Preserve. Approximately 36% said they were

TABLE 27: EXPENDITURE CATEGORIES

Types of Expenditures	% of Total Spending
Hotels, motels, cabins, and bed-and-breakfasts	36%
Restaurants and bars	18%
Groceries and take-out food	11%
Gas and oil	9%
All other purchases	8%
Other transportation costs	6%
Camping fees	5%
Admission, recreation, and entertainment	3%
Commercial guided tours to the backcountry	2%
Commercial airboat tours	1%
Donations to the preserve	1%
<b>TOTAL</b>	<b>100%</b>

Source: Park Studies Unit, University of Idaho, Spring 2007 Report

## NPS OPERATIONS AND MANAGEMENT

### ADMINISTRATIVE ORGANIZATION

The original Preserve is divided into six management planning units — the Bear Island, Corn Dance, Deep Lake, Loop, Stairsteps, and Turner River units. These units encompass about 582,000 acres. The Addition was established in 1988 and consists of two areas — the northeastern section that straddles Interstate 75, and the western section that parallels the north/south portion of SR 29. The two areas of these Addition lands encompass about 147,000 acres. Currently, NPS operations in the Addition are focused on gathering baseline information and fire/natural resource management activities, such as exotic plant management. Operations will not be fully extended to manage Addition lands to the same level as the original Preserve until this *General Management Plan* is finalized and a “Record of Decision” is published in the *Federal Register*.

The Preserve, including the Addition, is administered by a superintendent and a deputy superintendent. NPS headquarters is in the southwestern portion of the Preserve at Ochopee, Florida.

### NPS OPERATIONS AND MANAGEMENT

NPS staffing in 2007 was 77 employees. Currently, very minimal dedication of staff time is given to manage the Addition because visitation is minimal and a final management plan has yet to be concluded. Because the Addition makes up about 20% of the entire Preserve, active management for these lands will require additional staff and equipment.

Management of Big Cypress National Preserve, including the Addition, is organized into the following divisions: Visitor and Resource Protection, Interpretation, Resource

Management, Administration, Fire and Aviation, and Maintenance.

### Visitor and Resource Protection Division

The Visitor and Resource Protection Division is responsible for law enforcement activities and enforces laws and regulations intended to safeguard visitors and resources. In addition to law enforcement, this division is responsible for search-and-rescue operations and emergency medical services Preserve-wide. Rangers make routine visitor contacts to ensure that Preserve regulations and concurrent state hunting and fishing regulations are understood and being met, to check for safety and resource violations, and to respond to or direct visitor inquiries to appropriate NPS staff. The recreational fee program, ORV special use permit program, and various components of the overall special use permit program are also managed by the division.

### Interpretation Division

The Interpretation Division is responsible for educating and offering visitors opportunities to understand the significance of the Preserve and to ensure the protection and enjoyment of associated resources. This includes educating visitors, stakeholders, and the general public about these resources, including the natural systems in the South Florida ecosystem; cultural resources; wilderness and scenic values; scientific opportunities; and the role of the Preserve in local, regional, and national contexts. NPS staff fulfill these responsibilities through formal education and orientation programs, interpretive programs, curriculum-based educational programs, and interpretive media. Personal services include staffing of the visitor center, ranger-led walks and canoe trips, talks and evening programs, demonstrations and special events, and informal contacts

with visitors. This division is also responsible for supervision of publications and materials available at bookstores and sales outlets, exhibits and audiovisual media, the website, and electronic media.

### **Resource Management Division**

The Resource Management Division manages the Preserve's natural and cultural resources. This program includes the management of all natural resources in the Preserve to ensure the preservation of fundamental physical and biological processes, as well as individual species, features, and plant communities. This division lacks a cultural resource manager and uses the Southeastern Archeological and Conservation Center for technical assistance and guidance on the management of cultural resources. This division administers the Preserve's geographic information system (GIS) database and all cooperative research and research permits in the Preserve.

### **Administration Division**

The Administration Division is responsible for the Preserve's budget and financial accounting, property management, personnel management, procurement, contracting, mail services, administrative filing, and management of the Preserve-wide computer systems.

### **Fire and Aviation Division**

The Fire and Aviation Division is responsible both for fire-fighting activities and for restoring the natural fire regime to areas where fires naturally occur. The effects of fire on natural ecological systems will also be actively monitored by division staff where fires occur.

### **Maintenance Division**

The Maintenance Division is responsible for the operation and maintenance of all NPS facilities and equipment, including buildings and maintained grounds; utility systems such as water, sewer, and solid waste management; employee housing; roads; parking areas and trailheads; trails; and picnic areas. This division is also responsible for fleet management.

## **NPS FACILITIES**

NPS facilities are primarily designed to provide safe, enjoyable, and educational access and support to visitors who come to experience Big Cypress National Preserve. Facilities are typically located in areas that can sustain visitation while protecting resources, natural systems, and the generally wild character that was intended upon designation of these federally managed lands.

### **Public Facilities**

**Trails and Trailheads.** Within the Addition there are currently no designated trails or developed trailheads. A temporary route of the Florida National Scenic Trail has been designated through the Addition.

Within the original Preserve, there are officially designated and maintained trails for hiking, bicycling and ORV use. NPS staff patrols, maintains, and repairs all trails. Trail use is divided primarily between ORV riders and hikers, with limited use by bicyclists. The *Recreational ORV Management Plan* (completed in 2000) reflects existing use and associated impacts in the original Preserve.

**Roads.** Within the Addition there are no NPS-managed roads for standard highway vehicles. Interstate 75 crosses the northern portion of the Preserve for about 30 miles, 19 miles of which are in the Addition.

U.S. 41, also known as the Tamiami Trail, is a paved highway that crosses the southern portion of the Preserve for about 36 miles, 1 mile of which in the Addition.

State Road 29 is a paved highway that runs north/south between Immokalee and Everglades City and is immediately adjacent to the western border of the Addition for about 29 miles.

### **Visitor Information**

Within the Addition visitor information is limited to way-finding signs. No waysides or visitor information is available.

Within the original Preserve, visitor information is provided at the Oasis Visitor Center and a series of waysides along U.S. 41.

**Camping.** Backcountry camping is the only type of camping allowed in the Addition and is subject to NPS backcountry camping regulations and guidelines. No developed campgrounds currently exist in the Addition.

Within the original Preserve camping opportunities range from developed

campgrounds to backcountry camping. NPS-managed campgrounds are not near the Addition.

### **Administrative Facilities**

**Offices, Storage, and Buildings.** The NPS Fire Operations Center is in the Addition on SR 29 at Copeland. This facility provides office space for fire management staff and equipment storage.

All other NPS operations are based out of facilities in the original Preserve. There is limited space in these facilities to accommodate additional staff. It is at least an hour's drive from these facilities to access the northeast portion of the Addition from Interstate 75.

**Preserve Housing.** Within the Addition there is no housing for NPS staff. There is staff housing in the original Preserve, primarily NPS headquarters and the Oasis Visitor Center. Housing is provided to law enforcement, fire management, and seasonal staff.