Exploring the sawgrass and freshwater

Affected Environment 4

Snake Bight Trail

INTRODUCTION

This chapter describes the existing environment of Everglades National Park. The focus is on elements (natural and cultural resources, visitor opportunities, socioeconomic characteristics, etc.) that would be affected by the actions proposed in the alternatives, should they be implemented. These topics were selected on the basis of federal law, regulations, executive orders, NPS expertise, and concerns expressed by other agencies or members of the public during project scoping.

The first section in this chapter discusses impact topics that are analyzed in detail in this General Management Plan / Wilderness Study / Environmental Impact Statement. The next section discusses impact topics that are not analyzed in detail and explains why they were excluded. The table below identifies topics considered for detailed analysis and those topics dismissed.

TABLE 8. IMPACT TOPICS CONSIDERED AND DISMISSED

Impact Topics Considered in this Plan *Alternatives in this plan have potential to affect these resources or topics.*	**Impact Topics Dismissed from Detailed Analysis in this Plan** *These resources or topics are important, but alternatives in this plan would have only positive impacts on them, and/or any adverse impacts would be negligible to minor.*
Hydrologic Resources	Air Quality
Landscape and Soils	Federal Special Status Species (selected species)
Vegetation	Night Skies
Wildlife	Prime and Unique Farmlands
Fisheries	Floodplains
Federal Status Species (selected species)	Energy Efficiency and Conservation Potential
Natural Sounds	Indian Trust Resources
Wilderness Character	Environmental Justice
Archeological Resources	Ecologically Critical Areas, Wild and Scenic Rivers, and Other Unique Natural Areas
Historic Structures, Sites, and Districts	Carbon Footprint
Cultural Landscapes	Conformity with Land Use Plans
Ethnographic Resources	Public Health and Safety
Museum Collections	
Visitor Use	
Visitor Experience and Opportunities	
Regional Socioeconomic Environment	
Park Operations and Management	

IMPACT TOPICS CONSIDERED AND ANALYZED IN DETAIL

HYDROLOGIC RESOURCES

Everglades National Park is part of a large, interconnected freshwater system called the Kissimmee-Lake Okeechobee-Everglades Watershed. This watershed covers almost 11,000 square miles in south-central Florida (NPS 1997). Hydrology in the watershed is dominated by a dry season from December to May and a wet season from June to November when 75% of the annual precipitation falls (Duever et al. 1994; Lodge 2005). Rain falls across roughly 14,000 square miles in central and south Florida, which is nearly flat (there is about an inch per mile elevation change from Lake Okeechobee to Florida Bay) (Davis 1994; NPS 2008d).

Historically, the Everglades system was fed by sheet flow from lakes and wetlands in the northern reaches of the watershed during seasonal rainy periods. This surface flow moved slowly south into the extensive wetlands that define the Everglades, through the "river of grass," and on to Florida Bay or Ten Thousand Islands (SFWMD 2000a). This flow was as much as 50 miles wide and ranged from 6 inches to 3 feet in depth, moving about 100 feet per day from May to October (Obeysekera et al. 1999). During the wet season, the landscape was nearly covered with water. Much of the water flows through the unique ridge-and-slough habitat of south Florida. This landscape is characterized by elongated ridges and troughs of limestone and peat. Average water depth is about 1 foot but can be as deep as 3 feet during the rainy season (Lodge 2005). In other areas, wet season flows inundate marl prairie habitat and encroach upon pinelands, hardwood hammocks, and other tree islands. As winter approaches, water slows and then ceases for the annual dry season. Although most habitats dry completely during winter, the ridge-and-slough landscape usually retains some of its water, sometimes in shallow pools and sometimes as deep pools, both of which provide valuable aquatic habitat into which many animals retreat until the next rainy season (Gunderson and Loftus 1993).

The watershed has been highly engineered and managed for agriculture, flood control, and supplying water for a growing population (Fourqurean and Robblee 1999). The region is now characterized by large urban centers and highly productive agricultural areas, which have been made possible by the dramatic alterations of the natural hydrology. Beginning in the 1880s, development was assisted by the large-scale drainage of wetlands, construction of channels to carry water to the population centers of the east, and flood control structures. These efforts would eventually create an extensive system of levees, canals, and water control structures. Direct effects on the park's hydrology include disruption or elimination of overland sheet flows, changes in the location and timing of flows, and permanent flooding in some areas and permanent drainage of others (SFWMD 2000a; Sklar et al. 1999; SCT 2003). Portions of the park now flood more deeply during the rainy season and are drier during the winter. Indirect effects include land subsidence, abnormal fire patterns, and widespread changes in vegetation and animal communities (Gunderson and Snyder 1994; Sklar et al. 1999; USFWS 1999h). Canals can also serve as habitats and movement corridors for invasive nonnative plants (e.g., hydrilla and water hyacinth) and animals (e.g., cyclids and sailfin catfish) that impact Everglades ecosystems (ECISMA 2010).

Water Quality

Before regional urban and agricultural development, south Florida waters were low in nutrients (oligotrophic) such as nitrogen and phosphorus (SFWMD 2000a).

Historically, phosphorus content was approximately 10 parts per billion or less (Lodge 2005), 90% of which was contributed through wind-borne particles and rain (Davis 1994). The water was also generally highly oxygenated and ranged from "soft" (low in dissolved minerals) and slightly acidic in peat-dominated areas to "hard" (high in dissolved minerals, especially calcium) and alkaline where it came into contact with limestone bedrock such as in southern portions of the Everglades (Noe et al. 2001; Lodge 2005). This high-quality water fed the interior wetland systems and supplied Florida Bay with seasonal flushing that moderated the salinity of this large estuary (SFWMD 1992).

Today, water quality in some parts of the Everglades is dramatically different than it was before 1900. Surface water entering the park is almost completely controlled and, having drained from agricultural and developed areas, is periodically laden with nutrients, dissolved solids, and trace amounts of pesticides and herbicides. Average phosphorus content at discharge structures in the 1980s and 1990s was 0.1 to 0.25 milligrams/liter (mg/L), representing a ten-fold increase from historic levels (SFWMD 1992, 2000). This phosphorus enrichment modifies the structure and function of the Everglades ecosystem (Noe et al. 2001); even small changes in available phosphorus can alter the composition of plant and animal communities within a few years (Gaiser et al. 2005). Mercury contamination has been a concern in the Everglades since the 1980s. Sources include waste incineration and coal-burning power plants as well as indigenous sulfate-reducing bacteria in wetland soils that convert mercury deposited in wetlands, lakes, and streams into a toxic form called methyl mercury (FDEP 2003, 2010). The park, in association with the state of Florida and others, has been involved in a comprehensive mercury monitoring and effects research program since 1993 (FDEP 2003).

Freshwater Resources

Ridges and Sloughs. Most water in the Everglades flows along the ridge-and-slough systems of south Florida. Small differences in elevation associated with the ridge (high) and slough (low) topography create a varied environment with different water depths, hydroperiods, and flow environments. The average water depth of sloughs approaches 1 foot, but they can be as deep as 3 feet during the rainy season. They support a variety of marsh communities, including their hallmark tree islands. Sloughs are underlain by peat and support a wealth of microbes and fauna (Gunderson and Loftus 1993). Sloughs are the arteries that carry the lifeblood of the Everglades system—freshwater from the north—to the brackish and marine environments to the west and south.

Shark River Slough, the largest slough in the Everglades, supplies fresh water to the southern portion of the greater Everglades system. Shark River Slough is actually a ridge-slough system that flows in a southwesterly direction toward Whitewater Bay and the Gulf Coast (Livingston 1990). The slough width varies from 9 to 17 miles, with a flow gradient of only 2 to 3 inches per mile (Olmsted and Armentano 1997). Shark River Slough includes marshes, tree islands, and ponds; it supports important populations of freshwater fishes, reptiles, and birds. As the slough reaches the southwestern portions of the park, it gradually disperses into a complex web of small streams that form the coastal mangrove estuaries (Olmsted and Armentano 1997).

Shark River Slough was originally formed by sheet flow originating from Lake Okeechobee and traveling south. Now flows in the slough are fully supplied by diked impoundments north of the park, with the quantity and timing of flows dramatically altered from historic norms. In general, peak wet season flows are substantially reduced compared to natural conditions. However, in some areas of the park, such as the western marl prairies, peak wet season flows are greater due to the S-12 canal structures (see below). In northeast

Shark River Slough peak wet season flows are much lower than natural flows (Olmsted and Armentano 1997).

Taylor Slough provides the main flows in the eastern portions of Everglades National Park. Its headwaters include the park's northeastern boundary and the area known as Frog Pond (Livingston 1990). Although Taylor Slough is smaller than Shark River Slough, Taylor Slough flows are a critical component of park hydrology. This drainage is the primary source of freshwater flows into the northeastern portions of Florida Bay. Taylor Slough's current flows have been reduced from historic conditions, but it continues to provide important habitat for Everglades plant and animal communities.

Canals. Modern drainage and flood control measures have significantly altered the Everglades system. Despite early attempts at complete drainage, the vastness of the wetlands prevented their total loss (Ewel 1990; Kushlan 1990). Today a series of canals, levees, pump stations, and gates are used to manage water in the region. The South Florida Water Management District and the U.S. Army Corps of Engineers coordinate efforts to manage these structures to provide flood control and freshwater flows for human and natural systems. The following water management structures are near the park and affect flows:

- C111 (canal)
- S12 A, B, C, and D (all gates)
- S-332B, C, and D (all pump stations)
- L-67, L-31N, and L-31W (all canals)
- S-18C, S-197, and S-33 (all gates)

The most significant of these is the C-111, a large canal that controls freshwater in the southeastern reaches of the park. Historically, flow through Taylor Slough would eventually discharge to central Florida Bay. Now, however, the C-111 canal drains much of this water from Taylor Slough and diverts it into northeast Florida Bay (or into Barnes Sound during heavy rains). This canal drainage affects hydropatterns in Taylor Slough by reducing peak water levels and alters the timing and spatial distribution of discharge to Florida Bay. The C-111 Spreader Canal project, a CERP project begun in 2010, is intended to mitigate these negative impacts on park water resources by capturing the seepage from Taylor Slough and pumping it back toward the park boundary.

Canal waters are generally clear and free flowing, because they are managed to move large volumes of water. They support a fishery of both nonnative and native species and are frequently used for recreational fishing in the eastern portions of the park. In addition, these waterways have aided the spread of nonnative plants throughout south Florida. The park and other land management agencies control hydrilla, water hyacinth, melaleuca, and torpedo grass in the canals and along their adjacent levees.

Brackish and Saltwater Resources

The marine resources of Everglades National Park are shallow marine waters under the influence of freshwater inflows. Habitats include Florida Bay, the coastline of the Ten Thousand Islands region, and brackish Whitewater Bay (Livingston 1990). These areas are critical to the park's diverse and unique wildlife as well as its marine-based recreation.

Florida Bay. Florida Bay extends from the terrestrial portions of the southern Everglades southward to the Florida Keys. It is the portion of the Gulf of Mexico influenced by freshwater flows from the Everglades from both natural and man-made sources, including Taylor Slough, rainfall, groundwater input, and canal flows (Nelson et al. n.d.).

Florida Bay is a unique, subtropical estuary that has resulted from complex interactions of freshwater inflows, circulation patterns, and changing water conditions. Recent research

has shown that fluctuations in salinity and nitrogen loading occur with freshwater inflows, and that the bay generally has little, if any, phosphorus present. The bay serves as a marine lagoon, with salinity varying due to seasonal cycles in precipitation and evaporation and longer-term climate changes (Florida Bay Science Program 2003).

An ecotone of brackish water, mangrove forests, salt marshes, and tidal zones separates the Everglades from the bay (RECOVER 2004). The bay is generally a shallow, soft-bottomed environment that supports meadows of seagrasses. However, there are areas of exposed hard bottom, rocky outcroppings, and an occasional coral head. The bay is home to a variety of invertebrates—from queen conch to shrimp, oysters, and spiny lobsters. An overwhelming number of commercially and recreationally important fishes also spend time in Florida Bay, including snappers, black drum, and the Florida pompano (Livingston 1990).

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

Ten Thousand Islands Estuaries. The Ten Thousand Islands are a broken string of sandy islands divided by interconnected passes and tidal creeks. Covering the western portions of the park, these estuaries are fed by sheet flow from the park's interior and by tributaries that drain the Everglades system. Here, Gulf of Mexico waters mix with fresh inflows and create a salinity gradient. Salinity and water quality vary by season and can be dramatically affected by rains and tropical storms. This region is largely undisturbed by human activity, and it is one of the least polluted coastal regions of the United States (Livingston 1990).

This coastline is characterized by low energy: there is frequently little or no wave action or wind-mixing of the water column, and the twice-daily tidal range is about 3 feet. Under these conditions, warm air temperatures can rapidly heat the water, depleting oxygen, stressing plants and animals, and reducing system productivity. In addition, complex upstream processes can deliver turbidity and color released from vegetation (Livingston 1990). This results in the changing water conditions seen along the coast, from tan and milky to a relatively clear blue-green.

Whitewater Bay. Whitewater Bay, in the undeveloped southwestern reaches of the park, is an expanse of brackish water encasing a myriad of mangrove islands. Its name serves as a warning to those who venture into this wilderness—storms can generate enough wave action to reconfigure the islands and sloughs of the bay (Jackson 2000). The bay receives fresh water from Shark River Slough. It opens to the northwest and flows into the Gulf of Mexico. Tidal flows maintain the brackish environment, carrying nutrients out to deeper waters and creating a highly productive fishery and abundant wildlife habitat, including for manatees, wood storks, and osprey (Livingston 1990; Jackson 2000).

Wetlands Classification and Protection

Everglades National Park is predominantly a wetland environment. The classification system used by the National Park Service is that created by Cowardin et al. (1979). The most common wetland classifications within the park are the freshwater emergent wetland, freshwater-forested and shrub wetland, estuarine and marine wetland, and estuarine and marine deep waters (USFWS 2004a). The location and extent of these wetland types is determined by the period and depth of flooding, whether the water is fresh or saline, the degree to which soils have developed

specific hydrologic characteristics, and the vegetation community present. For a detailed description of park plant communities, see the "Vegetation" section later in this chapter.

Wetlands are afforded special protection under U.S. law in Executive Order 11990: "Protection of Wetlands" and by NPS management in Director's Order 77-1: "Wetland Protection." The National Park Service must avoid direct or indirect adverse impacts on wetlands or, where impacts cannot be avoided, minimize loss or degradation by every practicable effort. Any actions that may reduce or degrade wetlands are governed by the Clean Water Act and Rivers and Harbors Act, and wetlands are regulated by the U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency.

Ongoing and Planned Hydrologic Restoration Programs

In response to public concern about water management and continued ecosystem degradation, all levels of government have organized efforts to work toward a balanced and sustainable south Florida ecosystem. Several environmental and growth management laws have been passed in an attempt to address the needs of Everglades ecosystem restoration. Restoring and maintaining, at least in part, the natural hydrologic regimen of the area is the most vital component of all restoration efforts. These plans will ultimately affect the environment of the park, and the National Park Service will work in concert with these programs to protect vital resources of Everglades National Park. These plans and projects are summarized in chapter 1, and their impacts on park hydrologic resources are discussed in the cumulative analyses in chapter 5.

Climate Change

Climate change is expected to increase the extent and frequency of coastal flooding (Loehman and Anderson 2009) from storm surges and sea level rise. Potential effects on water resources due to climate change include increases in flooding, saltwater intrusion, and loss of protective berms, leading to conversion of freshwater wetlands to brackish or saltwater habitats. Changes in precipitation and in air and water temperatures in Florida will likely alter the nutrient cycling in the Everglades because temperature has a marked effect on biotic and abiotic processes, and can impact these processes in short time frames with even slight changes in temperature. Floods may alter the natural floodplain timing and distribution in Everglades National Park, leading to changes in vegetation, wildlife habitat, and fire regimes (Pearlstine et al. 2008). Additionally, shifts in water temperature may have dramatic impacts on dissolved oxygen, pH, and acidity of marine waters, causing a cascade of effects in oxygen content, nutrient cycling, and associated vegetation and wildlife. Wetlands, estuaries, and areas like Florida Bay are especially vulnerable because water temperature alters biochemical components in the ecosystems (Pearlstine et al. 2008). Declines in coastal water quality, habitat quality, and biodiversity are the most likely effects of these changes. Salt marshes may have better resilience to sea level rise, especially if new sedimentation rates are roughly equal to the rate of sea level rise. However, localized impacts on salt marshes could occur, depending on the rate and type of changes.

LANDSCAPE AND SOILS

Most of the physical structure of the Florida peninsula was in place about two million years ago. Since then, several periods of glaciation caused the sea level to rise and fall, alternately inundating and then retreating from the land. During inundation, layers of limestone (CaCO3), sand, and seashells were deposited to form the near-surface bedrock under modern-day Florida. Although minor compared to underlying layers, these most-recent sediments "are critically important to

modern vegetation and wildlife and to human uses of South Florida" (Lodge 2005).

Of the seven major soil types in Florida, three occur in Everglades National Park—spodosols, histosols, and entisols (Brown et al. 1990).

- **Spodosols** are sandy and characterized by a subsurface layer of accumulated organic matter in combination with aluminum and iron. These soils are nearly level, usually poorly drained, and common in flatwoods and wet to dry prairies.
- **Histosols** such as peat, are soils of organic origin from sawgrass (*Cladium jamaicense*) in some areas and white water lily (*Nymphaea odorata*) in others (Olmsted and Armentano 1997). Histosols are very poorly drained and underlain by marl or limestone. Marls are a mixture of clay and calcium derived from underlying limestone. Marls are formed by precipitation of calcite during photosynthesis by large mats of "periphyton," which are complex collections of cyanobacteria (blue-green algae), eubacteria, diatoms, and eukaryotic algae common in sparsely vegetated, open freshwater marshes and swamps in the Everglades (Browder et al. 1994; Scinto and Reddy 2003).
- **Entisols** are poorly drained, marly, and thin sandy soils underlain by limestone. They are common in south Florida rockland communities.

Soils on the park's Gulf Coast are combinations of entisols and histosols. They may be sloping sandy beaches or dunes, or poorly drained soils with a variable content of mineral and organic materials that are subject to frequent tidal inundation. Common communities include dunes, maritime forests, salt marshes, and mangroves (Brown et al. 1990).

Human activity has had widespread impacts on the soils of the Everglades. Because of their usefulness for agricultural purposes, spodosols and histosols have been most impacted in south Florida. Because of the importance of inundation in many soil processes in south Florida, chief among impacts on soils are changes in the timing, distribution, and amount of flooding. For instance, the natural rate of peat accumulation in Florida is estimated to be about 3 inches per 100 years. However, when drained, peat is subject to subsidence or thinning at about 1 inch per year. Causes include mechanical compaction (settling), burning, shrinkage due to dehydration, and most importantly oxidation of organic matter (Brown et al. 1990; Ingebritsen et al. 2005).

According to Ingebritsen et al. (2005), in the Everglades Agricultural Area, the initial peat thickness tapered southward from approximately 12 feet near Lake Okeechobee to about 5 feet near the southern boundary. However, subsidence from 3 to as much as 9 feet has occurred in cultivated areas, and uncultivated areas of similar size have subsided as much as 3 feet. The authors note that "such elevation changes are tremendously significant to a near-sea level wetlands system in which flow is driven by less than 20 feet of total relief."

Other impacts on soils include atmospheric deposition of metals, eutrophication of marshes and estuaries by sewage effluent, and agricultural runoff. Natural changes arise from hurricanes, drought, and fire (Brown et al. 1990).

Climate Change

Climate change may impact the landscape and soils in the Everglades as a result of increased storm intensity and duration. Soils subsidence and accretion could be affected by increased storm intensity (NPS 2008). Additionally, intrusion of saltwater inland could contribute to coastal erosion, inundation, and changes in wetlands and vegetation across vast areas of

south Florida (NWF 2006). The rate at which sea level rises in the future would be an important factor, and is unknown to some degree. If sea level were to rise slowly, mangroves and shallow mud banks might be able to keep pace with the change. If sea levels were to rise rapidly, mangrove areas and coastal wetlands may not be able to adapt and could be submerged. To date, the impact of coastal erosion has been localized and has not threatened the Everglades ecosystem. But this could change if the rate of sea level rise increases substantially.

VEGETATION

[Note: Appendix E is a listing of common and scientific names for various species discussed in this document.]

Everglades National Park contains a wide diversity of plants and plant communities that are distinctive in the continental United States and on a global scale. Several environmental factors combine to produce this assemblage of plant communities (SFWMD 1999; NPS 2001).

- The park occupies the transition zone between tropical and temperate climates.
- The park includes large expanses where fresh and saltwater mix.
- Water in the park is naturally low in nutrients.
- Nearly flat terrain creates a complex mosaic of habitats and plant communities dependent on subtle changes in elevation.
- Distinct wet and dry seasons create natural cycles of fire, drought, and tropical storms.

Major community types in the Everglades include marine and estuarine communities, mangrove forests, cypress swamps, coastal salt marshes, coastal prairies, freshwater sloughs, marl prairies, pine rocklands, and hardwood hammocks. The distinguishing characteristics and ecological importance of each habitat are discussed below. This section also reviews the status and impact of invasive nonnative plant species in the park.

Vegetation Communities

[Note: See the "Ecosystem" map on the following page to understand where these habitat types are in the park.]

Marine and Estuarine Communities. Florida Bay and the offshore portions of Ten Thousand Islands are the primary marine estuary environments of the park. These areas include a combination of habitats with complex physical, chemical, and biological interactions. Varying salinity and nutrient levels, shallow depths, and energy input from adjacent open seas provide a range of conditions that nevertheless retain universal characteristics. This marine system has high productivity of plankton and submerged aquatic vegetation, but is dominated by relatively few plant species such as seagrasses. These habitats have relatively low diversity compared to nearby coral reef environments (Livingston 1990).

According to Dawes et al. (2004), "nearly all of the commercially and recreationally valuable estuarine and marine animals depend on seagrass beds as refuge or habitat for parts or all of their life cycles." Seagrasses are the only flowering plants that live entirely in seawater, thriving in depths between 3 and 15 feet. Six species occur in Florida, three of which are dominant: turtle grass, manatee grass, and shoal grass (Jaap and Hallock 1990; Florida Bay Science Program 2003). Turtle grass is the best known seagrass, having thin blades reaching as long as 1 foot in length. Florida Bay supports about 1,900 square miles of turtle grass meadows, but there is little similar development in Ten Thousand Islands (Livingston 1990; Jaap and Hallock 1990). Manatee grass is found mixed with other species but can occur in small, monotypic patches. Manatee grass leaves are string-like:

round, about 1 millimeter in diameter, and as long as 18 inches in length. This species has shallow roots and is easily uprooted if sediments are disturbed. Shoal grass is a thin, ribbon-like seagrass that grows as long as 8 inches in length. Shoal grass is an early colonizer and can be found in areas where the sediment has been disturbed (Jaap and Hallock 1990).

Seagrass is the most productive and important habitat of the park's nearshore environment.

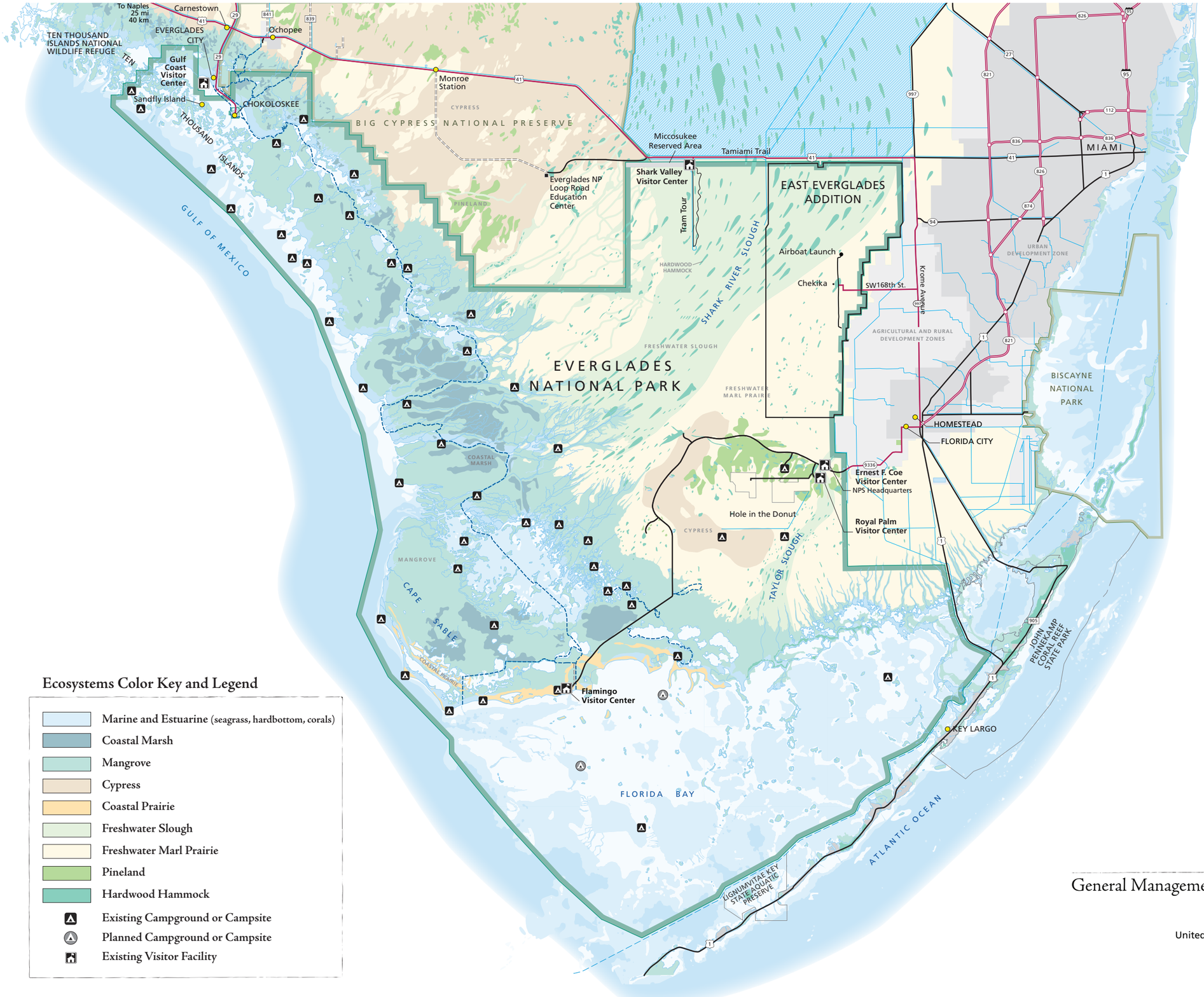
Seagrass communities historically covered about 90% of Florida Bay; by contrast, mangrove forests occupied only 7%. The seagrass usually occur as monocultures or as a mixture of the species, appearing as vast meadows on the shallow bottom. They greatly affect the chemical, physical, and biological processes of the bay and play a vital role as habitat (FBSP 2003). Local variations in salinity, water quality, and sediment properties can produce changes in seagrass populations. Environmental changes can reduce stem density, provide respite from diseases, or allow development of robust communities (FBSP 2003). In 1987, seagrass die-offs were reported by backcountry fishing guides; more than 9,884 acres (4,000 hectares) of seagrasses had died off (Robblee et al. 1991). After the initial signs of the die-off, seagrass communities in the bay rebounded and showed increases in abundance and productivity of shoal grass and turtle grass (Zieman et al. 1989), although they are now increasingly threatened by propeller scarring.

Florida Bay seagrass beds provide important habitat for many species of fish and other marine animals. Florida Bay is also heavily used by recreational boaters for, among other things, access to productive fishing areas. The bay is a complex system of mud banks, flats, and shallow basins, so boaters can easily damage the bay's sensitive bottom resources. Boat propellers can churn up sediment and bury or scar seagrass. Damage to the park's vast seagrass beds from motorboat propellers has been a problem for decades, but the extent and severity of the problem had not been well understood or described. During this planning process, the need to better understand seagrass scarring patterns and trends was identified.

To learn more about the problem of seagrass scarring by motorboat propellers and potential ways to address the problem, the park conducted a seagrass scarring mapping project. This study, using 2004 digital imagery that covered all of Florida Bay, found that Florida Bay seagrass scarring is widespread, with dense scarring found in shallow depths, near all navigational channel/access routes, and around areas most heavily used by recreational boats. In addition, scarring occurs when motorboat propellers dredge new channel/access routes or maintain unmarked human-made channel/access routes. Dense scarring is more common near marked and unmarked channel/access routes and shorelines. Substantially more scarring was identified in the study than in a previous statewide study conducted in 1995, and scarring may be increasing at specific Florida Bay sites. In 2006, higher resolution imagery was taken for Snake and Garfield bights. The results of both studies were combined into the complete peer-reviewed study "Patterns of Propeller Scarring of Seagrass in Florida Bay: Associations with Physical and Visitor Use Factors and Implications for Natural Resource Management" NPS 2008c). If higher resolution imagery had been available for all of Florida Bay, instead of for just Snake and Garfield bights, more scarring probably would have been documented.

In 2011, the park established the 9,400-acre Snake Bight pole and troll zone, the largest of its type in Florida as a noncombustion engine zone in northern Florida Bay to protect this important, heavily used shallow-water area. In advance of zone establishment, the park committed to a monitoring program to determine the effectiveness of the zone in protecting and recovering seagrass resources. The objective of the Snake Bight pole and troll zone monitoring project is to quantify the amount and severity of propeller scarring within the Snake Bight pole and troll zone and

to compare it to other areas in the bay that do not have restrictions to combustion engine use. High-resolution aerial photography was used for the initial propeller-scarring assessment and in-water verification was conducted (10% of total scars) to confirm the presence and severity. A total of 6,040 potential prop scars were identified and mapped in all three project areas during the 2011 aerial image analysis. Scars ranged from ~2 meters to ~4 km in length, and the mean length was ~103 meters. Nearly 66% of the scars had a high severity (extensive substrate exposure) classification. Results of these analyses indicated high prop scar densities and hot spots along and between marked and unmarked channel/access routes at the boundaries between seagrass banks and slightly deeper water and around areas most heavily used by boats (such as Porpoise Point and near Jimmy's Lake). The 2011 data will be compared to future monitoring events (funding is approved for a 2015 monitoring assessment) to determine the effectiveness of pole/troll zones as a management strategy and maximize their value for enhanced resource protection in the park. The baseline study "Snake Bight Pole and Troll Zone Everglades National Park: Year 1 Monitoring Report" NPS 2011 is available on the park website and future monitoring reports will be made available once completed.



Ecosystems Color Key and Legend

- Marine and Estuarine (seagrass, hardbottom, corals)
- Coastal Marsh
- Mangrove
- Cypress
- Coastal Prairie
- Freshwater Slough
- Freshwater Marl Prairie
- Pineland
- Hardwood Hammock
- Existing Campground or Campsite
- Planned Campground or Campsite
- Existing Visitor Facility

0 1 5 10 Kilometers
0 1 5 10 Miles

North

Ecosystems

General Management Plan/East Everglades Wilderness Study
Everglades National Park

United States Department of the Interior • National Park Service • DSC
December 18, 2012

The following "Propeller Scarring" map shows propeller scarring in Florida Bay obtained from the available data sources (2004 digital imagery for all of Florida Bay, combined with the higher resolution 2006 imagery for Snake and Garfield bights only).

The 2008 seagrass study detected some 12,000 seagrass scars ranging from 6 feet to almost a mile in length. The total length of scars was estimated at 325 miles, but additional imagery analysis suggested total scarring may be underestimated by a factor of 10, i.e., there may be as many as 3,250 miles of scars in Florida Bay. Scars are present throughout the shallow areas of Florida Bay, but most are at depths of 3.5 feet or less (NPS 2008c).

According to the NPS study (2008c), seagrass recovery from propeller scarring varies depending on the species and the severity of the scarring. Estimates range from as little as 0.9 year to 7.6 years. Experiments conducted in Florida Bay indicate that shoal grass and manatee grass recover five to seven times faster than turtle grass. However, other studies estimate that scar recovery in some areas in the Florida Keys may require from 10 to 60 years (USFWS 1999h; NPS 2008c). Differences in impacts on and recovery rates between species may alter the community composition and abundance of different seagrass species. Recovery rates are much slower when scarring is deep because substrate into which plants root themselves is removed and deep scars are more susceptible to secondary, continued erosion and expansion of scars from currents, winds, waves, and storms. A negative cycle may begin when increased turbidity reduces available light; lower light levels limit seagrass survival and growth, and the subsequent loss of seagrass reduces sediment stabilization, which increases turbidity (USFWS 1999h). The NPS study (2008c) also noted that "heavily used areas that are continually scarred will probably never recover under current boating pressure. Active restoration of damaged seagrass communities is technically possible but expensive and time consuming."

Because the seagrass scarring problem is not improving and may be worsening over time, the 2008 study suggested that new management strategies are needed to protect seagrass beds as part of an overall ecosystem management approach in Florida Bay. Potential management strategies to minimize damage cause by propeller scarring could include a mandatory education program, improved navigation aids, pole/troll zones, idle and speed zones, limits on motorized access by watercraft characteristics, and area-specific seasonal access limits or closures in highly impacted locations.

Like terrestrial grasslands, these marine meadows support a diverse community of other organisms. Macroalgae are primary producers of organic matter, and their calcium skeletons are incorporated into the sediment when they die. Moving up the food web, grazers such as shrimp and crabs forage in the grass, and predators then harvest these species (Jaap and Hallock 1990).

The seagrass root system anchors nearshore marine soils, while the leaves improve water quality by removing suspended sediments from the water column by slowing the velocity of water as it passes through the leaves, thereby allowing the suspended sediments to settle to the bottom. The leaves also provide important vertical structure and shelter, as well as important attachment surfaces for various algaes and other tiny plants. These algaes and plants provide the food base for a diverse assortment of invertebrates (e.g., echinoderms, mollusks, and crustaceans) that are, in turn, prey for other species. Species such as sea urchins, crabs, green sea turtles, and manatees feed directly on seagrass (Jaap and Hallock 1990; USFWS 1999h, Dawes et al. 2004). The nutrient removal function performed by seagrass beds may also play a role in protecting coral reefs (Dawes et al. 2004).

Mangrove Forests. Mangrove forests develop in coastal areas and are subject to regular or sometimes only occasional tidal flushing, which produces elevated soil salinity. Each

mangrove species has a different level of salt tolerance, which in part determines its location within the tidal zone. Mangroves grow best where wave energy is low and freshwater runoff contributes nutrients and helps maintain optimum salinity levels. As a transition zone from land to sea, mangroves serve important ecosystem functions in shore stabilization and nutrient cycling. Mangrove forests also provide foraging and nesting sites for wading birds and nursery habitat for pink shrimp and numerous other fish (Odum and McIvor 1990).

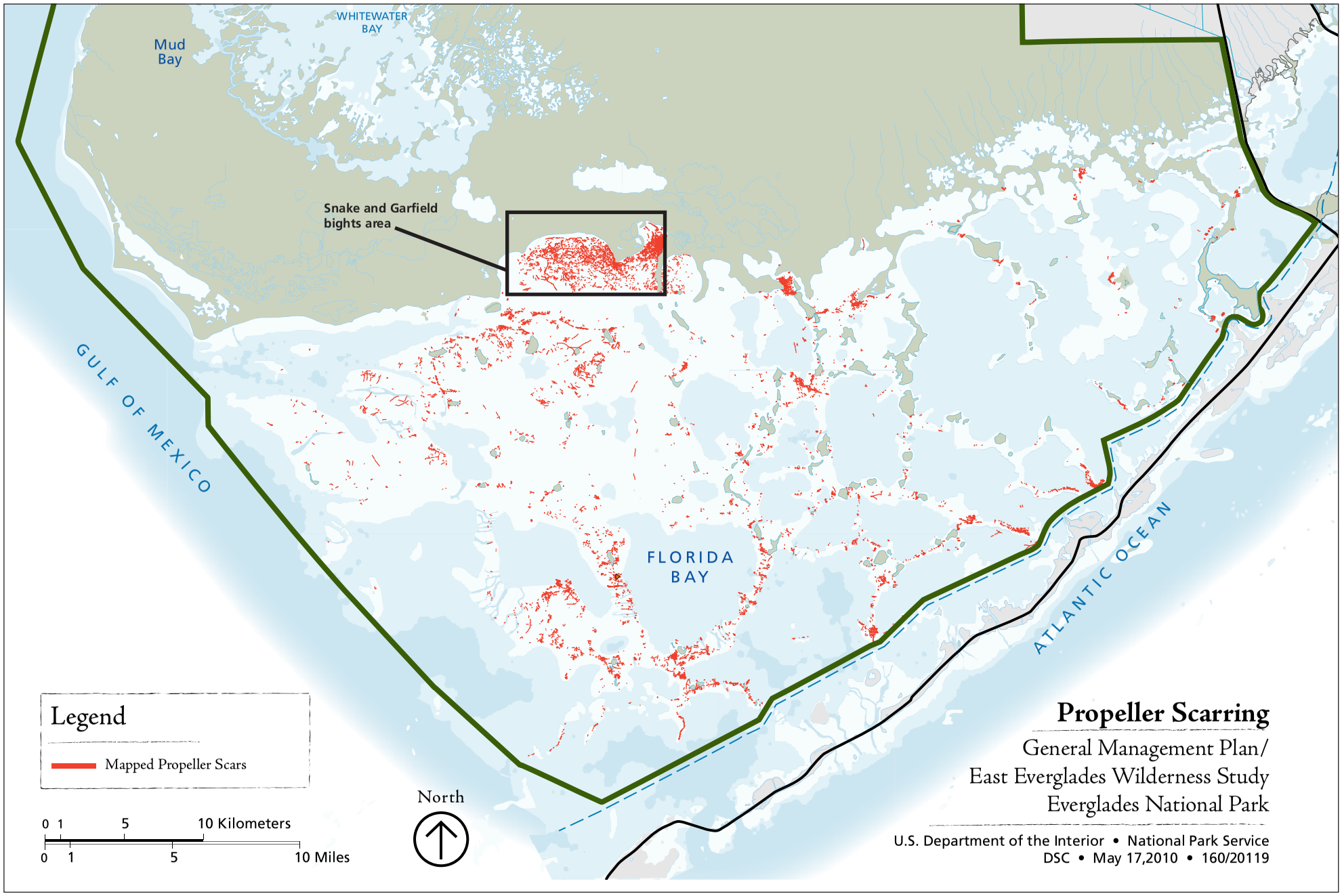
Mangrove forests in south Florida are composed of three mangrove species and one associated tree species, the buttonwood. Black mangroves are generally found rooted firmly on sandy shores and are most easily recognized by the short, aerial root projections (pneumatophores) that reach from 1 to 8 inches above the soil. Black mangroves can reach a height of 60 feet, but are seldom seen that size in the park. Red mangroves are often seen with their telltale "prop root" system extending through the seawater and into the soil beneath. They are generally shorter than black mangroves, and they flower throughout the spring and summer. White mangroves are trees or shrubs that have flat broad leaves as long as 3 inches long. The buttonwood is also a shrub or tree that grows with coastal mangroves. It resembles the white mangrove, with oval leaves as long as 4 inches long and a long-lasting woody fruit (Odum and McIvor 1990).

In Everglades National Park, mangrove forests extend from the shores of Florida Bay, westward along the coastline, to the northwestern region of the park in Ten Thousand Islands. Along the Everglades coastline, the most productive mangrove forest is found at the mouth of Shark River Slough, where it enters Florida Bay (FBSP 2003). Salinity, fluctuating water levels, and waterlogged anaerobic soils combine in the mangrove system to exclude many other vascular plants, including invasive nonnatives (Odum and McIvor 1990). However, where the forest canopy has been opened, a mosaic of other plant communities may appear. Patches of salt marsh, salt-tolerant prairie, hardwood hammock, and submerged aquatic vegetation can be found dispersed throughout the forests (USFWS 1999h).

In addition to the coastal forests, a rare community of dwarf mangroves grows in the shallow, upper inland reaches of Florida Bay, near the Flamingo area. The stunted height and wide-spaced open canopy of this forest reflects low productivity, in which reduced freshwater inflows, attenuated tidal movement inland, and low phosphorus content combine to limit tree height and density (RECOVER 2003). This is a visually striking landscape visited by many migratory and wading birds that forage in the shallows.

Cypress. "Cypress swamps" are the most common and widespread of the stillwater swamps. In south Florida, cypress occupies wet depressions in the soil underlain by peat and limestone bedrock. Water levels in the cypress community generally vary dramatically once or twice each year, with peat exposed for months at a time. When water is present, flow is seldom observed, and dissolved oxygen levels are low, reducing productivity beneath the cypress overstory (Ewel 1990).

Cypress forests composed of small diameter trees, widely spaced with a grassy understory, are similar to the communities that occur in Big Cypress National Preserve north of the park (Gunderson and Loftus 1993; Lodge 2005). Cypress are spindly, semi-deciduous trees, with leathery leaves and low transpiration rates. They can shed their leaves over the winter or during periods of drought stress. This leaf morphology and drought response helps them reduce their water



Propeller scarring in Florida Bay, Everglades National Park using best available data sources (2004 digital imagery for all of Florida Bay, plus higher resolution 2006 imagery for Snake and Garfield bights only).

requirements and survive during dry periods (Ewel 1990). Litter and fallen leaves that can accumulate beneath the canopy often release acids that tint any standing water a reddish brown (Ewel 1990).

Dome-like stands and river-like strands of cypress forest are common in the northern areas of the park. Here, cypress stands are interspersed with pinelands and sawgrass. Cypress trees often ring shallow ponds with fluctuating water levels, with a gradient to mixed hardwoods on the landward side. Further south, only stands of pond cypress occur (Ewel 1990).

Natural fires are typical in cypress communities, and in south Florida cypress may burn several times each decade. However, severe fire may cause stand replacement, with willows and hardwoods replacing cypress. Unfortunately, cypress is susceptible to melaleuca invasion if drained or burned (Ewel 1990).

Coastal Salt Marshes. Florida's coastal salt marshes develop where land meets sea, in intertidal zones that are at least occasionally inundated with seawater. Because mangrove forests dominate the coastal zones of the park, salt marshes are generally confined to seaward and landward fringes of the mangroves. They occur in areas of low wave energy where the mangroves are not dense enough to create heavy shade. There is also generally a watershed network of freshwater drainage immediately upstream of the marsh (Montague and Wiegert 1990).

There are from 825 to 1,175 square miles of nonmangrove "emergent tidal marshes" along Florida's Gulf Coast, most of which are in the park (Montague and Wiegert 1990).

Coastal salt marshes have both terrestrial and marine characteristics. These communities have been described as periodically flooded grassland. The vegetation consists of nonwoody, salt-tolerant plants that can adapt to the harsh conditions of high tidal exchange and freshwater inflows. Vegetation is often a combination of glasswort, saltwort, salt grass, sea purslane, and sea lavender. Narrow strips of smooth cordgrass occur seaward of some red mangroves, with strips of black needlerush on the landward side.

Despite the appearance of terrestrial plant species, the soils beneath these communities are generally anaerobic, a condition associated with mangrove forests and marine environments. These benthic soils support marine microalgae and phytoplankton, simple plants that provide the basis for a food web that sustains a myriad of crabs and snails. Coastal salt marshes are important for both resident and transient wildlife, including many commercially important wildlife species, and for cover, nurseries, and feeding. Predators move in and out of these marshes, using them to forage and for cover (Montague and Wiegert 1990; USFWS 1999h).

Coastal Prairies. Coastal prairies are the scattered sand beaches within the mangrove zone inland of Florida Bay and the Gulf of Mexico. The vegetation of this habitat is characterized by salt-tolerant herbaceous vegetation and shrubs that can withstand saltwater inundation from tropical storms and saltwater intrusion during droughts. Dominant plants are grasses, succulents, and other relatively low-growing plants that can withstand these harsh conditions (RECOVER 2004).

Common nonwoody species of the coastal prairie include West Indian bluestem, saltwort, glasswort, and sea oats. Shrubs of the system are sea grape, Jamaica dogwood, and lantana. This system is considered relatively low in productivity and does not promote formation of peat soils as do the nearby mangrove forests (Johnson and Barbour 1990; RECOVER 2004).

Coastal prairie communities are a long-term landscape that establishes after tropical storms have inundated coastal forests, depositing sediment and killing the mangroves and buttonwood species. Once halophytic (salt-tolerant or salt-loving) grasses and shrubs

have established, they seem to have the ability to repress recruitment of tree species, creating a stable prairie within the mangrove forest. These prairie communities became notably more common in the park following the great hurricane of 1935 and after hurricane Donna in 1960 (RECOVER 2004).

Freshwater Sloughs. Freshwater sloughs (channels), found throughout the park, are inundated year-round and contain a variety of wetland habitats. The gradual changes in elevation and hydrology within the slough determine the community type, and the landscape varies as these conditions change. Slough channels are dominated by vast stretches of sawgrass, a rhizomatous, perennial sedge, with some 14 other species found in this association. The sawgrass marsh transitions to spikerush and maidencane marshes, as subtle changes in substrate, hydrology, and elevation dictate. Elevated sites within the sloughs support a variety of tree islands, with willowheads occurring in ponded depressions (Olmsted and Armentano 1997). Willowheads are common tree islands that are generally monotypic stands of willow. Sawgrass stands in the Everglades comprise 65% to 70% of the total freshwater slough vegetation cover (SFWMD 1999).

Sawgrass communities range from a sparse 15% ground cover to dense tall sawgrass stands that provide more than 90% ground cover. Sparse sawgrass stands are the most extensive in the slough environment, and these stands have relatively low species diversity, including common spikerush and various periphyton and macrophyte species. Dense stands of tall sawgrass form distinctive strands of notable height and density. Secondary species in these stands include spikerush and blue water hyssop (Olmsted and Armentano 1997).

With subtle changes in hydrology, elevation, and substrate, sawgrass marshes transition to wet prairies with a greater variety of grass-like plants. Wet prairies over peat include beaksedge, blue maidencane, and spikerush. Wet prairies over marl (a mixture of clay and calcium derived from the underlying limestone) occur in the southern Everglades on the east and west margins of Shark River Slough and Taylor Slough where bedrock elevations are slightly higher and hydroperiods are shorter (Olmsted and Armentano 1997; SFWMD 1999).

Elevated sites within the sloughs support a variety of tree islands or hammocks (Olmsted and Armentano 1997). Tree islands develop on slightly elevated limestone outcrops within the sloughs and marshes. There are four different tree communities on the islands: hardwood hammocks, willowhead, bayhead, and swamp forest.

The major species of slough hardwood hammocks are gumbo limbo, hackberry, white stopper, and cabbage palm. Bayheads, which occur in the midsections of tree islands, are closed-canopy forests consisting of seven tropical species. These trees are red bay, sweet bay, dahoon holly, willow, wax myrtle, cocoplum, and pondapple. The swamp forest species composition is very similar to that of the bayheads, but this community generally occurs at the downstream end of tree islands, with hardwood hammocks occupying the upstream end. The swamp forest has an open canopy with an understory of sawgrass or cattails (Olmsted and Armentano 1997). Sawgrass is a common associate on higher sites, and aquatic plants such as mermaid weed occur on wetter sites. Because willow is an early colonizer, willowheads are usually found in disturbed areas such as alligator holes (Gunderson and Loftus 1993).

Marl Prairies. Marl prairies are marshy freshwater grasslands that occur on higher, drier sites that are flooded about 50 to 150 days each year to a maximum water depth of about 4 inches. These prairies, also known as "wet prairies," have the most diverse plant life in the Everglades, with more than 100 species recorded. Periphyton shares dominance of the prairies with many species of grasses and sedges that may reach 3 feet in height. Species composition varies greatly, depending on hydroperiod, local soil condition, and

disturbance history (Gunderson and Loftus 1993; Kushlan 1990). The park's marl prairies generally extend out laterally from the main drainages. These relatively large expanses contain interspersed deep-water marshes and upland rises that are seldom flooded (Kushlan 1990). According to Davis et al. (2005), there are approximately 735 square miles of marl prairie on either side of Shark River Slough.

Marl prairie plants are quite tolerant of both flooding and drying. Dominant vegetation common to these wet prairies include maidencane, beak rushes, black sedge, white top sedge, and grasses such as muhly grass and bluejoint panicgrass (Gunderson and Loftus 1993; Kushlan 1990). Sawgrass can be present in these prairies, but stands are sparse and stunted compared to their marsh-living relatives. Some shallow-rooted species that also occur in pineland understories, such as St. John's wort, also grow in marl prairies but are easily killed by drying, which triggers seed dispersal. Wet prairies in the highest elevations can also be invaded by saw palmetto (Kushlan 1990).

Marl prairies provide habitat for one of the park's endangered birds, the Cape Sable seaside sparrow; thus these areas are being protected from further development and degradation (Lodge 2005). Alligator holes, solution holes, and adjacent sloughs provide important refuge habitat for aquatic species during dry periods (Davis et al. 2005).

Periphyton. Where plant densities permit enough sunlight to penetrate to the substrate in slough and wet prairie habitat, periphyton develops. Periphyton is a complex collection of cyanobacteria (blue-green algae), eubacteria, diatoms, and eukaryotic algae common in sparsely vegetated, open freshwater marshes and swamps (Scinto and Reddy 2003). Periphyton grows on the substrate, attaches to rooted vegetation, or forms mats on the water surface, sometimes in association with floating vegetation such as bladderwort. Periphyton accounts for a significant portion of the total vegetation and productivity in sloughs and wet prairies, and it provides habitat for invertebrate populations.

Along with decaying plant material, periphyton forms the base of the Everglades food web. Periphyton accounts for much of the phosphorus storage in open-water habitats, and it plays a critical role in maintaining low phosphorus concentrations (Browder et al. 1994; Rader 1994; SFWMD 1999). Periphyton productivity and nutrient cycling influence many biological and chemical processes (Scinto and Reddy 2003). Biomass and productivity peak toward the end of the wet season (August through October) and reach a minimum during the colder months of the dry season (January through March) (SFWMD 1999).

Pinelands. Pinelands in south Florida are variously known as pine woodlands, pine flatwoods, pine barrens, and rockland pines (USFWS 1999h). Rockland pine forests in south Florida occur on elevated sites with thin soils, atop limestone bedrock ridges and outcroppings. These elevation peaks vary from feet to inches higher than the surrounding lowlands, resulting in varying inundation periods (Snyder et al. 1990). Within the pinelands are a series of transverse glades, marl prairies lower in elevation than the pinelands, which sometimes hold water in the wet season. In the past, some of these "finger glades" held enough water to act as channels for transverse flow across the pinelands southward into marshes. However, because of the general lowering of the water table and the crossing of roads and canals, this flow is essentially nonexistent today (Snyder et al. 1990; Armentano 2002).

These islands of pine forest are dominated by a lone canopy species—the south Florida variety of slash pine. These pines are tall and slender, reaching as much as 60 feet in height. Trees may reach a diameter of about 12 inches, but most individuals are much smaller. The pines are widely spaced, leaving an open understory with room for hardy plants that can withstand the shallow soils and periodic drought conditions. Subcanopy species are

rare because of the relatively frequent natural fire regimen, but can include wild tamarind and live oak (Snyder et al. 1990).

The shrubs of the community include cabbage palm, saw palmetto, wax myrtle, strangler fig, and willow bustic. If the shrubs leave room for sunlight to reach the soil, a herbaceous layer will occupy the open spaces. Representatives include angadenia, pineland clustervine, firegrass, and coontie. At least one member of the ancient cycad plant family is also found in the pineland community.

Pinelands provide nesting and roosting sites as well as higher ground during flooding. Species of concern that depend on these habitats include Kirtland's warbler, Key deer, eastern indigo snake, and Florida panther (Lodge 2005; USFWS 1999h). The various pineland habitat types also provide habitat to a wide variety of endemic plants and plant species of concern (USFWS 1999h).

Pinelands were once common along the Miami Ridge, at the eastern edge of the park, but are now the rarest of all south Florida communities and are considered a globally imperiled habitat type. They were the first areas in south Florida to be settled and developed, and they were intensively logged before the 1960s. Because of this extensive disturbance, invasive nonnative plants have invaded the region, which now supports thickets of Brazilian pepper and lather leaf.

Hardwood Hammocks. The upland hardwood forests of Everglades National Park cover the smallest area of any habitat type and are locally called "hardwood hammocks" or "tree islands." They occur on the highest elevation sites in the park and on bedrock outcroppings with limited soil development, and they are rarely inundated. Hammocks are relatively small patches of broad-leafed forest surrounded by other vegetation habitats (Gunderson and Loftus 1993; Olmsted and Armentano 1997; Snyder et al. 1990). They are commonly found in association with pinelands or cypress, and they can be surrounded by natural limestone moats (Snyder et al. 1990).

These tiny forest communities are dominated by hardwoods from both temperate and tropical origins and by native palm trees (Gunderson and Loftus 1993; Olmsted and Armentano 1997). The overstory species within the Everglades hardwood hammock include gumbo limbo, mastic, live oak, and willow bustic. Cabbage palms are frequently found in the hammocks, acting as hosts for strangler figs (Snyder et al. 1990). The tallest trees in the hammock reach 30 to 45 feet. Beneath this canopy is an environment of low light and moderated humidity and temperature. Thus, the interior of an undisturbed hammock supports few shrubs and is notably deficient in herbaceous ground cover (Gunderson and Loftus 1993; Olmsted and Armentano 1997; Snyder et al. 1990). However, two grasses, panic grass and shortleaf basketgrass, are commonly found near the margins or growing beneath canopy gaps (Snyder et al. 1990).

The ecotonal margins of hammocks are densely vegetated and can be nearly impenetrable. These thickets contain lancewood, wild coffee, devil's claw, and Virginia creeper, along with many others (Snyder et al. 1990).

Tree islands are important sites of high plant diversity and habitat for species such as birds, raptors, alligators, turtles, and mammals (USFWS 1999h; Brandt et al. 2000). Tree islands support more species of birds than any other habitat in the central Everglades (SFWMD 1999). Fire is less frequent in hardwood hammocks than other Everglades communities because soils and litter are moister, interior humidity is higher, and understory growth is limited. Unlike pinelands, hardwood hammock communities do not respond well to fire (Snyder et al. 1990; Lodge 2005).

Royal Palm Hammock (formerly known as Paradise Key) is probably the most famous hammock in south Florida. The designation of

this site as a state park was part of the original effort to protect the lands that have now become Everglades National Park. Although Royal Palm does not represent all hammocks, it is a good example of a mature tropical Florida forest. Visitors to this site can see the royal palm, which is native to the extreme southern mainland, and other species such as live oak, poisonwood, and strangler fig commonly found in the park's hardwood hammocks.

Nonnative and Invasive Plant Species. The most serious land-based threat to Everglades habitats is nonnative plant invasion. On the basis of recent aerial surveys, the park has an estimated 250,000 acres of canopy cover in nonnative plant species. The primary nonnative plant species of concern in the park are Brazilian pepper, melaleuca, lygodium, and Australian pine. According to the U.S. Fish and Wildlife Service, "Florida has been the epicenter for more nonnative species than almost any other region in the country," with the most severe threat coming from plants (1999h). With more than 1,000 plants reported within Everglades National Park, approximately 220 are invasive nonnatives (Everglades Cooperative Invasive Species Management Area 2009). Invasive nonnative plants were first introduced into the Everglades, both accidentally and intentionally, beginning in the mid-1880s (SFWMD 2000b). Thus, invasive nonnatives may represent one of the most serious long-term threats to the park (South Florida Ecosystem Restoration Task Force 2008).

Invasive nonnative plants have been introduced into south Florida to serve as agents of environmental change, as landscape ornamentals, or through natural pathways. They possess high reproductive rates, lack predators, and outcompete native species for resources such as water and sunlight. The four species mentioned above can dramatically modify habitats and bring about fundamental ecosystem changes (National Invasive Species Council 2001).

To combat this invasion, the National Park Service initiated parkwide invasive nonnative plant control in 1996 and began participating on the NPS Exotic Plant Management Team. Using herbicides approved by the U.S. Environmental Protection Agency, biological controls, cutting and chopping, and prescribed fire, the park has successfully treated three of the four aggressive invaders. Much of the melaleuca in the eastern portions of the park has been brought under control, and Australian pines have been virtually eradicated from the park's coastline. Long-term control and management of invasive nonnative plants is addressed by the regional exotic plant management plan (NPS 2010).

Climate Change

The effects of increased temperatures and alterations in precipitation would likely impact vegetation composition in Everglades National Park by reducing the duration of the wet season and increasing the evaporation rates. Increasing sea levels and salinity in the mangrove and salt marsh areas, and in other areas where changes in sea level may alter the water table or soil characteristics, may lead to the loss of these communities and transition to other vegetation communities. The altered community composition in the park could occur because vegetation species require water in particular seasons and durations. Components of the unique plant assemblage represent the interface between the subtropical and temperate zone, which may shift according to water conditions and availability, and may be affected even by slight changes in sea level, salinity, or temperature, for example Plant-animal interactions, such as pollination, seed dispersal, and forage availability, may be disrupted. Phenological changes may be noticeable on short time scales, while species composition may shift over longer time frames. Not only are invasive species expected to expand their ranges due to altered precipitation and temperature regimes (Loehman and Anderson 2009), they may also form new communities from

processes of succession once the effects of climate change compromise existing habitat.

WILDLIFE FISHERIES AND FEDERAL SPECIAL STATUS SPECIES

[Note: Appendix E is a listing of common and scientific names for various species discussed in this document.]

Wildlife (terrestrial)

The warm, wet climate and unique habitats in Everglades National Park support more than 40 species of mammals, more than 350 species of birds, 50 species of reptiles (including 27 snakes and 16 turtles), 15 species of amphibians, and a multitude of freshwater and marine aquatic species. The Everglades region forms the southern terminus of many northern species and is the northern limit for common neotropical species. The small and discontinuous nature of the dry upland habitats helps explain the limited range and subspecies development for several mammals, reptiles, and amphibians.

Although the climate is subtropical, many of the park's resident animal species arrived from the coastal plain of the southeastern United States. Because only a few hardy species ventured far enough south to reach south Florida, there is limited species diversity in all vertebrate groups (Snyder et al. 1990). All of the park's freshwater fishes, all mammals (except several bats), and most reptiles and amphibians also occur in northern portions of the park, where habitat conditions are more suitable for these species. Terrestrial invertebrates, land and tree snails, dragonflies, butterflies, and moths colonized the area from the tropics. The wetland and wading birds for which the park is famous are generally widespread in the neotropics and move freely from the West Indies to the Everglades system (Gunderson and Loftus 1993).

The Everglades provide natural and human-made habitats for freshwater and saltwater fisheries. Aquatic species range from the minnow-sized pond fishes of the park's interior to large marine species such as sharks and rays. The complex Everglades hydrology also created environments in which many estuarine species depend on the condition of and flows from the freshwater habitats.

Upland Wildlife. The park's upland habitats range from pine rocklands to hardwood hammocks and coastal prairies. These locations represent the only consistently dry habitats in this marshy system. Most of the truly terrestrial animals in the Everglades, therefore, must use these communities for at least part of the year. Many animals that inhabit the tree islands also use other habitats when water levels are low enough for them to relocate to other areas.

The mammals of the rocklands and hammocks are adaptive creatures, such as raccoon that forage among the trees, and the opossum, fox squirrel, marsh rabbits, white-tailed deer, and several species of rodents. The highly endangered Florida panther also uses the cover of the forests to forage and rest. In the trees, Jamaican fruit bats and mastiff bats can be observed foraging for fruit or insects (Gunderson and Loftus 1993; Snyder et al. 1990).

Pine rocklands and hammocks contain lower densities of birds than the nearby wetland habitats. However, several bird species that inhabit the upland forests also frequent the coastal mangrove habitats (see "Mangrove Wildlife" section below). The birds of the park's forests forage on the fruit, caterpillars, insects, and small amphibians and reptiles that reside here. Tropical West Indian land birds of the forested uplands include the mangrove cuckoo, gray kingbird, smooth-billed ani, Cuban yellow warbler, Antillean nighthawk, the greater Antillean subspecies of the mourning dove, the West Indian cave swallow, and the state listed threatened white-crowned pigeon. North American birds common to the area include the red-

shouldered hawk, blue-gray gnatcatcher, Carolina wren, pine warbler, and northern cardinal (Gunderson and Loftus 1993; Snyder et al. 1990).

Reptiles and amphibians in the upland forests can be found on the ground and in the trees. During daylight hours, small lizard-like anoles and geckos such as the green anole, brown anole, bark anole, and reef gecko scurry about in search of insects. A nighttime hammock chorus is provided by green and Cuban tree frogs, as well as greenhouse frogs and bufo toads. Forest snakes include the Miami black-headed snake, Florida king snake, black racer, rough green snake, and Burmese pythons. Several of these are considered to be nonnative to the area.

Invertebrates in the rockland communities are of both continental and Caribbean origin. For example, most ants are native to the southeastern United States, but nonnative ant species that are common in the Miami area, such as fire ants, have recently been introduced into Everglades National Park. Sixty species of land snails exist in the rockland habitat, including the Florida tree snail. This species displays a wide variety of color and shell patterning (Gunderson and Loftus 1993).

Butterflies include species of West Indian origin that can be seen only in subtropical areas of the United States. Some butterfly species are endemic to south Florida. Many species that were listed by Lenczewski (1980) as being recorded in the park have not been seen in recent years. Lenczewski's records include 99 species, of which 63 were present in a survey conducted by Dr. David Smith (1994). Park staff members are reintroducing butterfly species that have been extirpated from the park, including the state-listed endangered Miami blue butterfly and the atala. About a dozen extirpated species are candidates for reintroduction, including the federally listed endangered Schaus swallow-tail. Some butterfly species are winter migrants that fly great distances to arrive at the tip of the Florida peninsula.

Slough and Wetland Wildlife. The wetland habitats of the park vary from cypress domes and strands to sawgrass marsh and wet marl prairie. These environments make up most of Everglades National Park. The park's flat topography and high water tables allow water and nutrients to mix between adjacent ecosystems—and animals to use more than one habitat to forage and reproduce. It is common for a species to inhabit both terrestrial and wetland or aquatic and wetland ecosystems (Ewel 1990).

Many mammals range between the various wetland habitats and use the resources available in each. The vegetation, tree trunks, canopy, and water provide important cover, food sources, and hydration. The edges of floodplain forests, which provide cover and access to other species in adjacent forest stands, are used by adaptable wildlife such as opossum and white-tailed deer (Ewel 1990). Common terrestrial mammals of river swamps include the southeastern shrew, cotton mouse, and golden mouse. Some mammals commonly observed in sloughs extend their range far beyond the slough edge; the raccoon and Florida panther are known to range throughout most of the park's habitats.

The park wetlands provide important habitat for predatory water birds and raptors. Many of these species prefer cypress savannahs and open marshes for the sparse cover and availability of small fish, amphibians, and reptiles on which they prey. Majestic wood storks and seven heron species, including the great blue heron are often observed wading through the marsh grasses as they forage. Marshland environments are commonly inhabited by limpkins, white ibis, glossy ibis, and a variety of egrets. Belted kingfishers, anhinga, and double-crested cormorants perch in the trees above sloughs and ponds, searching the water for their meals.

Many birds also congregate in the Everglades for the greater availability of insects and the number of plants bearing fruit and seeds. As a result, the wetlands of the park are also home to at least 14 species of songbirds that breed

elsewhere, including the Swainson's warblers and the common yellowthroat. Slough and marsh habitats are also important foraging and breeding habitats for the swallow-tailed kite and the federally listed endangered Everglade snail kite, discussed further in the "Federal Special Status Species" section (Ewel 1990).

Amphibians and reptiles inhabit marsh habitat year-round. Rivers are less-preferred habitat among amphibians and reptiles because of their short floods and occasionally strong flow rates. However, American alligators, aquatic salamanders called "sirens," striped crayfish snakes, and glossy crayfish snakes can still be found in swamps and marshes (Ewel 1990). Cypress swamps lack understory and are not often used by amphibians and reptiles (except alligators), although still-water swamps are the ideal habitat for all amphibians and frogs because of the wet-dry cycles. Amphibians that occur in the marsh and slough wetlands in the Everglades include the greater siren, Everglades dwarf siren, and several frog species (Lodge 2005).

Invertebrates are important in marsh food webs. Hydrologic and chemical differences in the marl prairies and sloughs lead to a high diversity of worms, mollusks, aquatic insects (especially dragonflies, flies, and beetles), spiders, and crustaceans. Within the karst topography of the Rocky Glades are subterranean communities of small organisms, such as copepods, that find underground refuges when surface marshes dry up. Some species are important because they are the only food source for other native species; for example, the apple snail is the only food source for the endangered Everglade snail kite. Prawns (freshwater shrimp) are important indicators of adequate water depths in sloughs. Some invertebrate groups, such as midges (the aquatic insects Chironomidae and Ceratopogonidae), are excellent indicators of hydrologic conditions and unnatural nutrient enrichment, and they can be used to monitor the success of hydrologic restoration projects (Jacobsen 2008).

Freshwater Marsh Wildlife. Marshes are wetlands dominated by herbaceous plants rooted in shallow water that usually stand at or above ground level, with less than one-third of the surface area covered by trees and shrubs (Kushlan 1990). Florida contains nine types of marsh, designated by either their physiognomy or dominant plant types.

Mammals are not very abundant in Florida's freshwater marshes, and most of those occurring in the marsh habitat are quite small. The only large mammal species known to consistently use marshes are the Florida panther (as described in the later "Federal Special Status Species" section) and white-tailed deer. White-tailed deer in the Everglades are distinguished from their northern relatives by a smaller stature and adaptation to wetland conditions. The representative small marsh mammal is the Florida water rat, which occupies the same niche here that the larger muskrat fills in many North American marshes (Kushlan 1990).

Various bird species reside in freshwater marshes year-round, and many more winter there. Their number and diversity are limited by seasonal high water (Kushlan 1990). The waterbirds most dependent on freshwater marshes are the least bittern, American bittern, green-backed heron, white ibis, glossy ibis, limpkin, king rail, marsh wren, common yellowthroat, red-winged blackbird, and boat-tailed grackle. Several endangered species use the stable, deeply flooded marshes of the Everglades (Kushlan 1990); see also the later "Federal Special Status Species" section). Wading birds, including wood storks, herons, ibis, and egrets, create mixed-species colonies along the marsh borders as they roost and nest in adjoining forests. Wintering waterfowl, including one species of duck (mottled duck), are uncommon but increasing in the park's marshes. At least eight waterfowl species live in the Everglades year-round, but the diversity and density of species increases, and may even quadruple, in the winter.

Amphibians and reptiles are abundant in the park's marshes. They are both predator and

prey and provide a chorus of song in the quiet of the park's night. The park's most well-known and endemic reptile—the American alligator—is at home in both shallow and deep marshes, creating deep wallows, or alligator holes, in which to hide. Other species common to the marsh include the leopard frog, pig frog, green tree frog, fire-bellied newt, dwarf siren, green water snake, swamp snake, cottonmouth, mud turtle, musk turtle, Florida cooter, and red-bellied turtle (Kushlan 1990).

Macroinvertebrates and insects are essential in the freshwater marsh food web. Prawns, crayfish, snails, amphipods, dragonflies, mayflies, mosquitoes, and gnats are abundant in marshes, especially in the shelter of vegetation where they can safely hide from predators. These populations increase following the onset of the wet-season rains that signal the end of the dry season (Kushlan 1990).

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

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

Three species of birds are exclusive to salt marshes: clapper rails, long-billed marsh wrens, and seaside sparrows (FWC 2003). These birds use the stems and leaves of salt marsh plants to construct raised nests to avoid all but the highest tides. Other birds that use the marsh for foraging or nesting include the willet, tricolored heron, white ibis, roseate tern, and several species of swallows and wrens (Montague and Wiegert 1990; Lodge 2005).

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

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

Mangrove Wildlife. Mangrove forests grow along the coast and are subject to tidal flushing, which produces elevated soil salinity. Mangroves grow best where freshwater runoff adds nutrients and maintains optimum salinity levels. These dense, unbroken stands of shrubby trees provide protective nurseries and food for crustaceans, fish, and shellfish, and shelter for birds and other animals. Mangrove ecosystems provide valuable habitat for seven species listed as threatened or endangered by the U.S. Fish and Wildlife Service. In addition, the commercial and recreational fishing industries in Florida

depend on the services provided by the mangrove forests.

Eighteen species of terrestrial mammals depend on the Florida mangrove system for food and shelter, including the raccoon, opossum, river otter, black bear, and striped skunk. The federally listed endangered manatee is commonly sighted in the rivers, canals, and nearshore waters of the mangrove environment (Odum and McIvor 1990; RECOVER 2004).

About 180 bird species use mangroves to forage, roost, and nest. These include 18 wading birds, 25 shore birds, 29 floating and diving birds, 34 aerial searchers and raptors, and 70 songbirds from northern habitats (Odum and McIvor 1990). Some of these species are also present in the park's hardwood hammocks (see "Upland Wildlife"). The mangrove canopy has traditionally supported large nesting colonies of word storks, great egrets, colorful roseate spoonbills, and the popular brown pelican. Wading bird populations have increased by about 400% since the 1980s (Lodge 2005).

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

Because the American crocodiles were hunted and extirpated from their natural habitats in Florida, they were declared endangered in 1975, and with only a portion of their remaining habitat in Florida Bay, the National Park Service protected the remaining area and designated it as Crocodile Sanctuary, which is in two prominent bays in northeastern Florida Bay and southeast of Taylor Slough—Little Madeira Bay and Joe Bay. The sanctuary provides nesting and nursery habitat for the crocodiles, and there has been no public access to this area for more than 20 years.

Invertebrates in mangrove systems include terrestrial and marine species. Tree snails, dragonflies, fiddler crabs, and many insects found in other park habitats also use coastal mangroves for all or part of their lives. Mangrove estuaries are nursery grounds for pink shrimp and spiny lobsters, economically important species in south Florida. This pink shrimp fishery is one of the most valuable fisheries in the state (RESTORE 2004).

Florida Bay Wildlife. The area between the Florida Keys and the southern tip of the Everglades includes many dynamic and unique attributes that form Florida Bay. Florida Bay is a shallow, brackish estuary that contains numerous small islands (keys), seagrass flats, and sandbars. More than 700 square miles of this bay are within the boundary of Everglades National Park. Invertebrates and fishes have historically been abundant in its waters, and the bay also provides excellent habitat for birds, manatees, and crocodiles (SFWMD 2000a). The ecosystem's mangroves, seagrass habitats, and mud banks create a network of basins (Holmquist et al. 1989) and divide the bay into distinct subenvironments for fishes and invertebrate fauna. The sea trout is a key indicator species for the effects of these environmental changes because it spends its entire life in the bay.

Manatees forage in the seagrass meadows (Van Meter 1989), and bottlenose dolphin can find a lobster or crab meal on the sandy bottom. A variety of diving birds find fish in the waters, including brown pelicans, magnificent frigate birds, raucous laughing gulls, and elegant Royal terns with their bright orange-red beaks.

The islands in Florida Bay are important to nesting and roosting bird populations in Florida. Many islands provide roosting and nesting habitat to many birds, including great white herons, great and snowy egrets, white ibises, and roseate spoonbills. Many of the islands are covered with mangrove trees and hardwoods on the island interior and have little to no human activity, which creates ideal breeding sites for several bird species.

Several sea turtle species occasionally venture into the mangrove estuaries as they forage. The Kemp's Ridley, leatherback, green, and hawksbill turtles are federally listed endangered species, while the loggerhead turtle is classified as a threatened species; all are known to occur in Florida Bay estuaries.

Nestled between the Florida Keys and Florida's mainland, Florida Bay has many interconnected basins that average about 3 feet in depth. At its greatest depth, Florida Bay is 9 feet deep. The waters of Florida Bay support a variety of wildlife in addition to an important fishery. The combination of waters—saltwater from the Gulf of Mexico and fresh water from the Everglades—creates an estuary that flows between and around several hundred mangrove-islands. The basins, seagrass mats, mudflats, grass-lined mud banks, mangroves, and mangrove islands support habitat diversity for fish in Florida Bay. Fish larvae are transported into Florida Bay from neighboring keys by coastal eddies, Loop and Florida Current flow, Dry Tortugas Gyre, and local winds (Hunt and Nuttle 2007). Once larvae enter the bay, environmental conditions (salinity, temperature, and benthic conditions) dictate conditions for nursery habitat for larvae. Habitat diversity provides a variety of conditions for yearling fish (Mumby 2006). As fish grow and feed on the invertebrate resources in the bay, they travel to the many neighboring areas of the park such as the Florida Keys, Gulf Coast, and Atlantic Coast. Because the fish travel to these areas, they contribute to the community trophic structure as predator and prey. Without the mangroves along Florida Bay, the important recreational and fisheries would decline and collapse (Thayer et al 1987).

Estuaries, lagoons, and bays are extremely important habitats for the productivity of fisheries and wildlife in Florida Bay (Zieman et al. 1989). The network of seagrass meadows and mud banks in Florida Bay bridges the distance between coral reefs and mangrove habitats, which have widely different physical requirements (Zieman 1982). Seagrass meadows in the bay are important to many fisheries in the bay because they provide habitat for invertebrates and fish of all life stages. The dominant seagrasses in Florida Bay include turtle grass, shoal grass, and manatee grass (Zieman and Zieman 1989). Seagrasses historically covered an estimated 90% of the about 444,800 acres (180,000 hectares) of subtidal mud banks and basins within Florida Bay (Zieman et al. 1989). In 1987, seagrass die-offs were first reported by backcountry fishing guides, and it was soon discovered that more than 9,884 acres (4,000 hectares) of seagrasses had died off (Robblee et al. 1991). Since the initial signs of the die-off, seagrass communities in the bay have shown increases in abundance and productivity of shoal grass and turtle grass (Zieman et al. 1989). Researchers suggest that the die-off of seagrasses affected fisheries in the bay (Robblee et al. 1991). For additional information on the seagrasses in Florida Bay, please see the "Vegetation" section.

Invertebrates are important components of the Florida Bay system, and they vary from macroscopic phytoplankton to large mollusks such as queen conch. A variety of shrimp, blue crab, and stone crab (a local delicacy) use the soft substrates and seagrasses as juveniles before moving to deeper waters. Oyster bars, primarily composed of eastern oysters, can be observed near the mouths of rivers, where they filter-feed on algae and plankton larvae. Juveniles and larvae of spiny lobster also use the bay and inshore waters as nurseries before heading to the reef line and waters as deep as 240 feet (Livingston 1990).

Sponges are also an important component of the bay community. They are efficient filter feeders of small phytoplankton, and they can improve water quality and clarity. Prior to degradation of the bay noted in the 1980s and 1990s, it is estimated that the population of sponges was capable of filtering the entire water column in a single day. At present densities, it takes an estimated four days for the sponge population to accomplish the same feat (Florida Bay Science Program 2003).

Climate Change. Climate change is expected to have profound effects on wildlife because many of their biological cycles are so closely tied to temperature and their habitat. Birds, mammals, amphibians, and marine species are most likely to be affected. Bird migration patterns are already changing, with birds wintering in the southeast United States arriving on average 13 days earlier (Cotton 2003). Earlier breeding and egg-laying dates and range expansion are already being seen in a variety of bird species. Because Everglades National Park is home to both migratory and resident bird species, these effects are likely to be noticeable in the near future, as well as beyond the life of this plan. Fish and other marine species are especially sensitive to changes in water depth, temperature, and chemistry. The alteration of environmental conditions important to the life cycles of these species, especially breeding and egg laying, are occurring. Disease outbreaks in ocean species, due in part to range expansion of marine parasites, are also occurring and are expected to increase as water temperatures rise. Other documented impacts on predator-prey relationships and wildlife habitat in marine and terrestrial environments are already occurring such as changes in the male/female ratio of sea turtles and amphibians. Sensitive species such as the manatee, which already has a reduced habitat range, are especially vulnerable to the impacts of climate change because of habitat alteration and changes in forage availability (Loehman and Anderson 2009; Pearlstine et al. 2008).

Fisheries

About 300 fish species inhabit Everglades National Park. They occur in nearly all aquatic park habitats, from open flowing waters to areas that are seasonally flooded such as marl prairies. During inundation periods, small fishes move from deeper sloughs and dry season refuges (e.g., alligator holes) to repopulate the higher elevation marshes. The park's fishes occupy all trophic groups; they are both predator and prey. Many species serve as food sources for wading birds, raptors, and alligators. There is some fishing in freshwater ponds, but many of the freshwater sport fish species are suspected of being contaminated with mercury.

Changes in fish populations can affect the food web. Thus, changes are considered to be relatively good indicators of how fishing, water management, and resource protection measures will travel through the estuaries of the park (Florida Bay Science Program 2003). Fish composition and density are used to evaluate the success of hydrologic restoration and other efforts to enhance natural system functions in the park (Loftus and Eklund 1994).

Freshwater Fishery. Although abundant, native freshwater species in the Everglades are not highly diverse. The fishes of the Everglades are the most studied in Florida, and many of the marsh, pond, and slough populations are derived from northern temperate species, with the exception of a few species from the West Indies (Kushlan 1990).

The fish community is dominated by minnow-sized species such as the mosquito fish, which can make up 60% of a local population; least killifish; and several small, soft-finned species, including flagfish and golden topminnow. The dominance of small fishes arises from the mortality of large species during dry spells. Thus, the distribution and abundance of species can change seasonally or with climate variation (Kushlan 1990).

Deeper pools, ponds, and canals support populations of small sunfishes such as pygmy sunfish and bluespotted sunfish. These fishes are commonly preyed upon by anhinga, cormorants, and other diving birds. These perennial water bodies also support the largest fishes in the park—largemouth bass, the prehistoric-looking Florida gar, yellow bullhead, and pirate perch. Fluctuating marshes provide habitat for small individuals of larger species such as warmouth and redear sunfish (Gunderson and Loftus 1993; Kushlan 1990).

In the southern reaches of the park, freshwater diversity decreases, and estuarine and marine species augment the fish populations (Gunderson and Loftus 1993; Kushlan 1990). This ecotone of brackish water supports killfishes, livebearers, and several marine species. Spot, mullet, and pinfish, in various life stages, are often abundant. In turn, predators that feed on these species can also be observed in these inland waters. Tarpon, snook, and even sharks have been sighted foraging in salt marsh tidal creeks (Kushlan 1990).

The canals and water retention ponds on the periphery of Everglades National Park have facilitated the spread of invasive nonnative fishes into the park. Several catfish species, including the walking catfish and oscars, are common in these human-made waterways. These species and other nonnatives such as the blue tilapia now live in the park, especially in the unnatural borrow pits such as Anhinga Pond. Some invasive nonnative species, such as the Mayan cyclid, pike killifish, and black acara, have become well established in marshes. Changes in water delivery and overflowing of canals that border the park have recently introduced new nonnative species, including the jaguar guapote, brown hoplosternum, and jewel cichlid, which is now reproducing and spreading westward in the marshes. Nonnative species are still dominant in the western, less-disturbed areas of the park (Kushlan 1990).

Marine Fishery. Florida's inshore marine habitats include Florida Bay, Ten Thousand Islands, and Whitewater Bay. These estuary-like habitats are generally high in biological productivity and low in species diversity, and they are crucial habitat for fish and invertebrate populations. Some species use these inshore marine habitats during only part of their lives, such as in juvenile stages and early development, while others live in the shallow waters of the park.

The occurrence and density of fish species in these nearshore environments correlate with salinity, water temperature, water quality, and benthic habitat (especially seagrass type and density). Changes in populations and distribution depend on watershed processes acting on the system as a whole. At the species level, factors that influence populations include dietary needs, food-web relationships, spawning and migration requirements, and fishing pressure. Each species has a different set of needs, and presence and abundance will vary based on local conditions (Florida Bay Science Program 2003).

Bay anchovy and Spanish sardines are major food sources for almost all predatory fish, making them key species in the estuary food web. The spotted seatrout, snook, and tarpon are commercially important to both coasts; they inhabit shallow coastal areas such as salt marshes, sand flats, and seagrass beds. Sport fisheries on both coasts depend on the bonefish, tarpon, snook, Florida pompano, mutton snapper, gray snapper, lane snapper, and yellowtail snapper, all of which spend part of their time in inshore marine areas (Livingston 1990). Recreational fishing in Everglades National Park affects the size and structure of the gray snapper community, and evidence of overfishing is seen in this and other species that migrate outside the park (Florida Bay Science Program 2003).

Members of the shark family, including lemon sharks, nurse sharks, and bonnetheads, along with bottlenose dolphin, forage for fish, mollusks, and shellfish in park waters.

Climate Change. The quality of freshwater and marine fish habitat may be affected by climate change in south Florida. The altered hydrologic regime and increased surface water temperatures could result in decreased dissolved oxygen concentrations and increased toxicity from pollutants (Ficke et al. 2007). In marine and estuarine ecosystems, acidification and changes in salinity patterns associated with changing rainfall and increasing evaporation rates could also result in changes in the fish community and abundance. In response, species range and spawning and nursery habitat could likely shift to other habitats, which may lead to additional community-wide impacts resulting in reduced or adversely impacted fish species throughout the park (Pearlstine et al. 2008).These changes could be evident during the life of this plan, and also for years to come beyond the life span of this plan.

Essential Fish Habitat

The Council on Environmental Quality guidelines for implementing the National Environmental Policy Act requires an analysis of resources that would be considered ecologically critical areas. Within Everglades National Park, ecologically critical areas include essential fish habitat, as identified by the Gulf of Mexico Fisheries Management Council (GMFMC 2005), and habitat areas of particular concern, as defined by the National Oceanic and Atmospheric Administration and mapped by the council.

In 1996 Congress made substantial revisions to the Magnuson-Stevens Fishery Conservation and Management Act and refined the focus of fisheries management by emphasizing the need to protect fish habitat. Specifically, the act required that fishery management plans identify as essential fish habitat those areas that are necessary to fish for their basic life functions. Essential fish habitat is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." "Waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish. "Substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities. "Necessary" means the habitat required to support a sustainable fishery and the managed species' contributions to a healthy ecosystem. "Spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle (NOAA 2009b).

The intent of the 1996 Magnuson-Stevens Fishery Conservation and Management Act is to conserve and enhance essential fish habitat and focus conservation efforts on areas that are important to the life cycles of federally managed fish and shellfish. For this document, these areas include areas that provide refuge, foraging, and breeding areas for fish and invertebrates. For a detailed analysis of effects on mangroves, salt marshes, and seagrasses, please refer to the "Vegetation and Wetlands" section of this document.

The Magnuson-Stevens Fishery Conservation and Management Act requires the NOAA-Fisheries and regional fishery management council to minimize, to the extent practicable, adverse effects on essential fish habitat caused by fishing activities. The act also requires federal agencies to consult with NOAA-Fisheries about actions that would damage essential fish habitat.

Essential fish habitats in the park, as defined by the fishery management councils, include the following:

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

- hard bottoms

A description of mangroves has been provided previously in the discussion on vegetation. The following description and discussions of importance of these essential fish habitats have been taken from the Comprehensive Amendment Addressing Essential Fish Habitat in Fishery Management Plan of the Gulf of Mexico Fisheries Management Council (GMFMC 2004).

Seagrass meadows provide substrates and environmental conditions that are essential to the feeding, spawning, and growth of several managed species. Juvenile and adult invertebrates and fishes, as well as their food sources, use seagrass beds extensively (GMFMC 2004).

Mangroves and marshes provide essential habitat for many managed species, serving as nursery grounds for larvae, juveniles, and adults. Mangrove habitats (particularly riverine, overwash, and fringe forests) provide shelter for larvae, juvenile, and adult fish and invertebrates. In addition, mangroves and marshes provide dissolved and particulate organic detritus to estuarine food webs. Because of this dual role as habitat and as food resource, mangroves are important exporters of material to coastal systems. Mangroves also export materials to terrestrial systems by providing shelter, foraging grounds, and nursery/rookery areas for terrestrial organisms. The root system binds sediments, thereby contributing to sedimentation and sediment stabilization (GMFMC 2004).

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

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

Benthic algae occur in both estuarine and marine environments and are used as habitat by managed species such as the queen conch and early stages of the spiny lobster. Threatened sea turtles use some benthic algae species as food. Invertebrate species, including mollusks and crustaceans, inhabit this area and are eaten by various fishes.

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

The pelagic subsystem includes the habitat of pelagic fishes. Pelagic habitat is associated with open waters beyond the direct influence of coastal systems. In general, primary productivity in this zone is low and patchily distributed, being higher in nearshore areas as opposed to offshore areas. The pelagic system is inhabited by the eggs and larval stages of many reef fishes, highly migratory fishes, and invertebrates.

Oyster and shell essential fish habitat is defined as the natural structures found between (intertidal) and beneath (subtidal) tide lines. These structures are composed of oyster shell, live oysters, and other organisms

that are discrete. Oysters have often been described as the "keystone" species in an estuary, and they provide substantial surface area as habitat. Oyster communities are critical to a healthy ecosystem, because oyster reefs remove, via filter feeding, large amounts of particulate material from the water column and release large quantities of inorganic and organic nutrients. The oyster reef as a structure provides food and protection and contributes to critical fisheries habitat.

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

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

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

Florida Bay in Everglades National Park has been identified as a habitat area of particular concern. Mangrove-covered islands and submerged aquatic vegetation in the bay provide important habitat for many of the fisheries such as pink shrimp, red drum, and spiny lobster. Categories of essential fish habitat that would be affected by the proposed alternatives include the estuarine/marine water column and nonvegetated bottom (with mud, sand, and rock substrates). Essential fish habitat for the highly migratory pelagic species would be restricted to the estuarine/marine water column; essential fish habitat for the remaining species also includes the nonvegetated bottom.

Essential fish habitat in Everglades National Park is composed of estuarine waters and substrates (mud, sand, shell, rock, and associated biological communities) and includes submerged vegetation (seagrasses and algae), marshes and mangroves, and oyster shell reefs or banks (GMFMC 2004).

The Gulf of Mexico Fisheries Management Council identified six areas in Everglades National Park—Florida Bay; Lake Ingraham; Whitewater Bay; Cape Sable to Lostman's River; Lostman's River to Mormon Key; and Mormon Key, up to and beyond the park boundary, to Caxambas Pass—that contain essential fish habitat dominated by mangrove islands and mangrove forests that include marsh areas and areas of submerged aquatic vegetation (seagrass). The complex of six areas is referred to as the Florida Bay and Ten Thousand Islands area. Mangroves in these areas cover approximately 456 square miles, and marsh areas cover about 415 square miles. Cape Sable contains about 66% of the tidal marsh and greater than 60% of the mangroves in these areas. Submerged vegetation in the area totals nearly 413 square miles, mostly within Florida Bay.

These habitats provide forage, nursing, and spawning areas for species such as shrimp, red drum, spiny lobster, reef fish, and mackerels. The table below lists species that have been observed or recorded in the park or species that have prey that are found in the park (GMFMC 2004). The table indicates the essential fish habitat identified for federally managed species that inhabit in the park.

TABLE 9. FEDERALLY MANAGED FISH SPECIES USING ESSENTIAL FISH HABITATS IN EVERGLADES NATIONAL PARK

Common Name	Scientific Name	Habitat
Fin Fish		
Red drum	*Sciaenops ocellatus*	Marine plankton, submerged aquatic vegetation, mud bottom, marsh
Gray triggerfish	*Balistes capniscus*	Marine sand, floating plants, mangroves
Greater amberjack	*Seriola dumerili*	Floating plants, pelagic
Lesser amberjack	*Seriola fasciata*	Floating plants, pelagic
Red snapper	*Lutjanus campechanus*	Sand, mud, rock outcrops, gravel
Gray (mangrove) snapper	*Lutjanus griseus*	Marine plankton, submerged aquatic vegetation, mangrove, mud
Lane snapper	*Lutjanus synagris*	Submerged aquatic vegetation, mangrove, mud, sand, reefs
Yellowtail snapper	*Ocyurus chrysurus*	Submerged aquatic vegetation, mangrove, mud, sand, reefs
Vermilion snapper	*Rhomboplites aurorubens*	Submerged aquatic vegetation, mangrove, mud, sand, reefs
Golden tilefish	*Lopholatilus chamaeleonticeps*	Burrows, rough bottom
Red grouper	*Epinephelus mono*	Marine plankton, submerged aquatic vegetation, hard bottoms
Black grouper	*Mycteroperca bonaci*	Marine plankton, submerged aquatic vegetation, hard bottoms
Gag grouper	*Mycteroperca microlepis*	Marine plankton, submerged aquatic vegetation, hard bottoms
Scamp	*Mycteroperca phenax*	Hard bottoms, reefs
King mackerel	*Scomberomorus cavalla*	Pelagic
Spanish mackerel	*Scomberomorus maculates*	Pelagic
Cobia	*Rachycentron canadum*	Coastal
Cero	*Scomberomorus regalis*	Pelagic
Little tunny	Euthynnus alletteratus	Estuaries, pelagic
Dolphin fish	Coryphaena hippurus	Epipelagic
Bluefish	Pomatomus saltatrix	Estuaries, pelagic
Shrimp		
Brown shrimp	*Penaeus aztecus*	Marsh, mud
White shrimp	*Penaeus setiferus*	Marsh, mud
Pink shrimp	*Penaeus duorarum*	Sand
Royal red shrimp	*Pleoticus robustus*	Submerged aquatic vegetation
Lobsters		
Spiny lobster	*Panullrus argus*	Hard bottoms
Spotted spiny lobster	*Panulirus guttatus*	Hard bottoms
Smooth tail lobster	*Panulirus laevicauda*	Hard bottoms
Spanish slipper lobster	*Scyllarides aequinoctialis*	Hard bottoms

Source: Gulf of Mexico Fishery Management Council 2009

Federal Special Status Species

Table 10 summarizes information about the federally listed species found in Everglades National Park and indicates whether each species was retained for detailed analysis in this document, or whether it was dismissed from detailed analysis and why. The two categories are combined into this one table for ease of review by consulting agencies such as the U.S. Fish and Wildlife Service and the National Marine Fisheries Service.

It should be noted that NPS management actions are carried out or planned in Everglades National Park that are not described in detail in this document. In some cases, those actions may have the potential to affect Federal Special Status Species. Everglades National Park will request separate consultation for those projects and plans. Consultation will either be requested on a project by project basis (e.g., limited scientific research proposed by an outside entity) or on a programmatic basis (e.g., a parkwide fire management plan.) Other projects, such as the restoration projects comprising CERP, may have another federal agency as the lead agency. These projects have the potential to affect federal special status species and consultation will be requested by the federal agency leading the project.

Mammals. Everglades National Park provides habitat for a variety of federally listed endangered and threatened species. These species occupy many habitats and vary in size from ounces to 1,000 pounds. Although individuals from these imperiled groups find refuge in the park, their species' status and prognosis for survival may well depend on larger external factors acting outside the park boundaries. The park will endeavor to protect these species and continue to provide habitat for their continued survival. Two especially intriguing federally listed endangered mammals in Everglades National Park are the Florida panther and the manatee.

Birds. Special status birds in the park are threatened or endangered largely because of habitat loss and altered hydrologic conditions. Species that depend on the wetland environments typical of the Everglades system have lost most of their habitat over the last century. The endangered birds in the park include the highly specialized Everglades snail kite (which feeds almost exclusively on apple snails) and the Cape Sable seaside sparrow. Additionally, the wood stork is classified as threatened.

Reptiles. Threatened and endangered reptiles that live in the park include the eastern indigo snake and five of the world's seven species of sea turtle and two of the world's largest lizards—the American crocodile and the American alligator. Habitat loss and fragmentation due to increases in urbanization and agricultural land uses; natural catastrophes (e.g., hurricanes); changes in the distribution, timing, quantity, and quality of freshwater flows; and hunting affect crocodiles. Crocodilians were hunted to near extinction, but both species found in the park are staging comebacks. The remote and secluded areas of Crocodile Sanctuary (Little Madeira Bay and numerous other connected ponds and creeks) have been instrumental for crocodile recovery in the park.

The populations of sea turtles have been dramatically reduced worldwide by hunting and egg collecting, and they are now further threatened by effects of commercial fishing and shoreline habitat loss (FWC 2010b).

Invertebrates. Since 2011, three butterflies have either been listed or proposed to be listed as endangered within Everglades National Park. Habitat loss and fragmentation, pesticide use, and other factors have resulted in these species' decline. Everglades National Park represents one of the last strongholds for two of these butterflies—the Florida leafwing and the Bartram's hairstreak. The park is currently believed to support the entire remaining population of the Florida leafwing.

Plants. The populations of south Florida's imperiled plants have been reduced by habitat

loss. Changes in natural hydrology, large-scale agriculture, and urban development have eradicated most pineland communities and changed the nature of hardwood hammocks. Remaining populations of Florida prairie clover may be as low as 200 to 300 individuals. Likewise, fewer than 100 individual crenulate lead-plants may now exist in the wild.

Fish. Both freshwater and marine fish populations have declined because of habitat loss and altered hydrologic conditions. The endangered small-toothed sawfish lives in the marine waters of the park. Sawfish are inherently vulnerable to exploitation because of their tendency for entanglement in fishing gear, their restricted habitat, and their low rate of population growth. All of Ten Thousand Islands and Florida Bay waters less than 3 feet (1 meter) in depth are designated as critical habitat for the small-toothed sawfish.

Climate Change. The federal government has listed dozens of plant and animal species in south Florida as threatened or endangered, with many other species included on the state list. Many of the threatened and endangered species occupy specific aquatic or terrestrial habitats in the park. As the effects of climate change increase, the fragility of long-term recovery for threatened and endangered species in south Florida could be amplified. Climate change could increase habitat fragmentation and cause some species to migrate or occupy uncharacteristic habitats (Committee on Independent Scientific Review of Everglades Restoration Progress 2008), further contributing to potential loss of endangered species. Continual spread of invasive nonnative plants and animals could also contribute to the competition for resources among endangered plants and animals and is also likely to cause further endangerment of these species in the Everglades and south Florida (Pearlstine et al. 2008).

TABLE 10. FEDERALLY LISTED ENDANGERED, THREATENED, AND CANDIDATE SPECIES OF EVERGLADES NATIONAL PARK

	Common Name	Scientific Name	Status	Habitat Comments and Other Notes	Reasons for Dismissing from Detailed Analysis, if Dismissed
MAMMALS					
Analyzed	Florida panther	*Puma concolor coryi*	Endangered	The panther, Florida's state animal, is one of the most endangered large mammals in the world, largely from loss of habitat. Although it was listed as endangered by the U.S. Fish and Wildlife Service in 1967, there is no designated critical habitat. Population estimates in south Florida range between 100 to 120 total individuals (USFWS 2008c and FFWCC 2010c). Panthers appear to prefer large and remote tracts with adequate prey and cover. The preferred habitats of the Florida panther are pinelands, hardwood and cypress swamps, and hardwood hammocks (Comiskey et al. 2002). Dense saw palmetto is preferred for resting and denning. Panther breeding may occur throughout the year, with a peak during winter and spring. Panthers have 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 2008c). The panthers' preferred prey species are the white-tailed deer and feral hogs (USFWS 2006). The Florida panther's range encompasses nearly all of Everglades National Park (except the mangrove zone), and the park supports a small viable breeding population of Florida panthers, although most of the population occurs in Big Cypress National Park. Figure 4 shows lands considered essential to the long-term viability and persistence of the panther in the wild. Factors affecting the Florida panther include habitat loss and fragmentation, environmental contaminants, disease, genetic erosion, and prey availability; human activities and disturbance also are factors (Dunbar 1994). No critical habitat has been designated for the Florida panther. However, much of Everglades National Park lies within the panther "primary zone" of the panther focus areas identified by the U.S. Fish and Wildlife Service, indicating that these areas are important to the recovery of panthers in south Florida.	
Analyzed	bottlenose dolphin	*Tursiops truncatus*	Depleted	Bottlenose dolphins are one of the best-known species of marine mammals. They are protected under the Marine Mammal Protection Act of 1972, as amended. Bottlenose dolphins were designated as depleted in 1993 because of a substantial loss of bottlenose dolphins between 1987 and 1988 (Waring et al. 2002). The National Oceanic and Atmospheric Administration Fisheries Service (National Marine Fisheries Service, or NMFS), designated the Atlantic coastal population of bottlenose dolphins as a single migratory stock, designating the stock as "strategic" under the Marine Mammal Protection Act. Bottlenose dolphins have strong, powerful bodies that are blue-gray on top with lighter sides and bellies. They range in size from 6 to as much as 12 feet long and can weigh as much as 1,200 pounds. Bottlenose dolphins are found in groups of 2 to 15 individuals and feed on both fish and invertebrates (NMFS 2010b). These dolphins are found around the world in temperate and tropical waters. Some bottlenose populations migrate into bays, estuaries, and river mouths, while other populations inhabit oceanic waters along the continental shelf. The primary threat to bottlenose dolphins is incidental injury and mortality from fishing gear used in gillnet, seine, trawl, and longline commercial and recreational operations (NMFS 2010b).	
Analyzed	West Indian manatee	*Trichechus manatus latirostris*	Endangered, Critical Habitat	The Florida manatee is a subspecies of the West Indian manatee (USFWS 2007b). The manatee was first listed as endangered in 1967, and critical habitat (Gulf Coast waters and part of Florida Bay—see figure 5a at the end of this table) was designated in 1976. Past hunting and poaching and the present-day effects of boat impacts and propeller injuries (USFWS 2001) contribute to the manatee's endangered status. Manatees inhabit Everglades National Park waters in the Ten Thousand Islands area, Whitewater Bay, and some of the larger rivers that flow into the Gulf of Mexico (Park Ecologist Skip Snow, pers. comm., 2008).The Chokoloskee Area of Inadequate Protection for manatees was established by the U.S. Fish and Wildlife Service in 2001. This designation was removed in April 2010 based on implementing the zones depicted in figure 5b, along with signage and law enforcement commitments. The large, aquatic, herbivorous manatee lives in freshwater, brackish, and marine habitats, and eats submerged, emergent, and floating vegetation. Manatees generally seek out warm water refuges in quiet areas in canals, creeks, lagoons, or rivers. Water temperatures colder than 68 degrees Fahrenheit increase manatee susceptibility to cold stress and cold-induced mortality. The primary threats to manatee, aside from low temperatures, are collisions with watercraft, degradation of seagrasses, and entrapment in water-control structures. In the winter, manatees concentrate in southwest peninsular Florida, depending on warm water flows from natural springs and power plant outfalls.	
Analyzed	Key Largo woodrat	*Neotoma floridana smalli*	Endangered	The Key Largo woodrat is a small, endemic rodent that once ranged throughout Key Largo. Nearly half of the woodrat's habitat has been lost to development activities in Key Largo (McCleery et al. 2006). In 1986, the Key Largo woodrat was listed as an endangered species because of the drastic decline of known habitat and population size. The current distribution of the woodrat is restricted to the northern third of Key largo. Woodrats once inhabited the upland areas of Key Largo, but now are only found in the tropical hardwood hammocks. The Key Largo woodrat is gray-brown above with cream or white ventral coloration. It is also distinguishable by its large, rounded ears and protuberant eyes. It is critically dependent on native vegetation in Key Largo (USFWS 1999). Stick nests, solution holes, and the root systems of large trees are used by nesting Key Largo woodrats.	

TABLE 10. FEDERALLY LISTED ENDANGERED, THREATENED, AND CANDIDATE SPECIES OF EVERGLADES NATIONAL PARK

	Common Name	Scientific Name	Status	Habitat Comments and Other Notes	Reasons for Dismissing from Detailed Analysis, if Dismissed
Analyzed	Key Largo cotton mouse	*Peromyscus gossypinus allapaticola*	Endangered	The Key Largo cotton mouse was characterized as endangered by the U.S. Fish and Wildlife Service in 1984. The cotton mouse is susceptible to human encroachment and development activities that have impacted its primary habitat. It is now restricted to the northernmost portion of Key Largo. Urbanization of Key Largo has severely reduced the forests of the tropical hardwood hammocks and has reduced the availability of food, shelter, and habitat for the cotton mouse. The Key Largo cotton mouse is more reddish than other subspecies of mainland cotton mice. Habitats include tropical hardwoods and recently burned, early successional, and mature hammock forests. The Key Largo cotton mouse builds leaf-lined nests in logs, tree hollows, and rock crevices (USFWS 1999). Key Largo cotton mice are omnivorous and feed on a wide variety of plant and animal materials. The tropical hardwood hammock trees and shrubs produce fruits and berries that provide important food items for the Key Largo cotton mouse.	
Dismissed	mangrove fox squirrel	*Sciurus niger*	Candidate	The mangrove fox squirrel is a subspecies of the fox squirrel found only in southwest Florida. Mangrove fox squirrels are 10 to 12 inches in body length, with tails 8 to 10 inches long. Most mangrove fox squirrels in Florida are black with a white nose and tip of the tail. They may weigh as much as 2 pounds. Their preferred habitat is mangrove stands, but they spend a great deal of time on the ground searching for nuts, buds, and seeds (FWC 2000). Few details are known of the habits and specific preferences of this candidate species. Mangrove fox squirrels are most commonly reported from road fatalities. Three incidents of mortality along the road to Flamingo have been documented. Live animals are rarely observed in the park.	The preferred habitat of this species is mangrove stands. It is not anticipated that actions proposed in the alternatives would affect the species or its habitat. This species was not carried through for full analysis.
Dismissed	Florida bonneted bat	*Eumops glaucinus floridanus*	Endangered	The Florida bonneted bat is the largest bat species in Florida and is a free-tailed bat. It was formerly considered a subspecies known as the Florida mastiff bat, but in 2004 was determined to be a separate species unique to Florida. The Florida bonneted bat was listed as endangered in November 2013 (USFWS 2013a). It occurs only in the southern portion of Florida—excluding the Florida Keys—in urban, suburban, and forested areas. It roosts singly or in groups of up to a few dozen individuals in buildings (e.g., under Spanish roof tiles) or sometimes in tree hollows or in the foliage of palm trees. It has also been found under rocks and in fissures in limestone outcrops. It is nocturnal and feeds on night-flying insects. Critical habitat has not been proposed for the Florida bonneted bat. The Florida bonneted bat is vulnerable to habitat loss (in urban and forested areas), habitat alteration, and pesticide spraying for mosquitoes. The latter may be responsible for the species' decline in the Miami area because roosting sites are still abundant.	There is limited information about the occurrence of this species in the park. It has been documented through acoustic monitoring in several locations, but no known roosts or breeding sites have been identified. The proposed general management plan alternatives are not expected to affect areas where this species would be likely to roost and there are only minor differences among alternatives with respect to this species. If potential disturbance is identified, surveys would be conducted to determine if this species is present, and appropriate mitigation actions would be taken in consultation with the U.S. Fish and Wildlife Service. Therefore, this species was not carried through for full analysis.
BIRDS					
Analyzed	piping plover	*Charadrius melodus*	Threatened, Critical Habitat	The piping plover is a small, stocky, sand-colored shorebird with orange-yellow legs, a black band across the forehead between the eyes, and a black ring around its neck. The plover may be found on sandy beaches, mud flats, or algal mats in protected bays of south Florida. It breeds on outer coastal beaches from Newfoundland to North Carolina, beginning in late March or early April. The fledglings hatch about 28 days after incubation commences and are able to fly 28 days later. They winter on the Atlantic Coast as far south as the West Indies, departing in early September. In south Florida, plovers are considered rare and are usually observed during migration and winter months. The current Atlantic coast population of the piping plover is estimated to be about 2,000 pairs. An initial decline in population occurred in the late 19th century because of overhunting, but the species recovered by the 1940s under the protection of the Migratory Bird Treaty Act. A second decline has occurred more recently because of the development of coastal areas and the consequent loss of habitat. The species was federally listed as threatened in 1986. Current threats to the plover's existence include development, human disturbance (including pets), increased numbers of scavenging predators near concessions, and storm tides (USFWS 2007a). Wintering critical habitat was designated for the piping plover in 2002 and includes a relatively small area of beach on Sandy Key and Carl Ross Key in Florida Bay (USFWS 2002).	
Analyzed	wood stork	*Mycteria americana*	Threatened	Wood storks were listed as endangered in 1984 because of loss of foraging habitat and colony nesting failures. No critical habitat has been designated for the wood stork. Wood storks are birds of freshwater and brackish wetlands, primarily nesting in cypress or mangrove swamps. They feed in freshwater marshes, narrow tidal creeks, or flooded tidal pools, primarily on fish as long as 10 inches long (USFWS 1999h). Particularly attractive feeding sites are depressions in marshes or swamps where fish congregate during periods of falling water levels. 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. Feeding areas in south Florida have decreased by about 35% since 1900 because of human alteration of wetlands. Additionally, human-made levees, canals, and floodgates have greatly changed natural water regimes in south Florida (USFWS 1999h). Wood stork surveys completed in 1999 and 2001 to 2006 documented a population ranging from 5,560 to 11,279 pairs, with the greatest number of pairs occurring in 2006 (USFWS 2007c). The 2009 annual survey counted more than 2,600 wood stork nests among 14 sites in the Everglades (pers. comm. with Mr. O. L. "Sonny" Bass, Everglades National Park supervisory wildlife biologist, and Gabriel Cosyleon, Parsons, regarding the presence of wood stork nests in the park). The substantial increase in nesting pairs may be attributable to a favorable combination of water levels, rainfall timing, and forage availability (Morgan 2009). Currently, two wood stork colonies exist south of Tamiami Trail in the East Everglades Addition. Wood storks are susceptible to human activities, and habitat management guidelines are intended to improve environmental	

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	Common Name	Scientific Name	Status	Habitat Comments and Other Notes	Reasons for Dismissing from Detailed Analysis, if Dismissed
				conditions required for the survival and well-being of the wood stork (USFWS 1990). No critical habitat has been proposed for the wood stork. In December 2012, the U.S. Fish and Wildlife Service published a proposed rule to reclassify the wood stork's status from endangered to threatened in recognition of population growth and improved nesting since listing, primarily related to the northward expansion of the nesting range within the United States (USFWS 2012a). In June 2014, the U.S. Fish and Wildlife Service published the final rule for the reclassification of the wood stork from endangered to threatened (USFWS 2014a).	
Analyzed	roseate tern	*Sterna dougallii dougallii*	Threatened	Roseate terns are coastal birds that can range in size from 14 to 17 inches, with a wingspan of 30 inches. Their backs are pearly gray and the underparts are white, but in the summer, the tern has a black bill, cap, and nape. They breed on salt marsh islands and beaches with sparse vegetation from the Gulf of St. Lawrence in Canada, south to Virginia, and in the West Indies. Terns may breed on many substrate types including open sandy beaches isolated from human activity, pea gravel, open sand, and salt marshes. In Florida, a few dozen pairs nest every year among other terns in the Dry Tortugas, and pairs have been known to nest in Key West in recent years. The roseate tern migrates for the winter to the Caribbean and the northeastern coast of South America. In south Florida, roseate terns are considered rare and are usually observed during migration and winter months. The worldwide population was recently estimated to be 3,300 breeding pairs; this is down from the estimated 8,500 pairs 50 years ago (USFWS 1987). Roseate terns were in danger of extirpation between the late 1800s and the 1920s. They have again declined in number because of vegetation changes, competition for breeding areas, and predation (New York State Department of Environmental Conservation 2010). Large gulls prey on the eggs and chicks during the breeding season, and humans prey on the birds in their winter habitat for their plumage. No critical habitat has been designated for the roseate tern.	
Dismissed	Audubon's crested caracara	*Polyborus plancus audubonii*	Threatened	The Audubon's crested caracara is a member of the falcon family and has a length of 21 to 23 inches, with a wingspan of almost 4 feet. It has long, yellow legs and a large blue bill. It spends a great deal of time on the ground hunting or foraging. Populations occur in Florida, Baja California, Arizona, Texas, Cuba, and the Isle of Pines. A subspecies occurs in New Mexico and Louisiana. They maintain large territories with their mates. Unlike other falcon species, they build large nests of vines and sticks. These nests are usually in a cabbage palm or cactus or on the ground and contain two or three eggs. The caracara prefers dry prairies with wet areas, river edges, ranches, and lightly wooded areas with intermittent open grassland (USFWS 1999a). The crested caracara's center of abundance in Florida is Kissimmee Prairie, north of Lake Okeechobee (USFWS 1989), but it does not occur in Everglades National Park (pers. comm. with Mr. O. L. "Sonny" Bass, Everglades National Park supervisory wildlife biologist, and Gabriel Cosyleon, Parsons, regarding the presence of Audubon's crested caracara nests in the park). No critical habitat has been designated. This species' population decline is primarily because of habitat loss from real estate development, citrus groves, tree plantations, and agricultural use. The caracara also fall prey to illegal trapping/killing and collisions with vehicles (USFWS 1989).	The primary habitat for Audubon's crested caracara is the Kissimmee Lakes region in central Florida. Only occasional sightings of individuals have been reported in western portions of the park and the Florida Keys, most likely due to individual birds wandering beyond their range (FL Natural Areas Inventory 2001). The caracara does not occur in the park, given its preference for prairie or agricultural areas. It is unlikely that activities proposed in this management plan would affect this species. The caracara was not carried forward for analysis.
Dismissed	red-cockaded woodpecker	*Picoides borealis*	Endangered	The red-cockaded woodpecker was federally listed as endangered in 1970. This woodpecker is 7 inches long, with a wingspan of 15 inches. It has black and white horizontal stripes on its back, a black cap and throat, and white underparts. Males have a red spot on each side of the cap, called a cockade. These woodpeckers are nonmigratory and are a cooperative breeding species, meaning that a group of several adult birds share in the tasks of raising the chicks of only one set of parents. This group consists of a breeding pair and as many as seven other birds. They tend to the eggs and keep watch over the fledglings after they are hatched. The territory for a group of this size is about 200 acres, on average. Their primary habitat is a pine forest of 80- to 120-year-old trees. Longleaf pines are preferred, but they will occasionally nest in southern pines. Red-cockaded woodpeckers are the only woodpecker that excavates cavities in living pines. Pines with fungus infections, such as red-heart disease, are preferred for excavating cavities, which takes one to three years. The historical range for populations of this species was from as far west as Texas and Oklahoma, east to Florida, and north to New Jersey, with scattered populations on islands. The current population estimate is 12,500 birds (USFWS 2004b). They have been extirpated in New Jersey, Maryland, Tennessee, and Missouri. The red-cockaded woodpecker is not known to occur in Everglades National Park (pers. comm. with Mr. O. L. "Sonny" Bass, Everglades National Park supervisory wildlife biologist, and Gabriel Cosyleon, Parsons, regarding the presence of red-cockaded woodpecker nests in the park). The number of these woodpeckers has declined primarily because of habitat destruction. Pine trees older than 80 years are at risk of both harvest and the encroachment of mid-story hardwood trees because of fire suppression (USFWS 2004b). Several federal agencies are working with private landowners to implement the recovery plan for the species.	The red-cockaded woodpecker nests and roosts in pine or pine-hardwood stands with a low or sparse understory and ample old-growth pines; primary threats include habitat destruction or degradation by timbering and other land-clearing activities (USFWS 1999h). Suitable habitat for the red-cockaded woodpecker is in Big Cypress National Preserve, approximately 20 miles southeast of Everglades City. This location is well outside areas that would be affected by actions proposed in this general management plan. Therefore, this species was not carried through for full analysis.

TABLE 10. FEDERALLY LISTED ENDANGERED, THREATENED, AND CANDIDATE SPECIES OF EVERGLADES NATIONAL PARK

	Common Name	Scientific Name	Status	Habitat Comments and Other Notes	Reasons for Dismissing from Detailed Analysis, if Dismissed
Dismissed	Cape Sable seaside sparrow	*Ammodramus maritimus mirabilis*	Endangered, Critical Habitat	The Cape Sable seaside sparrow is an ecologically isolated subspecies of the seaside sparrow listed as an endangered species by the U.S. Fish and Wildlife Service in 1967; critical habitat was designated in 1977. Most of the critical habitat for the seaside sparrows occurs in Everglades National Park. Recent surveys estimate the population at approximately 3,000 individuals, mostly east of the Northeast Shark River Slough (USFWS 2013b). The Cape Sable seaside sparrow has a specific habitat preference of dense stands of gramminoid species less than 3 feet tall and naturally inundated by freshwater during part of the year. The sparrow has a generalist diet; it commonly feeds on soft-bodied insects, such as grasshoppers, spiders, moths, caterpillars, beetles, dragonflies, wasps, marine worms, shrimp, grass, and sedge seeds, in rough proportion to their availability (USFWS 1999b). The sparrow's breeding season typically extends about six months. Nesting may begin as early as late February and continue into early August. The amount of summer nesting, which essentially means the number of third broods attempted, may depend on the characteristics of individual rainy seasons. Nesting activity decreases abruptly when water depths in nesting habitat exceed 4 to 8 inches. Critical habitat for the Cape Sable seaside sparrow was designated in 1976 and revised in 2007 (USFWS 2007d). The majority of designated critical habitat for this species lies within the short-hydroperiod marl prairies of Everglades National Park. Important characteristics of critical habitat include calcareous marl soils; open, expansive marl prairie habitat with few trees and shrubs; and diverse herbaceous vegetation composed of native grasses characteristic of short-hydroperiod marl prairies.	Cape Sable seaside sparrows are distributed in two areas of marl prairies east and west of Shark River Slough and flanking Taylor Slough (USFWS 1999b); designated critical habitat is outside the park in Miami-Dade County (72 FR 62735 et seq.). The main threat to this species is habitat change resulting from alteration of the natural distribution, timing, and quantity of water flows in south Florida. Although ongoing projects designed to improve water flow and quality in the park might affect the Cape Sable seaside sparrow and its habitat, these actions are not part of this general management plan. It is not anticipated that actions proposed in the alternatives of this plan would affect this species or its habitat. Therefore, this species was not carried through for full analysis.
Analyzed	Everglade snail kite	*Rostrhamus sociabilis plumbeus*	Endangered, Critical Habitat	The Everglade snail kite is a wide-ranging raptor listed as endangered by the U.S. Fish and Wildlife Service in 1967; critical habitat was designated in 1977. This endangered raptor inhabits freshwater marshes and marl prairies of the Florida peninsula. The Everglade snail kite feeds almost exclusively on the apple snail, so the continued existence and availability of this snail primarily decides the fate of the snail kite. The apple snail lives in freshwater wetlands with sparsely distributed emergent vegetation consisting predominantly of grass and sedge species. Managing the hydrology of these marshes is important to the survival of the snails. There are snail kite management zones within the northeast side of the East Everglades Addition (USACE and NPS 2008). It is anticipated that, with the proposed hydrologic and other habitat improvements associated with the Everglades restoration projects (including the Modified Water Deliveries project and the *Comprehensive Everglades Restoration Plan*), the kite could return to its historical habitat (USFWS 1999d) within Everglades National Park. Kites only rarely use the designated critical habitat within Everglades National Park. Important characteristics of critical habitat include availability of native apple snails, native herbaceous wetlands, and availability of nesting substrate such as small trees.	
Analyzed	red knot	*Calidris canutus rufa*	Proposed threatened	The red knot is a robin-sized, highly migratory shorebird that breeds in the arctic regions of North America and winters in southern South America, but also rarely in the southeastern United States and Central America. It makes one of the longest migrations of any bird species, and consequently, migration stopover sites are an important component of their habitat needs, primarily during spring migration. Red knots forage for mollusks on expansive intertidal areas and often are seen in large flocks of several hundred birds. High quality foraging habitat that is largely free of disturbance is important for red knots. The steepest decline in red knot population occurred since 2000 and is believed to be a result of limited food availability at key stopover sites in Delaware Bay, where a horseshoe crab fishery was reducing availability of prey. Timing of prey availability is also crucial during migration. Within Everglades National Park there are few sites that routinely support red knots during migration. However, red knots occur in Lake Ingraham, on Cape Sable, and in exposed intertidal areas of Florida Bay and mainland beaches during low tide. The red knot (rufa subspecies) was proposed for listing as threatened under the Endangered Species Act in September 2013 due to significant population declines (USFWS 2013c). No critical habitat for the red knot has been proposed.	
REPTILES					
Analyzed	eastern indigo snake	*Drymarchon corais couperi*	Threatened	The eastern indigo snake was first listed by the U.S. Fish and Wildlife Service as threatened in 1979 and has no designated critical habitat. The indigo snake is the longest of the North American snakes, with a heavy body and shiny blue-black coloring. This docile, nonvenomous snake has declined in numbers over the last 100 years because of habitat loss, pesticide use, and collection for the pet trade. Individuals require large areas with a variety of habitats, and areas of 10,000 acres or more may be essential for population viability. The U.S. Fish and Wildlife Service has categorized the species as declining, with strict enforcement of anti-collection laws needed (NatureServe 2008; USFWS 2008b). In the park, the indigo snake can be observed in wet prairie and hardwood hammock areas. It uses the burrows of other animals for denning or to lay eggs and may inhabit canal banks where there are numerous burrows. The preferred diet of these snakes is frogs, other snakes, toads, salamanders, small mammals, and birds. In summer, the eastern indigo snake ranges widely (over 125 to 250 acres) in search of prey, but in winter it stays close to the den (within 25 acres). A year-long road kill survey along Tamiami Trail found many reptiles and amphibians but documented no eastern indigo snakes (USFWS 2004c). No critical habitat for the eastern indigo snake has been designated.	

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	Common Name	Scientific Name	Status	Habitat Comments and Other Notes	Reasons for Dismissing from Detailed Analysis, if Dismissed
Analyzed	American alligator	*Alligator mississippiensis*	Threatened S/A — (similar in appearance)	Since American alligators were first protected in 1967, before the Endangered Species Act, the species has made a dramatic comeback. In 1987, the U.S. Fish and Wildlife Service pronounced the species "fully recovered." However, it remains protected as a threatened species because of its similarity in appearance to the threatened American crocodile. The alligator can be distinguished from the American crocodile by its broader snout and dark body color and it is found in freshwater and brackish water habitats. Alligators may live 30 years or more, reach lengths of 10 to 13 feet, and weigh 1,000 pounds at maturity. Alligators prey on fish, turtles, snails, and any animals that come to the water's edge. They depend on wetland habitats, and in some ways the wetlands of the Everglades depend on them. An alligator uses its mouth and claws to uproot vegetation; then, slashing with its powerful tail, it wallows out a depression. This "alligator hole" is full of water in the wet season and holds water during the dry season. During extended droughts, 'gator holes provide vital water for fish, insects, crustaceans, snakes, turtles, birds, and other animals in addition to the alligator (USFWS 2008a).	
Analyzed	American crocodile	*Crocodylus acutus*	Threatened, Critical Habitat	The American crocodile is listed by the U.S. Fish and Wildlife Service as threatened. Critical habitat was designated in 1979. The crocodile population in Florida, although small, appears stable. The American crocodile inhabits coastal habitats of extreme south Florida, including coastal areas of Miami-Dade, Monroe, Collier, and Lee counties. Crocodiles are regularly observed in Florida and Biscayne bays, and they are observed primarily in mangrove swamps, low-energy mangrove-lined bays, creeks, and inland swamps (Kushlan and Mazzotti 1989). The status of the American crocodile population in Florida was upgraded from endangered to threatened in 2007 (USFWS 2007e). It remains listed as endangered outside of Florida. Important characteristics of critical habitat include low salinity waters resulting from freshwater flows to the estuarine zone and sheltered bays and creeks protected from wave action and disturbance.	
Analyzed	green sea turtle	*Chelonia mydas*	Endangered	In 1978, the breeding populations of green sea turtles off Florida and the Pacific coast of Mexico were listed as endangered, while all other populations were listed as threatened (NMFS 2003a). Adult green sea turtles measure from 35 to 46 inches in straight carapace length and weigh 220 to more than 300 pounds. Green sea turtles range throughout the tropics worldwide. They are the only herbivorous sea turtle (Guseman and Ehrhart 1992). During the day, green sea turtles feed in the seagrass beds that grow in shallow waters. At night, they sleep on the shallow bottom and sometimes out of the water on rocky ledges. Although sea turtles are subject to predation throughout their life cycle, predation is particularly high during the first two years of life. Sharks prey on green sea turtles of all ages (NMFS 2003a). The greatest cause of decline in green sea turtle populations is commercial harvest for eggs, food, skin, and shells for jewelry. Incidental catch and mortality during commercial shrimp trawling adversely affects the species' recovery (NMFS 2003a). Total population estimates for the green sea turtle are unavailable, and trends are particularly difficult to assess because of wide year-to-year fluctuations in numbers of nesting females, difficulties of conducting research on young turtles and time to reach reproductive maturity. The recovery team for the green sea turtle concluded that the species' status has not improved appreciably since listing. Present estimates range from 200 to 1,100 females nesting on U.S. beaches (NMFS 2003a), and almost all U.S. nesting occurs on eastern Florida beaches between May and September (Guseman and Ehrhart 1992). The Dry Tortugas support the largest green turtle rookery in Monroe County. Green sea turtles are found in Florida Bay and along the west coast of the park. There is no designated critical habitat for green sea turtles in Florida.	
Analyzed	hawksbill sea turtle	*Eretmochelys imbricata*	Endangered	The hawksbill sea turtle was listed as endangered in 1970, and its status has not changed since. The hawksbill sea turtle is a small to medium-sized sea turtle ranging worldwide throughout the tropics. In the Caribbean, nesting females average about 24 to 37 inches in straight carapace length (Meylan 1999). Weight is typically as much as 176 pounds in the wider Caribbean (NMFS 2003b). The hawksbill is a solitary nester, and thus population trends or estimates are difficult to determine; however, most researchers agree that the nesting population is declining. The major cause for the hawksbill's continued decline is commercial exploitation for its shell and for other products, including leather, oil, perfume, and cosmetics (NMFS 2003b). Substantial incidental catch and mortality from commercial fishing, petroleum pollution in offshore waters, and entanglement in marine debris, such as monofilament line, have also been documented. In Florida, only a few hawksbill nests are documented each year (Meylan 1992). Hawksbill sea turtles inhabit the waters of the Dry Tortugas, Florida Bay, and along the west coast of the park (Smith 2001). Post-hatchling hawksbills are seagoing, but juveniles through adults use coral reefs as foraging habitat and prey on sponges. Hawksbills are also known to inhabit mangrove-fringed bays and estuaries, particularly along the eastern shore of continents where coral reefs are absent. Both insular and mainland nesting sites are known. Hawksbills will nest on small pocket beaches, and they nest in a variety of soils. Nests are typically placed under vegetation (NMFS 2003b). There is no designated critical habitat for hawksbill sea turtles in Florida.	

TABLE 10. FEDERALLY LISTED ENDANGERED, THREATENED, AND CANDIDATE SPECIES OF EVERGLADES NATIONAL PARK

	Common Name	Scientific Name	Status	Habitat Comments and Other Notes	Reasons for Dismissing from Detailed Analysis, if Dismissed
Analyzed	Kemp's Ridley sea turtle	*Lepidochelys kempii*	Endangered	The Kemp's Ridley sea turtle was federally listed as endangered throughout its range in 1970, and its status has remained unchanged. The Kemp's Ridley population has declined since 1947, when an estimated 42,000 females nested in one day, to a nesting population of approximately 1,000 in the mid-980s. The decline of this species was primarily due to human activities, including collection of eggs, fishing for juveniles and adults, killing adults for meat and other products, and incidental take by shrimp trawlers. Today, under strict protection, the population appears to be in the earliest stages of recovery due to full protection of nesting females and their nests in Mexico, and the requirement to use turtle excluder devices in shrimp trawls both in the United States and Mexico (NMFS 2003c). The Kemp's Ridley is the smallest of all extant sea turtles, with the weight of an adult generally less than 100 pounds and the straight carapace length around 26 inches. Adult Kemp's Ridley shells are almost as wide as long. Hatchling Kemp's Ridley's feed on the available sargassum and associated fauna occurring in the Gulf of Mexico. Juvenile and adult Kemp's Ridleys are largely crab eaters, with a preference for portunid crabs, and live in a wide variety of coastal benthic habitats, usually sand or mud bottoms. The major nesting beach for Kemp's Ridleys is on the northeastern coast of Mexico. The species occurs mainly in coastal areas of the Gulf of Mexico and the northwestern Atlantic Ocean. Nesting in Florida is incidental, but adult Kemp's Ridleys can be found in Florida's coastal waters (Meylan 1992).	
Analyzed	leatherback sea turtle	*Dermochelys coriacea*	Endangered	The leatherback sea turtle was listed as endangered throughout its range in 1970. Nesting populations of leatherback sea turtles are especially difficult to discern because the females frequently change beaches. However, current estimates are that 20,000 to 30,000 female leatherbacks exist worldwide. Leatherbacks do not nest frequently enough in the United States to assess an accurate trend. In the Atlantic and Caribbean, the largest nesting assemblages are found in the U.S. Virgin Islands, Puerto Rico, and Florida. Nesting data for these locations since the 1980s suggest that the annual number of nests is likely stable; however, information regarding the status of the entire leatherback population in the Atlantic is lacking. The population faces significant threats from incidental take in commercial fisheries, marine pollution, harvest of eggs and flesh, and habitat destruction (NMFS 2003d). The leatherback sea turtle is the largest living species of turtle. The average curved carapace length for adult turtles is 60 inches, and the turtles can weigh from 440 to 1,500 pounds (NMFS 2003d). The bulk of the leatherback diet consists of jellyfish (Pritchard 1992). The leatherback turtle is an extremely wide-ranging species. Nonbreeding turtles in the Atlantic may occur from Canada to Argentina, while breeding adults nest on tropical, usually mainland, shores in the Atlantic, Indian, and Pacific oceans (Pritchard 1992). Critical habitat for the leatherback includes the waters adjacent to Sandy Point, St. Croix, U.S. Virgin Islands. During the summer, leatherbacks tend to occur along the east coast of the United States from the Gulf of Maine south to the middle of Florida (NMFS 2003d). No nesting occurs on U.S. beaches. There is no designated critical habitat for leatherback sea turtles in Florida.	
Analyzed	loggerhead sea turtle	*Caretta caretta*	Threatened, Proposed Critical Habitat	Loggerhead sea turtles were federally listed as threatened in 1978 because of past overhunting for its meat, leather, eggs, and fat. They winter in shallow waters and feed near the water surface, both of which make them susceptible to being caught in shrimp trawl nets and drowning (Texas Parks and Wildlife 2009). Loggerheads have characteristically large, block-like heads, strong jaws, and a ruddy brown carapace on top. They are among the larger sea turtles, as long as 45 inches in length and weighing 170 to 500 pounds. A slow swimmer compared to other sea turtles, this species is more likely to fall prey to larger, faster predators. Throughout their entire lives, they are at risk of becoming prey to different predators—from crabs when they are hatchlings to sharks when they are fully grown. Their life span is about 30 years, but can exceed 50 years. Loggerhead turtles are life-long carnivores. They feed on fish, crab, shrimp, sponges, squid, jellyfish, and various other animals throughout the stages of their lives. Loggerhead turtles can be observed in various environments: the brackish waters of coastal lagoons; the open sea; and at the bottom of sounds, bays, and estuaries where they remain dormant in winter. Their primary nesting beaches are along the southeastern coast of the United States, from North Carolina to Florida, where each female can lay as many as 190 eggs per nest. They are the only sea turtle that can nest outside the tropics, as long as the water temperature is above 68 degrees Fahrenheit (FWC 2010b). Loggerheads are known to nest on the sand beaches of Cape Sable, Highlands Beach, and islands with sand beaches. In 2009, more than 1,000 nests were estimated to occur within the park. In 2013, U.S. Fish and Wildlife Service and NOAA separately proposed to designate critical habitat for loggerhead sea turtles within their areas of jurisdiction, including land and water within Everglades National Park (USFWS 2013d; NMFS 2013). The U.S. Fish and Wildlife Service proposed critical habitat includes beaches and shoreline along portions of Cape Sable, Highlands Beach, and Shark Point, while the NOAA proposal includes the waters offshore of those areas. Important characteristics of these proposed critical habitats include unaltered sandy beaches (USFWS) and unimpeded access for hatchlings from shore to deeper waters (NOAA).	

TABLE 10. FEDERALLY LISTED ENDANGERED, THREATENED, AND CANDIDATE SPECIES OF EVERGLADES NATIONAL PARK

	Common Name	Scientific Name	Status	Habitat Comments and Other Notes	Reasons for Dismissing from Detailed Analysis, if Dismissed
FISHES					
Analyzed	smalltooth sawfish	*Pristis pectinata*	Endangered, Critical Habitat	The lone endangered fish species that occurs in the park is the smalltooth sawfish. The smalltooth sawfish is a tropical marine and estuarine elasmobranch (the ray and skate family) that was listed as endangered in 2003. Smalltooth sawfish may grow as long as 18 feet long and sport an elongated, blade-like snout studded with numerous teeth on either side. Habitat destruction and overfishing have eradicated this species from its former range of New York to Texas. The last remaining U.S. population inhabits the waters of Florida Bay (Florida Museum of Natural History 2010b) and the Charlotte Harbor Estuary (NMFS 2009a). Critical habitat for the smalltooth sawfish was designated by the National Marine Fisheries Service in September 2009 (NMFS 2009a, see figure 5 at the end of this table). The smalltooth sawfish diet consists of small schooling fish such as mullets and clupeids. They are also reported to feed on crustaceans and other benthic-dwelling organisms. According to a status review, sawfish inhabit sheltered bays with shallow coastal waters very close to shorelines in muddy and sandy bottoms (NMFS 2000). Sawfish seldom reside in waters deeper than 32 feet (10 meters). Designated smalltooth sawfish critical habitat encompasses most of the nearshore waters of Florida Bay and the Ten Thousand Islands region of Everglades National Park. Important characteristics of critical habitat include shallow (less than 3 feet) euryhaline estuarine waters resulting from freshwater flows to estuarine waters and red mangroves. These characteristics support young sawfish.	
Dismissed	dusky shark	*Carcharhinus obscurus*	Species of Concern	Dusky sharks are found in the western Atlantic, ranging from Nova Scotia to Cuba to southern Brazil. They spend the summers in the north and migrate south in winter. They can be found in the surf zone to offshore depths of 1,312 feet (400 meters). They are not commonly found in estuaries. The principal threat to the sharks is from recreational fisheries. In 2000 possession was outlawed in commercial fisheries. Dusky sharks are susceptible to overfishing and by catch in longline and gillnet fisheries.	The dusky shark is not commonly found in estuary environments. Management actions proposed in this document would not directly affect the population of the sharks. The principal threat to the sharks is overfishing. The general management plan alternatives would not provide further protection of the sharks from this threat. Proposed actions such as larger protected areas in Florida Bay might provide indirect marginal benefits to the species through protection of important fisheries habitats. There would be no marked difference in the effects on sharks from the various alternatives; therefore, this species was not carried forward for full analysis.
Dismissed	opossum pipefish	*Microphis branchyurus*	Species of Concern	The opossum pipefish are a widespread diadromous species that spawn in brackish waters or the low-salinity areas of estuaries. The young live in the open ocean for an indeterminate time and return to fresh water to reproduce. In the United States, permanent populations only occur in southeastern Florida tributaries. In Florida, breeding occurs in freshwater tributaries with dense emergent vegetation dominated by *Panicum* spp. and *Polygonum* sp. The pipefish prey on crustaceans and small fish. Major threats to this species are habitat destruction from nonnative plant treatments, water control structures that prevent migration and alter hydrologic regimes, declining water quality, and increasing disease.	The population of the opossum pipefish in the brackish waters in the park depends on the hydrology and water quality of the Everglades ecosystem. Although ongoing projects designed to improve water flow and quality in the park may affect the pipefish, these actions are not part of this general management plan. It is not anticipated that actions proposed in the alternatives of this plan would affect the pipefish or their habitat. Therefore, this species was not carried through for full analysis.
Dismissed	saltmarsh top-minnow	*Fundulus jenkinsi*	Species of Concern	The saltmarsh topminnow is endemic to brackish waters from Texas to the western panhandle of Florida. They are generally associated with salt marshes and brackish water and breed in flooded marshes. Habitat alteration, dredging, and marsh erosion are the most serious threats to the species.	Based on National Marine Fisheries distribution maps for the saltmarsh topminnow, the species is not found within the park (NMFS 2009b). If it does occur in the park, it would most likely occur in the northwestern portion in the area of the Thousand Islands. Activities proposed in the alternatives for this portion of the park would not have detectable effects on the distribution or population of this species, and therefore this species was not carried through for full analysis.
Dismissed	Goliath grouper	*Epinephelus itajara*	Species of Concern	The goliath grouper occurs in the North Atlantic from Florida, south to Brazil. The current center of abundance of the Gulf of Mexico population of the goliath grouper is thought to be the Ten Thousand Islands region, where extensive mangrove habitat exists. This grouper occurs in shallow, inshore waters to depths of 150 feet. It prefers areas of rock, coral, and mud bottoms. Juveniles are found in mangroves and brackish estuaries. This grouper preys on crustaceans, fish, and young sea turtles. Juvenile mangrove habitat destruction has been a principal factor in the decline of the species in south Florida, particularly early in the 20th century (NMFS 2006b). Given its large size, slow growth, and slow reproductive rate, the goliath grouper is also susceptible to overfishing. In the United States, take of this species is prohibited (Florida Museum of Natural History 2010a).	Mangroves are abundant near this species' center of abundance (Ten Thousand Islands). The alternative management actions do not markedly affect the mangrove habitat in this area of the park. Therefore there would be no expected change in the population or distribution of the species as a result of the proposed management actions, and this species was not carried through for full analysis.
Dismissed	key silverside	*Menidia conchorum*	Species of Concern	The key silverside is a small species occurring in swift-moving schools. It is currently found in the Florida Keys from Key West to Long Key. Its main habitats are tidal creek, lagoon, and pond waters of varying salinity. It is commonly found in the rhizomes of black mangrove trees or in areas of turtle grass and other macroalgae, where it is less vulnerable to predation. Habitat destruction through loss of ponds and black mangroves has resulted in a decline of this species. Introduced bluegill are resulting in loss of silverside populations as well.	This species is not currently known to occur in the park. If the species migrates to the southern boundary of the park, the pole/troll zones in the NPS preferred alternative and alternative 4 might provide some negligible to minor benefit to the species through protection of seagrass habitat. Because the impacts would likely only be negligible to minor, this species was not carried through for full analysis.

TABLE 10. FEDERALLY LISTED ENDANGERED, THREATENED, AND CANDIDATE SPECIES OF EVERGLADES NATIONAL PARK

	Common Name	Scientific Name	Status	Habitat Comments and Other Notes	Reasons for Dismissing from Detailed Analysis, if Dismissed
Dismissed	mangrove rivulus	*Rivulus marmoratus*	Species of Concern	The mangrove rivulus is a small fish species that occurs in the mangrove system of Florida Bay and throughout keys. This species is extremely vulnerable to habitat modification and fragmentation, environmental alteration, and human development and encroachment. Much of its habitat has been isolated and fragmented as a result of the destruction of mangroves and impounding of high marshes.	The proposed management actions do not markedly affect the mangrove habitat in the park, although some protection from wave action would occur with idle speed, no-wake areas and pole/troll areas. Therefore, there would be no expected change in the population or distribution of the species as a result of the proposed management actions, and this species was not carried through for full analysis.
Dismissed	Nassau grouper	*Epinephelus striatus*	Species of Concern	Nassau groupers are predatory fish found from inshore to depths of about 330 feet in many areas of the Caribbean and south Atlantic. Adults are found near high-relief coral reefs and rocky bottoms, and juveniles are found at shallower depths in and around coral clumps covered with microalgae and above seagrass beds. They feed mostly on fishes and crabs. The Florida and Caribbean populations of the species are considered overfished by the National Marine Fisheries Service. The species occurs all along Florida's coast and in marine areas of park. Fishing pressure is no longer occurring in the United States because it is illegal to possess a Nassau grouper. In addition, there is no record of any Nassau grouper spawning aggregations in the NMFS jurisdictional waters that would include Everglades National Park.	The proposed management actions would not directly affect the Nassau grouper population. The principal threat to this species is overfishing, particularly at spawning aggregation sites. The general management plan alternatives would not provide further protection of the species from this threat. There would be no marked difference in the negligible effects on sharks from the various alternatives; therefore, this species was not carried forward for full analysis.
Dismissed	Sand tiger shark	*Carcharias taurus*	Species of Concern (western Atlantic)	The sand tiger shark is a coastal species in the Atlantic and Gulf of Mexico, including all coastal areas of Florida. The shark is usually found from the surf zone down to a depth of 75 feet. It has also been noted in shallow bays, around coral reefs, and at depths of as much as 600 feet. Threats to the species include overfishing and low rates of reproduction, and juveniles are vulnerable to pollution in estuaries.	The proposed management actions would not directly affect the sand tiger shark population. Given the current threats to the species from overfishing and pollution, the management alternatives would not further protect the species from this threat. Proposed actions such as larger protected areas in Florida Bay might provide indirect marginal benefits to the species through protection of important fisheries habitats. There would be no marked difference in the effects on sand tiger sharks from the various alternatives; therefore, this species was not carried forward for full analysis.
INVERTEBRATES					
Dismissed	Stock Island tree snail	*Orthalicus reses reses*	Threatened	Stock Island tree snails are large, buff-colored, conical snails, about 2 inches long. The species is hermaphroditic and lives about six years. The snails are active during the rainy season and enter a dormant stage during the dry months of December through May. Nests are built in September and contain about 8 to 20 eggs, which hatch in June. These snails graze on fungi and algae that grow on both smooth and rough-barked trees of hardwood hammocks. The historical range includes natural hammocks of Stock Island and Key West within the Florida Keys, but the species has recently been observed only in one hammock on Stock Island (USFWS 1992). The Stock Island tree snail has declined in population largely because of the destruction of habitat. There is no direct competitor with this species for food. Individuals are also lost to predation by cats and rodents. Recovery efforts have included collection of wild specimens for captive breeding. Additional sites in the Florida Keys are being investigated for reintroduction, and The Nature Conservancy has been contracted to enhance the current stock (USFWS 1992).	Found only in tropical hardwood hammocks on Stock Island and Key West; distribution has been extended by collectors who have introduced them to Key Largo and the southernmost parts of the mainland (USFWS 1999h); known habitat is outside the general management plan potential area of affect.
Dismissed	Schaus swallowtail	*Heraclides aristodemus ponceanus*	Endangered	The Schaus swallowtail butterfly was first described in 1911 from collections in the Miami area. From 1924 to 1981 there was a general decline in range and numbers. The species was listed as threatened in 1976 because of population declines caused by the destruction of its tropical hardwood hammock habitat, mosquito control practices, and over-harvesting by collectors. The Schaus swallowtail butterfly was reclassified as an endangered species in 1984 because its numbers and range had declined dramatically since its initial listing (USFWS 1999). The butterfly occurs exclusively in subtropical hardwood hammocks and ecotones. Hammocks are now extensive only in the Upper Keys in Miami-Dade and Monroe counties. About half of the remaining suitable habitat is in Biscayne National Park. Most of the population in that park is on Elliott Key, with smaller populations on Adams, Old Rhodes, Swan, and Totten keys.	Known occupied habitat for this butterfly occurs only on north Key Largo, Crocodile Lake National Wildlife Refuge, and keys in Biscayne National Park—i.e., not in Everglades National Park (USFWS 2008d). Therefore, this species was not carried forward for full analysis.

TABLE 10. FEDERALLY LISTED ENDANGERED, THREATENED, AND CANDIDATE SPECIES OF EVERGLADES NATIONAL PARK

	Common Name	Scientific Name	Status	Habitat Comments and Other Notes	Reasons for Dismissing from Detailed Analysis, if Dismissed
Dismissed	Miami blue butterfly	*Cyclargus thomasi bethunebakeri*	Endangered	Primarily a south Florida coastal species, the Miami blue butterfly's historical distribution ranged as far north as Hillsborough County on the Gulf Coast, Volusia County on the Atlantic Coast, and south to the Florida Keys and the Dry Tortugas. The species was believed to have been extirpated until it was rediscovered in Bahia Honda State Park in 1999; a second metapopulation was discovered in the Key West National Wildlife Refuge in 2006. Both areas are on the Florida Keys. The Miami blue butterfly was added to the list of federal candidate species in 2005 because of the overall magnitude of threats (high) and immediacy of threats (imminent) (FFWCC 2010a). The Miami blue occurs at the edges of tropical hardwood hammocks, in beachside scrub, and occasionally on pine rocklands. This butterfly lays its eggs on flowers, flower buds, and terminal growth of its host plants. Historically, this species was known to occur in the Royal Palm Hammock, Chokoloskee, and Flamingo areas of Everglades National Park, but the Miami blue is now believed to be extirpated from the park. Reintroduction attempts in 2004 did not establish viable populations. The Miami blue was emergency listed as endangered in August 2011, and then listed as endangered on April 6, 2012, upon publication of the final rule in the Federal Register (USFWS 2012b). No critical habitat has been proposed.	This species is believed to be extirpated from Everglades National Park, and the only known populations occur in the Florida Keys—in Bahia Honda State Park and the Key West National Wildlife Refuge. Therefore, this species was not carried forward for full analysis. Despite the fact that the Miami blue is believed to be extirpated from Everglades National Park, there remains potential for it to become established in the future within the park. In this manner, the park may contribute to its recovery. However, none of the actions proposed in the GMP alternatives are expected to adversely affect Miami blue butterfly recovery or potential habitat within the park, and all alternatives will generally provide equal levels of protection and maintenance of potential habitat. Future projects or actions that may affect the Miami blue butterfly in the park will be considered in coordination with USFWS and FWC.
Dismissed	Florida leafwing butterfly	*Anaea troglogyta floridalis*	Endangered, Critical Habitat	The Florida leafwing is a medium-sized butterfly, measuring as long as 3 inches. It is restricted to the pine rocklands of Long Pine Key. Larvae depend on pineland croton (*Croton linearis*) as a food source. Adult Florida leafwings have been observed regularly in a widespread area of Long Pine Key over the last several years but do not appear to be abundant. The population size of Florida leafwings in Long Pine Key is estimated to be several hundred or fewer individuals (USFWS 2013e). Although individuals are observed in the park, this species has suffered range-wide decline outside the park. The Florida leafwing is now believed to be extant only within the boundaries of Everglades National Park (USFWS 2013e). Within the park, individuals and populations are threatened by displacement of host plants by nonnative invasive species, fire suppression activities, and improper fire intervals. Illegal collecting may also pose a threat to this species because of its rarity. The effects of these threats, alone and in combination, on populations of Florida leafwing in the park are largely unknown. USFWS (2013e, 2013f) recently proposed listing the Florida leafwing as endangered and included designation of critical habitat in the proposed rule. USFWS (2014b, 2014c) released the final rule to list the Florida leafwing as endangered and designate critical habitat. Critical habitat includes much of the pine rockland habitat within Long Pine Key. Important components of proposed critical habitat include large areas of native pine rockland communities that support the butterfly's host plant, pineland croton. A natural disturbance regime, low levels of invasive plants, and absence of pesticides are also important within critical habitat. Prescribed fire is currently used in pine rocklands to maintain habitat for pineland croton. Post fire monitoring of pineland croton and of this butterfly species is also being carried out. The combination of prescribed fire, lack of soil disturbance and localized control measures maintains nonnative vegetation at very low levels in the park's pine rocklands. Current management related to this species is expected to continue to benefit Florida leafwing populations by maintaining pine rockland habitat. These actions will be modified over time as new information on this species is better understood.	No development or other impacts to undisturbed areas in Long Pine Key are proposed in this general management plan. It is not anticipated that actions proposed in any of the alternatives in this plan would affect this species or any of the areas of critical habitat. Therefore, this species was not carried through for full analysis.
Dismissed	Bartram's hairstreak butterfly	*Strymon acis bartrami*	Endangered, Critical Habitat	The Bartram's scrub-hairstreak is a small butterfly, measuring 1 inch long. It is restricted to the pine rocklands of Miami-Dade County, both within and outside of Everglades National Park and on Big Pine Key in Monroe County. Larvae depend on pineland croton (*Croton linearis*) as a food source. Adult Bartram's scrub-hairstreak butterflies have been observed regularly in a widespread area of Long Pine Key over the last several years but do not appear to be abundant. The population of Bartram's scrub-hairstreak in Long Pine Key is estimated to be in the hundreds at most (USFWS 2013e). Although individuals are observed in the park, this species has suffered rangewide decline outside the park. Within the park, individuals and populations are threatened by displacement of host plants by nonnative invasive species, fire suppression activities, and improper fire intervals. Illegal collecting may also pose a threat to this species because of its rarity. The effects of these threats, alone and in combination, on populations of Bartram's scrub-hairstreak in the park are largely unknown. The U.S. Fish and Wildlife Service (2013d, 2013e) recently proposed listing the Florida leafwing as endangered and included designation of critical habitat in the proposed rule. USFWS (2014b, 2014c) released the final rule to list the Florida leafwing as endangered and designate critical habitat. Critical habitat includes much of the pine rockland habitat within Long Pine Key. The important characteristics of critical habitat are the same as those described for the Florida leafwing, above. Prescribed fire is currently used in pine rocklands to maintain habitat for pineland croton. Post fire monitoring of pineland croton and of this butterfly species is also being carried out. The combination of prescribed fire, lack of soil disturbance and localized control measures maintains nonnative vegetation at very low levels in the park's pine rocklands. Current management related to this species is expected to continue to benefit Bartram's scrub-hairstreak populations by maintaining pine rockland habitat. These actions will be modified over time as new information on this species is better understood.	No development or other impacts to undisturbed areas in Long Pine Key are proposed in this general management plan. It is not anticipated that actions proposed in any of the alternatives in this plan would affect this species or any of the areas of critical habitat. Therefore, this species was not carried through for full analysis.

TABLE 10. FEDERALLY LISTED ENDANGERED, THREATENED, AND CANDIDATE SPECIES OF EVERGLADES NATIONAL PARK

	Common Name	Scientific Name	Status	Habitat Comments and Other Notes	Reasons for Dismissing from Detailed Analysis, if Dismissed
Dismissed	Cassius blue butterfly	*Leptotes cassius theonus*	Threatened S/A (similar in appearance)	The cassius blue butterfly is a common butterfly in South Florida. It is frequently encountered in Everglades National Park. Due to the difficulty in distinguishing this species from the Miami blue, the cassius blue butterfly was listed as threatened due to similarity of appearance to the Miami blue butterfly (USFWS 2012b). The rule prohibits collecting cassius blue butterflies within the historic range of the Miami blue butterfly.	Collection of cassius blue butterflies would not occur as a direct result of any of the activities proposed in this general management plan. As a result, the cassius blue butterfly was not carried through for analysis.
Dismissed	Ceraunus blue butterfly	*Hemiargus ceraunus antibubastus*	Threatened S/A (similar in appearance)	The ceraunus blue butterfly is a common butterfly in South Florida. It is frequently encountered in Everglades National Park. Due to the difficulty in distinguishing this species from the Miami blue, the ceraunus blue butterfly was listed as threatened due to similarity of appearance to the Miami blue butterfly (USFWS 2012b). The rule prohibits collecting ceraunus blue butterflies within the historic range of the Miami blue butterfly, which includes Everglades National Park.	Collection of ceraunus blue butterflies would not occur as a direct result of any of the activities proposed in this management plant. As a result, the ceraunus blue butterfly was not carried forward for analysis.
PLANTS					
Dismissed	Blodgett's silverbush	*Argythamnia blodgettii*	Candidate	Blodgett's silverbush is a small, semi-woody, perennial plant that grows as tall as 2 feet. The leaves are long and slender, and the stems and leaves are covered with fine hairs. It is known to occur only at the edges of pine rocklands, in hammocks, and along coastal berms. It requires sunny sites and periodic low-intensity fires to reduce competition from larger woody species. This species can tolerate a degree of disturbance, having been identified in abandoned rock quarries (USFWS 2009a). Currently, fewer than 10,000 individuals are known to exist, with 90% of these restricted to 11 protected areas, including the eastern portions of Everglades National Park. This species is a candidate species for listing by the U.S. Fish and Wildlife Service. Habitat loss is the primary threat to this species, with extirpation having occurred even in protected areas as a result of development. Other threats include fire suppression, nonnative plant invasion, and changes to the regional hydrology. This species is also highly susceptible to extirpation by catastrophic events (USFWS 2009a).	No development is proposed in undisturbed areas where this plant occurs, in any GMP alternative. Should this change, surveys would be completed prior to any ground disturbance to determine if this (or other special status species) is present, and appropriate mitigation would be provided. Therefore, this species was not carried through for full analysis.
Dismissed	Garber's spurge	*Chamaesyce garberi*	Threatened	Garber's spurge is a small (0.5 inch long), perennial, herbaceous plant with hairy stems and oval leaves. The flowering and fruiting period is from March to December, and this plant is generally thought to reproduce by seed. Garber's spurge is endemic to south Florida and formerly occurred in Dade and Monroe counties from the Miami area to the Lower Florida Keys—between rockland hammocks and rock pinelands and on beach ridges in saline coastal areas. It needs open, sunny areas that have frequent fires to maintain suitable habitat, and it prefers thin, sandy soils (USFWS 1991b, 1999c). The plant was listed as threatened in 1985 because of habitat loss from development. It apparently no longer exists on eight of the Florida Keys, and it has not been observed in the Miami area since 1949. The plant's current populations are present at four sites in Everglades National Park in Dade and Monroe Counties and at one privately owned site on Big Pine Key in Monroe County. The population of this species is estimated to exceed 600,000 individuals in the Cape Sable area (Green et al. 2007a) and 4,800 individuals in Long Pine Key (Green et al. 2007b). No populations or individuals of Garber's spurge are known to occur on or near developed trails, and none are found in areas generally accessed by visitors. Three of the known sites are in coastal locations, where there is a risk of destruction by storms or hurricanes. A potential threat in some locations is the lack of periodic fire to control successional vegetation that might overshade this plant (USFWS 1991b, 1999c). In the South Florida Multiple Species Recovery Plan, one objective is to stabilize the Garber's spurge population and then delist the species. This could occur when the remaining population is free from the threats of further development, fire suppression, and nonnative species invasion, and when population levels are determined to ensure 95% probability of persistence for 100 years (USFWS 1999e). Monitoring of Garber's spurge in the park is scheduled to occur once every five years to track changes in populations.	Visitor access and use of habitat occupied by Garber's spurge in both Long Pine Key and the Cape Sable area is very limited. No populations or individuals are known to occur on or near developed trails and they this species is not found in areas generally accessed by visitors. These conditions would not change as a result of any actions Proposed in the GMP alternatives.
Dismissed	Pineland sandmat	*Chamaesyce deltoidea spp. pinetorum*	Candidate	Pineland sandmat is a small, perennial, herbaceous plant that forms small tufts. The stems have long hairs and irregularly shaped leaves. It is known to occur only in pine rocklands along the Miami Rock Ridge in southern Dade County. It is not shade tolerant, and it requires periodic low-intensity fires to reduce competition by woody species. Loss of pine rockland habitat, fire suppression, and invasion by nonnative species have reduced the population of this species to around 10,000 individuals. This species is a candidate species for listing by the U.S. Fish and Wildlife Service. About 90% of these individuals occur in seven protected areas: Everglades National Park, Florida City Pineland, Navy Wells Pineland, Palm Drive Pineland, Pine Ridge Sanctuary, Rock Pit 39, and Seminole Wayside Park. Except for the national park, all of these sites are managed by Miami-Dade County. Pineland sandmat is covered under the U.S. Fish and Wildlife Service South Florida Multiple Species Recovery Plan, which emphasizes conservation of the remaining pine rockland communities (USFWS 2003b).	In the park, the plant occurs near Long Pine Key. Threats to this species are not imminent because fire management is regularly conducted at the site of largest occurrence. No development in undisturbed areas at Long Pine Key is proposed in this plan. Should this change, surveys would be completed before any ground disturbance to determine if this (or other special status species) is present, and appropriate mitigation would be provided. Thus, this species was not carried on for full analysis.
Dismissed	Crenulate lead-plant	*Amorpha crenulata*	Endangered	The crenulate lead-plant is an endangered shrub growing to about 8 feet high with compound leaves of 20 to 30 leaflets. Lead-plants blossom in the spring, bearing clustered flowers with a single, tiny petal and seed pods 0.25 inch long. They inhabit the pine rockland community and historically occurred along the slightly elevated south Florida limestone ridge, from southeastern Broward County to Long Pine Key in Everglades National Park. Because an estimated 98% of the Dade County pinelands outside Everglades National Park have been destroyed by development, the crenulate lead-plant now occurs mainly in protected areas, with less than 50 individuals known to exist in two metropolitan Miami parks. Fire suppression may also affect the species, because pine rocklands depend on periodic fires to prevent succession to hardwoods. Invasion of nonnative plants, such as Brazilian pepper and a large reed, present an additional threat. Crenulate lead-plant is now so limited in number that that any collecting,	In Everglades National Park, crenulate lead-plant occurs as a single, planted individual that persists from cultivation in a developed area. This species was not historically found in the park and is not considered to be native to the park. As a result, this species was not carried through for full analysis.

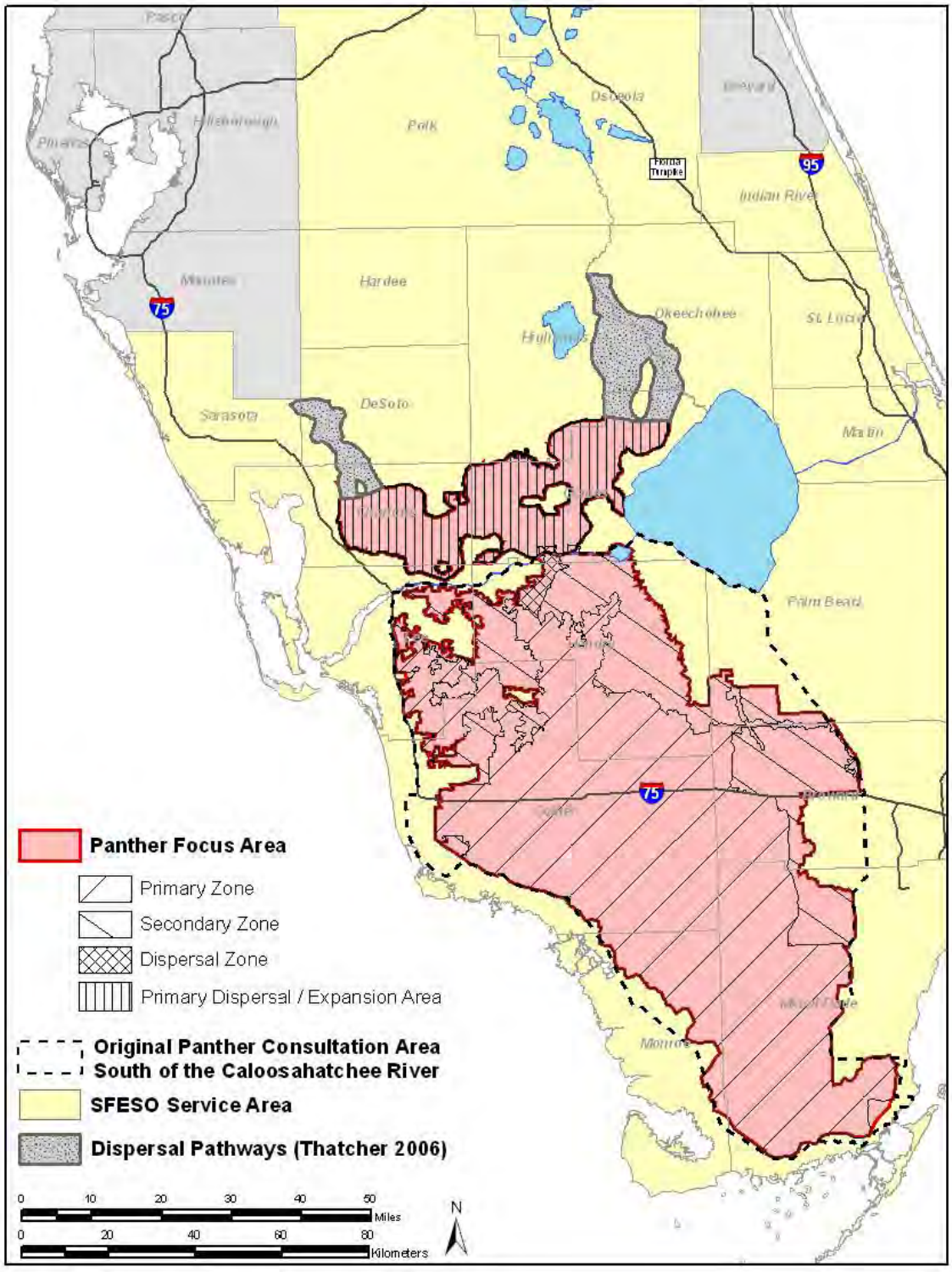
TABLE 10. FEDERALLY LISTED ENDANGERED, THREATENED, AND CANDIDATE SPECIES OF EVERGLADES NATIONAL PARK

	Common Name	Scientific Name	Status	Habitat Comments and Other Notes	Reasons for Dismissing from Detailed Analysis, if Dismissed
				scientific or otherwise, could adversely affect its status (USFWS 1991a).	
Dismissed	Florida prairie clover	*Dalea carthagenensis var. floridana*	Candidate	Florida prairie clover is a shrub that reaches 6 feet tall and bears small pea-like flowers on spikes. It is known to occur only in pine rocklands, edges of ham-mocks, and coastal uplands. Currently, this species is known to occur only in protected lands at Big Cypress National Preserve, at two Miami-Dade parks (the Deering Estate and Matheson Hammock), and along the eastern edge of the park. Most of the Florida prairie clover habitat has been destroyed by human activities. This species is also threatened by fire suppression and invasion of nonnative plants. The remaining population is estimated at fewer than 1,000 individuals, perhaps as few as 200 to 300. Catastrophic events such as a hurricane or tropical storm could imperil the species, given its limited range and low population. This species is a candidate species for listing by the U.S. Fish and Wildlife Service. No specific conservation activities are being undertaken to protect Florida prairie clover. The U.S. Fish and Wildlife Service has an ecosystem-based multiple species recovery plan for the threatened and endangered species of south Florida that emphasizes conservation of rockland communities (USFWS 2003c).	Recent surveys to locate the Florida prairie clover in Everglades National Park have not been successful (NPS 2010). This species is considered to be extirpated from the park. Thus this species was not carried through for analysis.
Dismissed	Cape Sable thoroughwort	*Chromolaena frustrata*	Endangered, Critical Habitat	Cape Sable thoroughwort is a flowering herb that reaches approximately 3 feet in height and bears 25 or more small, fragrant, blue or violet flowers. The plant is most commonly seen in full sun or partial shade on the edges of hammocks and in coastal rock barrens. This species tolerates some disturbance and may become abundant following hurricanes. Cape Sable thoroughwort historically ranged through the Florida Keys and into the Cape Sable area of Everglades National Park. Cape Sable thoroughwort was proposed for listing as endangered in 2013, and was listed as endangered in January 2014 (USFWS 2013g). Critical habitat was also designated and includes significant acreage in coastal regions of Everglades National Park (USFWS 2014d). The primary threats to this species in the park are nonnative plant invasions and sea level rise, both of which may alter habitat and displace individuals. Important characteristics of critical habitat in the park are native hardwood hammock and buttonwood forests with semi-open canopy and calcareous soils. Nonnative plant control in the Flamingo region of Everglades National Park may indirectly benefit Cape Sable thoroughwort through habitat maintenance. NPS staff also monitor the status of populations by conducting periodic surveys of known sites and by surveying for additional sites within the park.	No development or actions that may impact Cape Sable thoroughwort are proposed in this general management plan. It is not anticipated that actions proposed in any of the alternatives in this plan would affect this species or any of the areas designated as critical habitat. Thus this species was not carried through for analysis.
Dismissed	Everglades bully	*Sideroxylon reclinatum* ssp. *austrofloridense*	Candidate	The Everglades bully is an upright shrub that reaches 3 to 6 feet in height. Its branches are smooth, slightly geniculate, and somewhat spiny, with thin, obovate or ovate evergreen leaves that are persistently pubescent (fuzzy) on their undersides, a distinguishing characteristic from the other two subspecies of *S. reclinatum*. The Everglades bully is restricted to pinelands with tropical understory vegetation on limestone rock (pine rocklands) (USFWS 2009c). The largest population of Everglades bully occurs in the Long Pine Key area of the park, an area of pine rockland surrounded by wetlands. The species has been seen in pinelands east of the park, the Nixon-Lewis Hammock (where the pinelands have since been destroyed), two privately owned sites, and four small occurrences in Miami-Dade County; a known population also exists in Big Cypress National Preserve, south of the Loop Road (USFWS 2009c). Abundance estimate for the species is 10,000 to 100,000 individuals. This species is a candidate species for listing by the U.S. Fish and Wildlife Service (USFWS 2009c). Habitat destruction and degradation remain the primary threats to this species. In Miami-Dade County, pine rocklands (including patches of marl prairie) have been reduced to about 11% of their former extent (USFWS 2009c). The Everglades bully is threatened to some extent by invasive nonnative plant species and fire suppression. Individuals of the Long Pine Key population are found on or adjacent to hiking trails, and occasionally off-trail hiking may result in trampling. In the long term, global climate change and sea level rise further threaten the species' habitat. No specific conservation activities are being undertaken to protect the Everglades bully. Miami-Dade County has undertaken efforts to conserve pine rocklands and tropical hardwood hammocks. Everglades National Park and Big Cypress National Preserve are conservation areas, with pinelands managed to maintain the natural vegetation, which includes the Everglades bully (USFWS 2009c).	Within the park, this species occurs in the Long Pine Key area. Current management in the park includes an active plant control program as well as application of prescribed fire. No development in undisturbed areas at Long Pine Key is proposed in this general management plan. Should this change, surveys would be completed before any ground disturbance to determine if this species (or other special status species) is present, and appropriate mitigation would be provided. Therefore, this species was not carried through for full analysis.

TABLE 10. FEDERALLY LISTED ENDANGERED, THREATENED, AND CANDIDATE SPECIES OF EVERGLADES NATIONAL PARK

	Common Name	Scientific Name	Status	Habitat Comments and Other Notes	Reasons for Dismissing from Detailed Analysis, if Dismissed
Dismissed	Everglades crabgrass	*Digitaria pauciflora*	Candidate	Everglades crabgrass, also known as Florida pineland crabgrass, is a is a blue-green to gray bunch grass that forms mounds of as much as 3 feet (1 meter) in diameter (Center for Plant Conservation 2010). This species is a rhizomatous perennial with flexuous or twisted leaf blades that are hairy on both surfaces. Reproduction is sexual, and the species fruits in the fall (USFWS 2009b). Everglades crabgrass occurs in rocky pinelands and is only known to occur within Long Pine Key in Everglades National Park and in Big Cypress National Preserve. Everglades crabgrass occurs within Long Pine Key in the park, and in 2003 the species was discovered south of the Loop Road in Big Cypress National Preserve. The Big Cypress population is the first known population of the species outside the Long Pine Key area. Population estimates at Long Pine Key are estimated to be between 1,001 to 10,000 individuals and possibly greater than 10,000 individuals in the Big Cypress population (USFWS 2009b). Habitat destruction and degradation remain the primary threats to this species. In Miami-Dade County, pine rocklands (including patches of marl prairie) have been reduced to about 11% of their former extent. Two large occurrences of the crabgrass remain, protected within the Everglades and Big Cypress (USFWS 2009b). Everglades crabgrass is threatened to some extent by invasive nonnative plant species and fire suppression. Individuals of the Long Pine Key population are found on or adjacent to hiking trails, and occasionally off-trail hiking may result in trampling. In the long term, global climate change and sea level rise further threaten the species' habitat. No specific conservation activities are being undertaken to protect the crabgrass. Miami-Dade County has undertaken efforts to conserve pine rocklands and tropical hardwood hammocks. Everglades National Park and Big Cypress National Preserve are conservation areas, with pinelands managed to maintain the natural vegetation, which includes the Everglades crabgrass (USFWS 2009c).	In the park, this species occurs in the Long Pine Key area. Current management in the park includes an active nonnative plant control program as well as application of prescribed fire. No development in undisturbed areas at Long Pine Key is proposed in this general management plan. Should this change, surveys would be completed before any ground disturbance to determine if this (or other special status species) is present, and appropriate mitigation would be provided. Therefore, this species was not carried through for full analysis.
Dismissed	Johnson's seagrass	*Halophila johnsonii*	Threatened	Johnson's seagrass has a disjunct and patchy distribution along the east coast of Florida, from Virginia Key in central Biscayne Bay north to Sebastian Inlet near Fort Pearce. The plant is most often found in coarse sand and muddy substrates in the intertidal zone of coastal lagoons. Water is usually deeper and more turbid than tolerated by other seagrasses, and tidal currents may be stronger. Threats include storm erosion, sedimentation (e.g., dredging), poor water quality, and habitat destruction (e.g., propeller scarring).	Ten areas are designated as critical habitat for Johnson's seagrass, none of which are within Everglades National Park. The management actions proposed in this management plan would not affect the population or distribution of Johnson's seagrass; therefore this species was not carried forward for full analysis.
Dismissed	Florida bristle fern	*Trichomanes punctatum* ssp. *Floridanum*	Candidate	Florida Bristle fern is a small herb that is endemic to the Florida peninsula. In southern Florida, this species is restricted to a few tropical hardwood hammocks in Miami-Dade County where it grows on exposed limestone of the vertical walls of solution holes and also at the bases of trees. Within Everglades National Park, Florida Bristle fern was collected once in 1909 at Royal Palm Hammock and the last known report of a natural population was made in 1917 (Gann 2013). One attempt to reintroduce this species into the park appears to have been made in the 1960s and that effort is believed to have been unsuccessful. Surveys carried out for this species in Royal Palm Hammock and at other hammocks in the vicinity failed to result in the relocation of Florida filmy-fern. Based on these surveys and the length of time that has passed since the last reported observation, this species is considered to be extirpated from the park.	Recent surveys to locate Florida Bristle fern in Everglades National Park have not been successful. This species is considered to be extirpated from the park. Therefore, this species was not carried forward for analysis.

[Note: Information pertaining to the fish species of concern was obtained primarily from the National Marine Fisheries Service (2010a) unless otherwise indicated.]



Source: USFWS 2006

FIGURE 4. FLORIDA PANTHER FOCUS AREA AND ZONES OF IMPORTANCE IN CENTRAL AND SOUTH FLORIDA

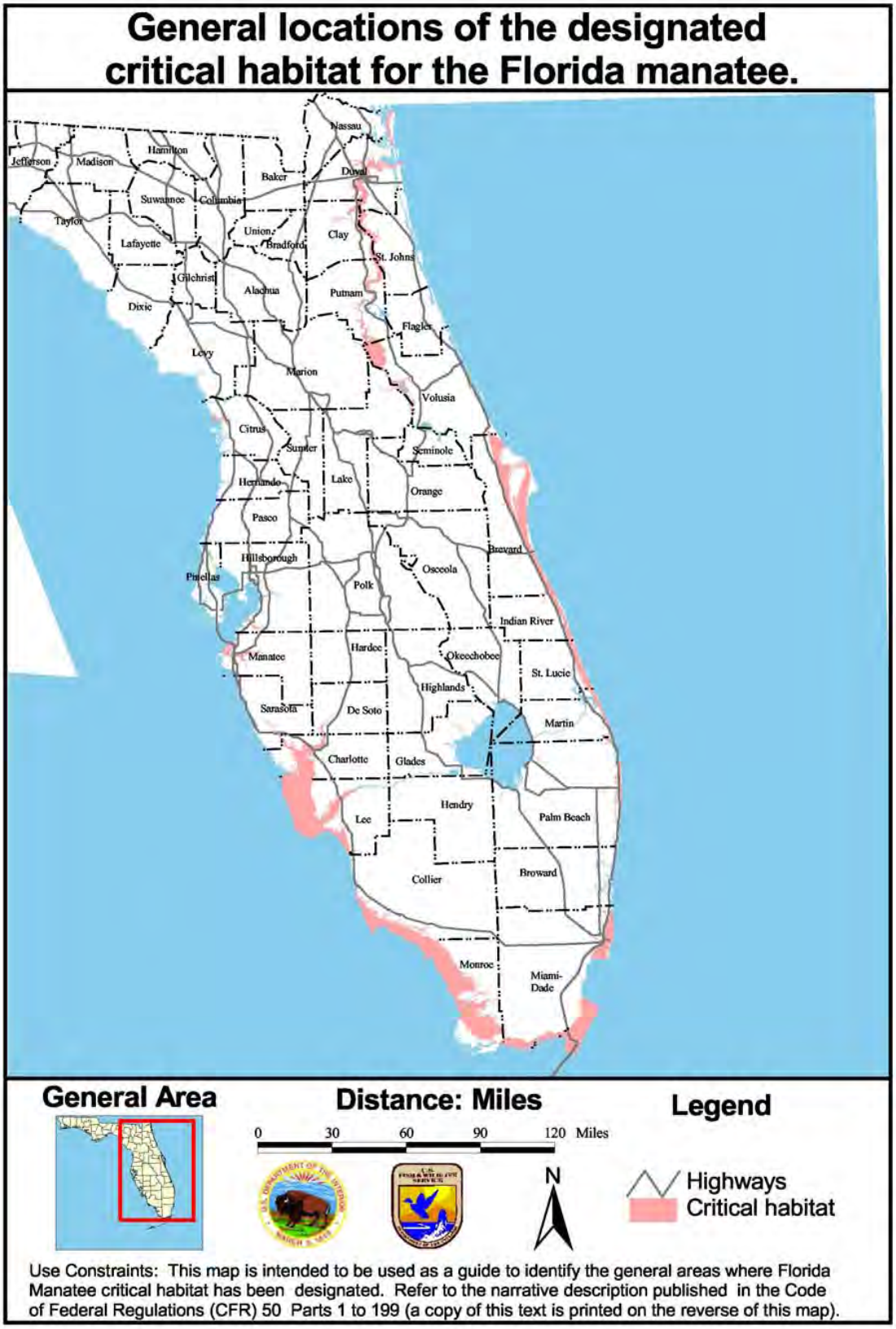


FIGURE 5A. MANATEE CRITICAL HABITAT

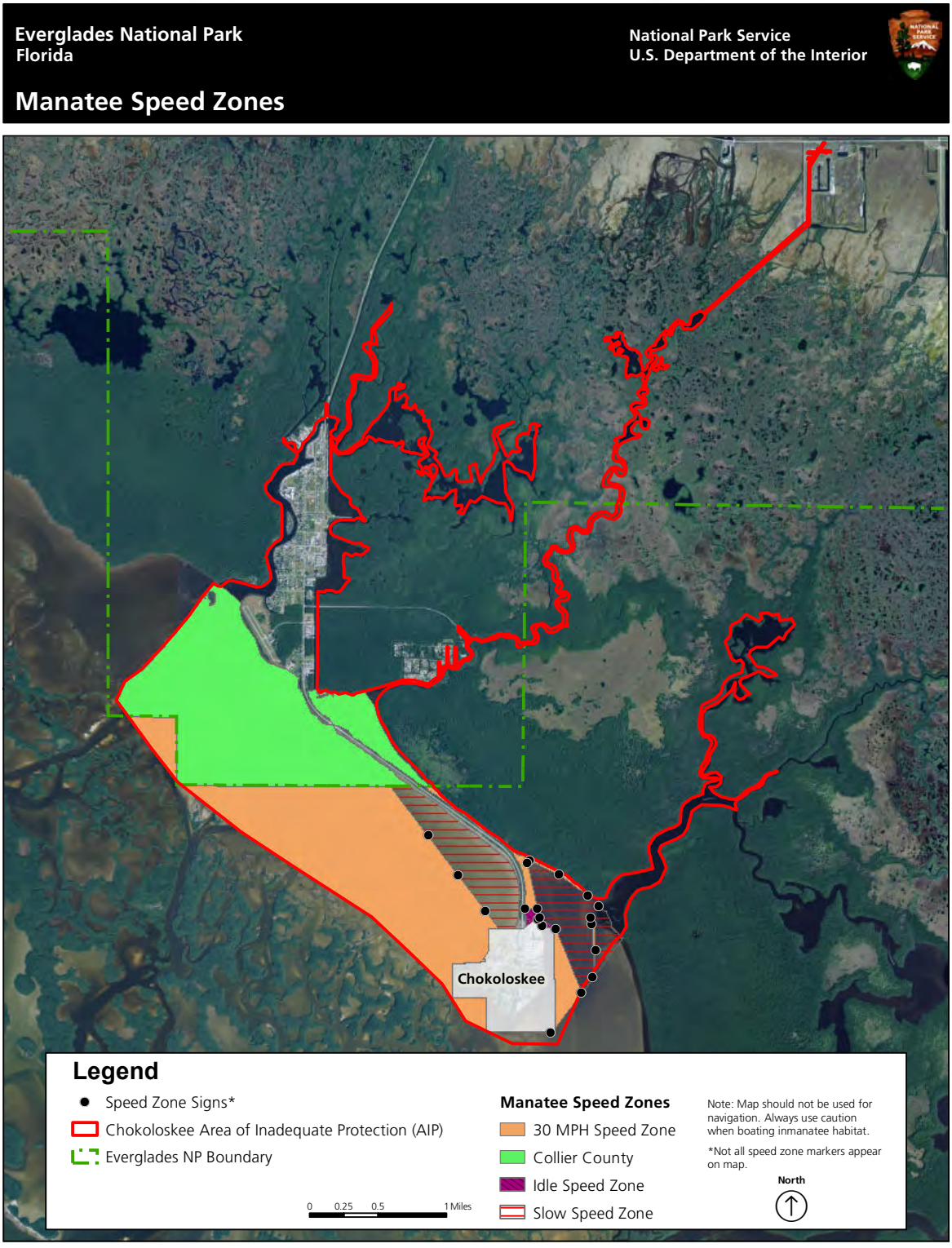


FIGURE 5B. MANATEE SPEED ZONES

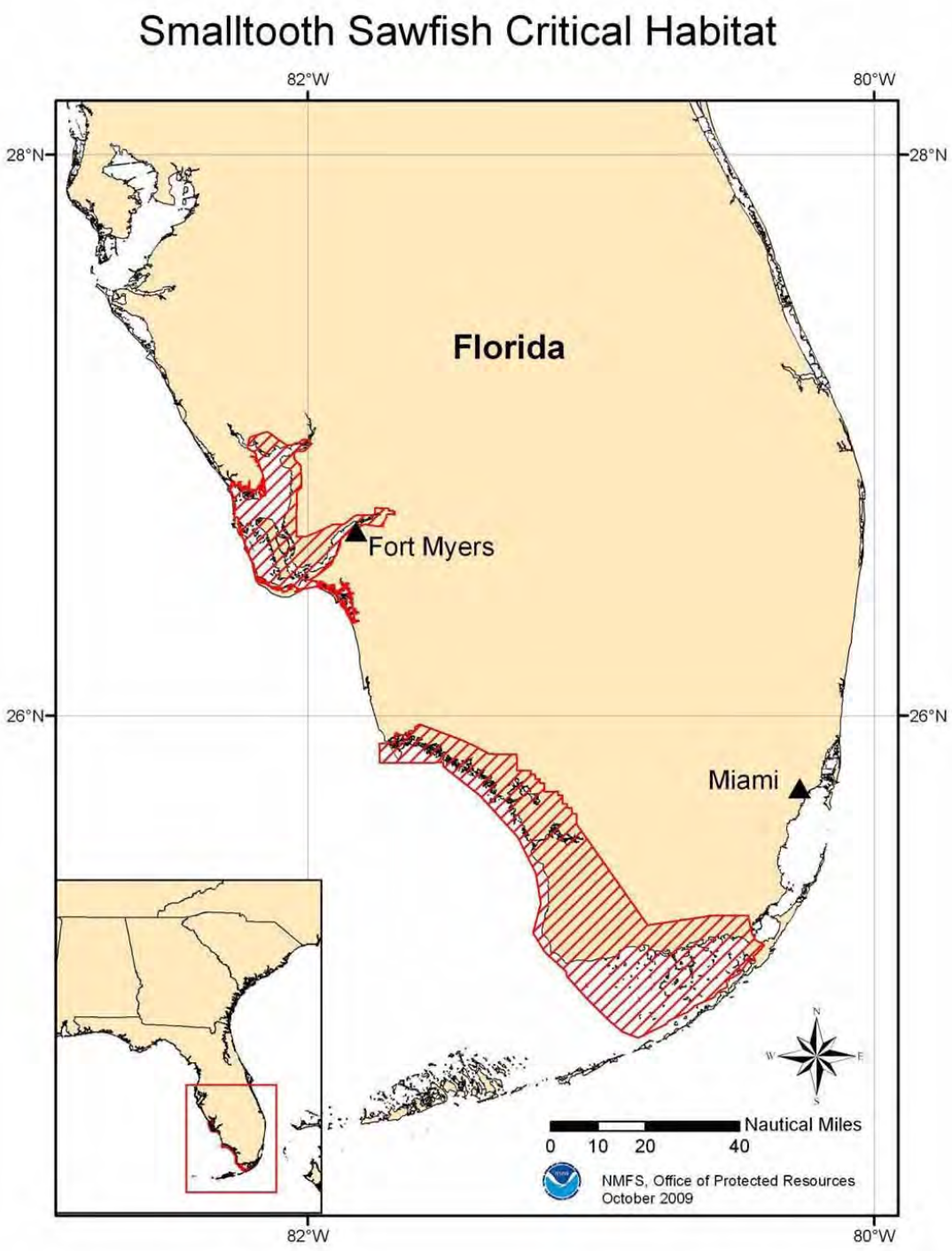


FIGURE 6. SMALLTOOTH SAWFISH CRITICAL HABITAT

NATURAL SOUNDSCAPE

Natural Soundscapes at Everglades National Park

The natural soundscape is an important component of "the scenery and the natural and historic objects and the wild life" protected by the Organic Act of 1916. NPS management policies direct the National Park Service to preserve the park's natural soundscape. Natural soundscapes exist in the absence of human-caused sound and are the aggregate of all the natural sounds that occur in a park or portion of a park; they are vital to the function and character of the park.

The National Park Service will preserve, to the greatest extent possible, the natural soundscapes of parks. The Service will restore to the natural condition wherever possible park soundscapes that have become degraded by unnatural sounds (noise), and will protect natural soundscapes from unacceptable impacts. Some natural sounds are part of the biological or physical resources of the park. Examples of such natural sounds in Everglades National Park include

- sounds produced by birds, frogs, or insects to define territories or attract mates
- sounds produced by bats or porpoises to navigate or locate prey
- sounds produced by physical processes such as wind in the trees, lapping of water, or claps of thunder

Characteristics of Sound. Sound consists of minute vibrations of pressure that travel through a medium such as air or water. Sound is measured in decibels (dB). The decibel is commonly used to relate sound pressures to some common reference level. The loudness of a sound as heard by the human ear is estimated by an A-weighted decibel scale. This adjustment for human hearing is expressed as dB(A). For this discussion, the A-weighted values are used to describe potential effects on the park's natural soundscape. Table 11 provides examples of A-weighted sound levels. Table 12 shows the effects that sounds have on humans.

Noise is generally defined as undesired sound that disrupts normal activities or diminishes the quality of the environment (Morfey 2001). In outdoor conditions at a distance of 1 meter from the speaker, relaxed conversation occurs at a voice level of approximately 54 to 56 dB(A), and normal and raised voices at levels of approximately 60 to 66 dB(A) (Berglund and Lindvall 1995).

Natural Soundscapes. Natural sounds in Everglades National Park include the sounds of blowing wind, bird vocalizations, and many other sounds found in nature. The opportunity to experience an unimpaired natural soundscape is an important part of the overall visitor experience, especially because it contributes to the solitude and wilderness experience that is integral to much of the park. Maintaining an unimpaired natural soundscape is as important to the wildlife of the Everglades as it is to park visitors, and impacts on the soundscape must be considered. Research shows that noise can affect an animal's physiology and behavior, and if it becomes a chronic stress, noise can be injurious to an animal's energy budget, reproductive success, and long-term survival. Noise affects wildlife in both terrestrial and marine environments in the park (Radle 2007).

TABLE 11. SOUND LEVELS FOR COMMON OCCURRENCES

Reference Sound	dB(A) Level
Normal breathing	10
Whispering at 5 feet	20
Quiet residential area, crickets (16 feet)	40
Distant bird calls	45
Light traffic at 100 feet	50
Normal conversation at 5 feet	60
Two-stroke snowmobile (30 mph at 50 feet)	70
Helicopter landing at 200 feet	80
Heavy truck or motorcycle (25 feet)	90
Thunder	100
Heavy surf at 3 feet	107
Military jet at 110 feet	120
Shotgun firing	130

Source: NPS 2009a, 2010

TABLE 12. EFFECTS OF SOUND

Sound Levels (dBA)	Relevance
35	Blood pressure and heart rate increase in sleeping humans (Haralabidis et al. 2008)
45	World Health Organization's recommendation for maximum noise levels inside bedrooms (Berglund et al. 1999)
52	Speech interference for interpretive programs (EPA 1974)
60	Speech interruption for normal conversation (EPA 1974)

Source: NPS 2008

At Everglades National Park, natural sounds prevail throughout the backcountry, and therefore most of the park. A report of an ambient sound study titled "Measurement of Natural Soundscapes in South Florida National Parks" found that protected shorelines were the quietest sites, while dense forests were the loudest sites in the parks (Downing et al. 1999). This study also found that daytime is the quietest period for ambient sound and nighttime hours are the loudest.

Human-caused sounds at Everglades National Park are created mostly by vehicles, aircraft,

motorized watercraft including airboats, heavy equipment, and construction activity. Some threats to the natural soundscape come from activities on lands adjacent to the park boundaries such as construction and agricultural operations. Additionally, aircraft over flights (private, commercial, or sightseeing) may also adversely affect soundscapes because aircraft occasionally fly over the interior of the park. Helicopters and airboats are occasionally used by park staff to conduct operations in interior locations of the park.

Existing Sound Levels in Everglades National Park. Although the park's water trails are a popular way to explore and enjoy its wilderness, they do not offer respite from man-made sounds. Thus there are issues of sound control as well as the need for better, quieter equipment where operations require motors (Coalition of NPS Retirees 2008).

The NPS Natural Sounds Program conducted acoustical monitoring in Ever-glades National Park in the summer of 2008 and winter of 2009 to gather information about natural and existing ambient sound levels and types of sound sources (NPS 2008a and 2009o). The ambient sound level is the composite, all-inclusive sound associated with a given area during a given period of time. The natural ambient sound level is generally used as a baseline for park management purposes and represents an estimate of what the acoustical environment might sound like without the contribution of human-made sounds (NPS 2009c). However, the natural ambient sound level for the Everglades has not yet been determined. Exceedance levels (L_x) are metrics used to describe acoustical data. Exceedance levels represent the dBA exceeded *x* percent of the time during the given measurement period (e.g., L_{90} is the dBA that has been exceeded 90% of the time). L_{90} is currently the closest approximation to the natural ambient sound level available at the park (Lelaina Marin, NPS Natural Sounds Program, Fort Collins, Colorado, pers. comm. with Aaron Sidder, Parsons, February 2010).

The Natural Sounds Program collected data at nine sites throughout the park during the summer of 2008 and winter of 2009. Sounds from wildlife in the park can contribute substantial energy in frequency bands that are far removed from the portion of the spectrum occupied by noises from human activities (i.e., transportation noise). The full frequency spectrum levels (12.5–20,000 Hz) are likely to substantially overstate the existing conditions in the park (Lelaina Marin, NPS Natural Sounds Program, Fort Collins, CO pers. comm. with Aaron Sidder, Parsons, February 2010). Frequencies affected by transportation fall within a range of 100–800 Hz, though this range does not correspond to a specific vehicle or type of transportation. Table 13 shows the daytime (0700–1900) and nighttime (1900–0700) L_{90} exceedance levels during the summer season at both the full frequency spectrum and the frequencies affected by transportation. Similarly, table 14 shows the daytime (0700–1900) and nighttime (1900–0700) L_{90} exceedance levels during the winter season at both frequency ranges. The data indicate that Everglades National Park is a relatively quiet soundscape.

Natural sounds generally predominate throughout the park. Some of the common natural sounds in the Everglades come from birds, frogs, or insects; sounds produced by bats or porpoises to navigate or locate prey; and sound produced by physical processes such as wind in the trees, lapping of water, or claps of thunder. Human-generated noise in the park is predominantly from vehicle traffic, aircraft over flights, and administrative activities that involve motorboat, airboat, and/or aircraft use; these sounds are usually confined to developed areas, popular boating (or airboating) areas, campgrounds, and major roads, although administrative airboat use and aircraft over flights occur throughout the park. Sound levels vary according to the season, relating to the number of park visitors. The impact of human-made sounds may also fluctuate with variations in weather conditions (including temperature, wind, and humidity) and vegetation in an area.

TABLE 13. EXCEEDANCE LEVELS FOR EXISTING CONDITIONS IN EVERGLADES NATIONAL PARK: SUMMER LEVELS

Frequency (Hz)	L_{90} Exceedance levels (dBA) 0700 to 1900	L_{90} Exceedance levels (dBA) 1900 to 0700
100-800	25.3-52.6	14.6-36.3
12.5-20,000	32.9-42.4	40.6-52.6

Source: NPS 2008

TABLE 14. EXCEEDANCE LEVELS FOR EXISTING CONDITIONS IN EVERGLADES NATIONAL PARK: WINTER LEVELS

Frequency (Hz)	L_{90} Exceedance levels (dBA) 0700 to 1900	L_{90} Exceedance levels (dBA) 1900 to 0700
100-800	23.5-32.4	7.0-29.1
12.5-20,000	29.9-35.8	32.9-39.8

Source: NPS 2009b

Frontcountry areas near campgrounds and roads often have higher sound levels. Mechanical noises, such as those produced by aircraft, airboats, chainsaws, or construction equipment, may temporarily mask these natural sounds. There can be human-caused noise in the backcountry such as sounds related to NPS management activities and recreational activities such as boating.

The natural soundscape throughout the park is affected by aircraft noise from a variety of over flight 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; and municipal and commercial air traffic from surrounding counties.

Helicopters are frequently used to access the backcountry when it is determined to be the minimum requirement needed for work in the vast wilderness of the park. In 2009, the park recorded more than 3,000 wilderness landings. 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 air (NPS 2009a).

The East Everglades Addition is susceptible to human-generated noise similar to the rest of the park, but the Addition is additionally affected by commercial and private airboat use, which is not allowed elsewhere in the park. However, park rangers and researchers use airboats in the designated wilderness areas of the park when appropriate. A study for the Florida Fish and Wildlife Conservation Commission showed that the airboats generated peak instantaneous noise levels between 95 dB(A) and 110 dB(A) at 50 feet at maximum operating conditions (Glegg et al. 2005). Airboat noise can vary depending on a variety of factors (e.g., propeller type, engine type, atmospheric conditions), but airboats consistently generate substantial noise at close distances.

Climate Change. While the anticipated increase in sea level may change human access

and could change the boundaries between terrestrial landscapes and aquatic landscapes, any predicted impacts on soundscapes would be extremely speculative and difficult to quantify.

WILDERNESS CHARACTER

For a description of existing designated terrestrial and submerged wilderness, please refer to the "Wilderness at Everglades National Park" Subsection in chapter 3. Wilderness character is ideally described as the unique combination of (1) natural environments that are relatively free from modern human manipulation and impacts; (2) opportunities for personal experiences in environments that are relatively free from the encumbrances and signs of modern society; and (3) symbolic meanings of humility, restraint, and interdependence in how individuals and society view their relationship to nature (Landres et al. 2008). Using the definition of wilderness from section 2(c) of the Wilderness Act of 1964, four qualities of wilderness are relevant, as follows (Landres et al. 2008):

Untrammeled: Wilderness is essentially unhindered and free from the actions of modern human control or manipulation.

Natural: Wilderness ecological systems are substantially free from the effects of modern civilization.

Undeveloped: Wilderness retains its primeval character and influence, and is essentially without permanent improvement or modern human occupation.

Solitude or Primitive and Unconfined Recreation: Wilderness provides outstanding opportunities for solitude or primitive and unconfined recreation.

The area may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value.

Untrammeled

Historically, the larger Everglades area has been heavily manipulated with an intricate series of canals, levees, and drainage systems in an attempt to drain the watery landscape. Expanded dredging efforts between 1905 and 1910 transformed large tracts from wetland to agricultural land. Developers cut more canals, built new roads, and removed mangroves from the shorelines and replaced them with palm trees. Canals, roads, and buildings gradually displaced native habitats. After the designation of the park in 1947, much of the dredging inside the park stopped, but the Central and Southern Florida project—to build an elaborate system of roads, canals, levees, and water-control structures stretching throughout south Florida—ensured continued outside alterations that still impact the park (NPS 2009e). Today, human intervention is required to undo or mitigate many hydrologic changes that have altered the natural hydrologic regime.

Human intervention is required to control the invasive nonnative plant and animal species that have taken hold in the Everglades. Also human intervention or control is required to restore seagrass areas that have been damaged by motorboat propellers and groundings.

The manipulation of ecological systems in the park infringes on the untrammeled qualities of its wilderness areas, and there are many plans to restore natural conditions to the park (see the last two sections of chapter 1). Some of these plans manipulate portions of the park's ecological systems with the aim of restoring natural conditions.

Natural and Undeveloped

Much of the park's designated wilderness is largely natural and undeveloped. The interior of the park, in particular, maintains its natural quality, far from the influence of roads or development along Tamiami Trail or the main park road. Additionally, the Wilderness Waterway traverses large spans of the park

that are free from development and remain in their natural state.

The submerged marine wilderness (see glossary) in Florida Bay has been compromised in recent years by boat groundings and propeller scarring of seagrass in addition, scarring occurs when boat propellers dredge new channel/access routes or boaters maintain existing, unmarked human-made channel/access routes (NPS 2008c).

In the park, wilderness areas may include facilities such as marked trails, campsites or chickees, toilets, and signs. Such structures are as compatible as possible with their surroundings and are typically removed when no longer needed. Because of the history of human occupation and development in the region, wilderness areas in the park may include remnant structures or evidence from before designation such as canals, levees, or agricultural areas. There are three dams dating from the early 20th century on canals near Florida Bay.

There are approximately 250 "structures" (relatively small pieces of equipment, some enclosed in a metal box and some accessed by a small boardwalk or platform in hard-to-access locations) within the park's wilderness areas. There are also many research plots that are marked with stakes, posts, tags, etc. This equipment is used for research and monitoring primarily in freshwater and marine environments for a wide range of scientific and resource management purposes (e.g., to investigate water quality or monitor threatened and endangered species, vegetation, or habitat).

The study "Airboat/ORV Trail Inventory for the East Everglades Addition Lands" (University of Georgia 2006) mapped, classified, and inventoried airboat and off-road vehicle trails in the East Everglades Addition from 1999 aerial imagery. The study documented evidence of substantial airboat activity in the northern half of the Addition. It also compared airboat trails that were evident in the 1999 aerial photos with trails evident in aerial photos taken in 1994 and 2003, and determined that airboat trails are declining over time. Specific findings included the following:

- Category 1 trails (>33 feet [>10 meters] wide) have declined 57%, from 105 miles to 45 miles (169 kilometers to 73 kilometers), while the commercial airboat business has been growing. This implies that airboat tour companies are following more consistent routes.
- Category 2 trails (10–33 feet [3–10 meters]) wide have remained fairly constant in location and length, 115 miles [185 kilometers) in 1994 down to 102 miles (164 kilometers) in 2003, indicating that these trails are subject to persistent use by private and limited commercial tours. These trails continue to be the most widely used private airboat trails.
- Category 3 trails (<10 feet [<3 meters] wide) have declined 91%, from almost 10,861 miles (17,479 kilometers) in 1994 to 1,246 miles (2,005 kilometers) in 2003. This reduction indicates that as private airboat use has declined in the East Everglades, the grasses are able to recover from occasional, dispersed use.
- Open water areas mostly in the vicinity of commercial airboat operations (polygons representing deep water areas of high airboat use) have declined 77%, from 633 acres (256 hectares) to 148 acres (60 hectares).

Airboat use for administrative and research purposes occurs on some of the airboat routes within the East Everglades and on a limited number of other routes in other areas of the park to support operational, scientific, and resource management needs.

Outstanding Opportunities for Solitude or Primitive, Unconfined Recreation

Primitive (nonmotorized) forms of recreation are allowed in wilderness. At Everglades National Park these include hiking, canoeing, and kayaking. Marked water trails are provided for nonmotorized boaters. The 99-mile-long Wilderness Waterway is open to paddlers, and paddle-only wilderness trails are available near Flamingo. Cross-country boat and foot travel is allowed, but a backcountry permit is required for all overnight trips. The interior wilderness receives very little use by the public. There are numerous opportunities for backcountry camping at isolated and primitive sites, primarily in the southern and western portions of the park.

Human-caused sound can be an unwanted intrusion into the solitude of the park. These sounds are usually confined to developed areas, popular airboating (in the East Everglades) and boating areas, campgrounds, and along major roads. From October 2008 through April 2009, there were more than 16,500 backcountry visitors, combined, in the Flamingo and Gulf Coast districts (pers. comm. between Fred Herling, Everglades National Park Supervisory Park Planner, and Aaron Sidder, Parsons. 10/2010). Administrative and research activities that are conducted with the aid of helicopters or airboats also affect opportunities for solitude within the national park. As discussed under the preceding "Natural Soundscape" discussion, in 2009 the park recorded more than 3,000 helicopters landings in the park's designated or potential wilderness areas. Nonetheless, opportunities for solitude abound with nearly 1.3 million acres of wilderness in the park.

Other Features: Cultural Resources

The Wilderness Act states that a wilderness "may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value." This fifth quality, unlike the other four, is unique to the Everglades wilderness based on the features that are inside the wilderness (NPS 2012). There are many cultural resources in both the existing designated wilderness and in the East Everglades Addition, including ethnographic, archeological, and historic resources. Cultural resources clearly fit within this fifth quality of wilderness character because they are tangible features that have educational and historical value.

The cultural resources in the wilderness area are covered in detail in the "Cultural Resources" section below.

Climate Change

Changes anticipated because of climate change would not be expected to impact the undeveloped and untrammeled quality of backcountry and wilderness areas the park. However, boundaries of protected areas may become easier to access and may require greater education of the public and management of visitor access to protect the wilderness resources.

CULTURAL RESOURCES

Archeological Resources

The first archeological investigations of the Everglades, conducted in the late 19th and early 20th centuries, were focused primarily along Florida's southwest coast. Beginning in the late 1930s, subsequent investigations laid the groundwork for understanding of the Glades Tradition period in south Florida (ca. 500 BC–AD 1700), which was divided into three sub-periods differentiated and dated by ceramic types. The NPS Southeast Archeological Center (SEAC) conducted a comprehensive survey of the park between 1982 and 1984. Using aerial imagery and a predictive site location model based on vegetation characteristics, SEAC archeologists identified 191 sites during follow-up field

surveys. A summary of the SEAC investigations ("The Archeology of Everglades National Park: A Synthesis") was prepared by John Griffin in 1988 (Griffin 1988).

In 1996, 196 archeological sites inside the park were listed in the National Register of Historic Places under a SEAC-prepared multiple property nomination. The nomination included four districts (the Bear Lake Mounds, Monroe Lake, Shark River Slough, and the Ten Thousand Islands districts), and three individual sites (the Anhinga Trail, Cane Patch, and Rookery Mound sites). Resources listed in the nomination commonly consist of middens, shell/earthen works, and other mound features with associated artifacts reflecting occupation from the Glades Tradition period, sometimes extending to historic and modern period Seminole and European American occupation. Although some of the sites have been disturbed, they retain overall good integrity with the potential to yield further information and expand the understanding of indigenous life ways and cultural adaptation/interaction in the Everglades (NPS, Schwadron 1996).

The Mud Lake Canal on Cape Sable, an aboriginal canal associated with the Bear Lake Mound complex, is believed to have been constructed during the Glades II period (AD 750–1200) by ancestors of the Tequesta people. The canal extends about 4 miles, linking Bear Lake and the waters of Whitewater Bay with Florida Bay. It likely provided safe passage, easy access to aquatic resources, and a route to facilitate exchange and tribute among groups. The canal was designated a national historic landmark in 2006, exhibiting exceptional national significance as the best preserved example of a rare prehistoric engineering feat (Wheeler 2005).

In 2004, the Southeast Archeological Center initiated a phased archeological survey and assessment of selected portions of the Eastern Everglades Addition, the area added to the eastern half of the park under the Everglades Protection and Expansion Act of 1989. Few systematic archeological surveys of these lands had been conducted in the past, although 40 sites were recorded in the area before the 2004 investigations. The primary objectives of the SEAC investigations were (1) to locate, test, and provide baseline condition assessments for potential archeological sites in the East Everglades Addition, and (2) to test a geographic information system (GIS) predictive model. The model suggested that the highest potential for archeological sites correlated with hardwood hammock tree islands. Following the initial site survey and testing phase, systematic test excavations were conducted for several selected sites, along with additional testing of low potential site areas, to evaluate the accuracy of the predictive model (NPS, Schwadron 2002, 2007a).

The 2004–2005 SEAC investigations of the East Everglades Addition resulted in the identification and recording of 42 new archeological sites. All the sites were found to be in good condition, exhibiting only light to moderate disturbance despite the frequent presence of former hunter's camps and cabins on the same tree island locations. Five archeological sites were found to provide well-preserved deposits supporting occupation from the Middle Archaic period (5000–3000 BC) to the Late Archaic period (3000–500 BC), the oldest sites identified to date in the park. The findings are anticipated to alter understanding of early prehistoric migration and settlement of south Florida. Most artifacts collected, however, were from the subsequent Glades period. The predictive model used in the survey was found to be a highly accurate means of predicting archeological site locations in the park (NPS, Schwadron 2007a).

In consultation with the NPS office of the National Register of Historic Places and the Florida state historic preservation office, the Southeast Archeological Center has also recently initiated a national historic landmark (NHL) investigation of prehistoric shell works sites in the Ten Thousand Islands area along the western perimeter of the park. The NHL

nomination process includes the development of a thematic study and historic contexts for the sites and the preparation of individual property nominations. Archeological fieldwork and testing will be conducted in support of the NHL study to address major research questions and to lay the foundation for a long-term, multiyear program to intensively investigate the sites. Of the 17 known shell works sites in the Ten Thousand Islands area, 12 are within the park. The largest sites are likely to represent large villages or the political seats of local chiefdoms (NPS, Schwadron 2006).

Another project (scheduled to begin in 2013) will develop a site probability model for submerged prehistoric sites in Florida Bay. The project will be jointly undertaken by the University of Miami Rosenstiel School of Marine and Atmospheric Sciences and the National Park Service Climate Change Adaptation Program. The U.S. Army Corps of Engineers also plans to gather baseline archeological data for sites in the Shark River Slough Archeological District and associated sites in the East Everglades Addition area. These investigations will assess the resource effects of future water delivery operations planned as part of the Everglades restoration efforts. In 2012, a historic trash dump was documented and evaluated in the location of the Gulf Coast District Developed Area. The dump, comprised predominantly of mid-20th century glass and other domestic refuse, was determined ineligible for the National Register of Historic Places.

The range of site types identified by archeological investigations in the park typically falls into several distinct categories. Among these, accretionary middens consist of unplanned deposits of cultural waste materials such as animal bones, shell, carbonized wood, plant materials, ceramic debris, and stone/shell tool fragments. These materials are intermixed within two primary contexts: earth middens (characterized by a matrix of dark organic soils), and shell middens (consisting primarily of shell debris from oysters and other marine shellfish). Shell middens are commonly found along the margins of coastal rivers and in coastal mangrove swamps. Some extensive shell middens are thought to represent former village locations, while other smaller middens may be the remains of temporary or seasonal camps. Earth middens, located on isolated inland hammocks and tree islands, are widely distributed throughout the Shark River Slough and elsewhere within mangrove areas. The archeological data preserved in these middens can provide valuable information to expand understanding of cultural ecology, subsistence patterns, and other aspects of prehistoric indigenous populations (NPS, Schwadron 2002).

Prehistoric earthworks are another site type, representing planned construction for such functions as house and temple bases, and observatory platforms. Earthworks are often pyramidal in shape and are usually constructed of soil and marl. As an extremely rare site type in south Florida, earthworks have correspondingly heightened archeological importance for expanding understanding of Everglades prehistory, particularly the Glades Tradition period. Shell works are also intentionally constructed sites where shells were piled to form high mounds, ridges, raised platforms, canals, and other structural features. Shell work sites date from possible pre-Glades times (ca. 1000 BC) through the entire Glades Tradition period, extending to historic Calusa and possibly Spanish occupation. Burial mounds represent another constructed site type, with human remains interred in some cases with grave goods and ceremonial objects. These mounds (constructed variously of earth, sand, shell, and stone) are sometimes found in and next to middens. Inundated sites (located in wet areas such as swamps, bogs, rivers, and sloughs) were often located on upland areas that have become submerged due to rising sea levels, damming, dredging, and other environmental changes. These sites have a high potential for preserved organic materials and perishable artifacts such as wood and textiles that could yield important data on paleoenvironments. Although inundated sites may be associated

with all cultural periods, archeologists are giving greater attention to the potential for Paleo-Indian and Archaic period sites within inundated contexts because of the expanded land base that existed during the drier climate of those periods (NPS, Schwadron 2002).

Historic archeological resources, representing sites associated primarily with nonindigenous people who arrived in south Florida after the time of first European contact in the 16th century, are also present in Everglades National Park. These sites provide valuable research information concerning Spanish, European American, present-day American, and Seminole settlement and activities (NPS, Schwadron 2002). Among the site types known to exist (or anticipated) on the basis of historic activities are fishing and hunting camps, fish processing facilities and ice plants, tannic acid plants, charcoal production sites, road construction camps, military outposts, sugar cane mill sites, farmsteads, private recreational development, and oil exploration sites. The archeological data associated with historic domestic settlement is associated in part with structural features such as the remnants of houses, outbuildings, cisterns, and gardens. Artifacts commonly include ceramic and glass fragments, metal hardware, tools, and personal items. The integrity and cultural significance of most of these historic archeological resources is currently unknown.

To date, over 250 archeological sites have been recorded in the park's Archeological Sites Management Information System (ASMIS) database. Of this number, 196 sites are listed in the National Register of Historic Places, either as individual sites or as part of larger districts. The prehistoric Mud Lake Canal is designated a national historic landmark. Specific information regarding site locations is restricted to assist protection efforts.

Climate Change. Increased storm frequency and intensity along with rising sea levels are anticipated consequences of climate change. Damaging storms and erosion could adversely impact archeological resources such as prehistoric shell mounds and buried sites, diminishing their archeological integrity and informational potential. Some terrestrial sites may be at risk of submersion as sea levels rise.

Historic Structures, Sites, and Districts

Historic structures are defined as constructed works, consciously created to serve some human activity. Historic structures can be buildings, monuments, dams, canals, bridges, roads, nautical vessels, defensive works, temple mounds, ruins, and outdoor sculpture (NPS-28: Cultural Resource Management Guideline 1997). Prehistoric structures are discussed in the previous archeological resources section.

Old Ingraham Highway and Associated Canals. The Ingraham Highway was constructed between 1915 and 1922 to link Homestead with Flamingo and Cape Sable. Construction of the 41-mile-long highway, the first road to penetrate the Everglades, was undertaken by the Florida East Coast Railway Company and its subsidiaries, the Model Land Company and the Dade Muck Company. In 1912, the railroad company completed a rail line from the Florida mainland to Key West, and the company sought to capitalize on its newly acquired land acquisitions in south Florida to promote settlement and agricultural development. Toward these ends, the Model Land Company acquired 210,000 acres in the Cape Sable area that it intended to drain and sell to investors for fruit, vegetable, and sugar cane production. The Florida East Coast Railway Company, in cooperation with the state and the Florida Federation of Women's Clubs, also provided vital support toward the establishment of Royal Palm State Park in 1916. The Ingraham Highway (named in honor of James E. Ingraham, vice president of the railroad company) was initially extended as far as Royal Palm for the 1916 dedication of the state park (NPS, Trebellas 2000a; NPS, Ogden et al. 2009a).

Construction of the highway through the difficult environmental conditions of the Everglades was a daunting task marked by frequent delays and mounting costs. The conditions led to the development of innovative construction techniques, and a steam dredge (later abandoned at Cape Sable) was used as the primary piece of machinery. A typical section of completed roadway consisted of a roadbed of limestone and earth fill, with a graded, rolled, and oiled surface.

The approximately 50-mile-long Homestead Canal was excavated alongside the roadway to provide drainage and fill material for road construction. The East Cape and Buttonwood Canals (completed in the early 1920s) were part of the canal network constructed to drain Cape Sable for development and to provide road-building material. The canal network forms part of the park's Wilderness Waterway. Completion of the Ingraham Highway and its associated network of canals failed to bring the level of lasting development and settlement envisioned by the railroad and its land promoters. Real estate near Flamingo and Cape Sable could not reasonably compete with more accessible and desirable lands near Lake Okeechobee and Miami (NPS, Paige 1986).

In the 1960s, the National Park Service constructed a new road that ran from the eastern park entrance west toward Long Pine Key, eventually connecting with the Old Ingraham Highway. Most of the first 12 miles and last 17 miles of the paved section of the Ingraham Highway were incorporated into the current park road from Florida City to Flamingo. Although the National Park Service abandoned 12.5 miles of the old highway south of the current park road, some of the abandoned road section was adapted for administrative roads and trails. Because the Ingraham Highway impeded the flow of fresh water through the Everglades, portions of the highway crossing Taylor Slough were removed in the 1990s to create more natural hydrologic patterns and restore ecosystem functions.

A *Cultural Resource Assessment of the Old Ingraham Highway and Homestead, East Cape and Buttonwood Canals* (NPS, Buttram et al. 2009) provides documentation and condition assessments of the highway and its associated resources, and evaluates the eligibility of these resources for the National Register of Historic Places as a historic district. The physical integrity of these historic structures has been altered in varying degrees over the years by the removal of road sections, paving, erosion, widening, and the placement of canal plugs to impede the flow of saltwater into interior waterways. However, the Old Ingraham Highway and the East Cape, Homestead, and Buttonwood canals are considered eligible for the national register for their historical associations with the development of south Florida and subsequent conservation efforts (e.g., the establishment of Royal Palm State Park, Everglades National Park, and recent restoration undertakings). The district's period of significance is recommended to extend from 1915 to the present (NPS, Buttram et. al. 2009). The Florida state historic preservation office concurred with the national register eligibility of these properties and the park has submitted a draft national register nomination.

Nike Missile Base Site HM-69. Buildings and structures associated with a Nike Missile Base installation (HM-69) are located at the "Hole-in-the-Donut" area of Everglades National Park in the Pine Island district. The installation was part of the United States strategic defense efforts to deter a possible missile attack from Cuba or bombs from Soviet aircraft. It was constructed during 1963–64 under a special use permit issued by the National Park Service to the U.S. Army Air Defense Command. Construction occurred during a period of prolonged Cold War tensions between the United States and the Soviet Union, particularly heightened in the aftermath of the Cuban Missile Crisis of 1962. Nationwide deployment of the Nike missile defense system also peaked in 1963, with some 134 Nike Hercules batteries placed near the nation's major population centers. HM-69 was among four Nike Hercules batteries and

four HAWK batteries in the Miami-Homestead defense area. Unique within the missile defense system, the south Florida Nike sites were integrated with HAWK missile systems to provide an all-altitude defense capability. HM-69 operated until it was deactivated in 1979; it was among the last group of active Nike Missile Base sites in the continental United States (NPS, Welling & Dickey 2003; NPS, Leynes 1998a).

The missile complex at HM-69 consisted of a launch area and battery control/ administration area (about 1 mile apart) linked by a paved access road. About 146 Army soldiers were stationed at the complex. Missiles were assembled, tested, launched, and stored at the launch area. The launch area was built on fill dredged from a borrow pit along the south-west edge of the site. Because of the high water table, the missiles at HM-69 were stored in three aboveground reinforced concrete and steel buildings (currently used by the park for storage and hurricane shelters). The storage shelters were protected by U-shaped earthen berms. The battery control area was directly north of the launch site, and open sight lines were maintained between the two locations. Among the functions housed at the battery control area were administrative offices, barracks, mess hall, officers' quarters, and the equipment and radar systems needed for target identification and missile guidance. The Nike system was intended to be mobile, and battery and radar control equipment was maintained in on-site trailers (NPS, Welling and Dickey 2003).

Nike Missile Base Site HM-69 was listed on the National Register of Historic Places in July 2004 as a historic district, with 22 contributing buildings and structures. A cultural landscape inventory of the district has been completed. The nomination notes that the district retains a high degree of integrity of setting, feeling, and association. The site's overall preservation and good condition have been achieved in part by NPS adaptive use of several of the former missile base buildings and structures for park operations, including the building currently used for the Daniel Beard Center. Although the original missiles, radar towers, and some support buildings and trailers have been removed, most of the associated buildings and structures remain intact (NPS, Welling and Dickey 2003). Historic structure reports and detailed artwork documenting all site structures have been completed to guide future preservation efforts. Plans have also been developed to mitigate lead contamination identified on the earthworks and in the interior of the structures. The park conducts guided public tours of the missile site's launch area and procured a historic missile in 2012 to aid site interpretation.

Flamingo. Flamingo was initially established in the late 19th century as a small, isolated village. Residents of the community supported themselves primarily by fishing, hunting, and producing charcoal. Although completion of the Ingraham Highway failed to bring the level of development to Cape Sable envisioned by investors, the road provided a direct connection between Flamingo and Homestead and facilitated the transport of supplies and services to the remote village. Despite these improvements, all of Flamingo's permanent structures were destroyed by the Labor Day hurricane of 1935, and the community continued as a small enclave of families in the aftermath of the storm (NPS Buttram et al. 2009). Former residents who survived the storm were displaced from Flamingo upon NPS acquisition of the Flamingo area.

NPS development at Flamingo began as part of the NPS design and construction initiative known as "Mission 66." The National Park Service undertook this nationwide program in 1956 (intended to be completed by 1966) largely to address the need for new facilities and infrastructure to accommodate the dramatic upsurge in visitation that followed World War II. In contrast with the emphasis on rustic design that had previously characterized NPS architecture, Mission 66 designers incorporated modern building materials and design elements (e.g., flat or gently pitched roofs, concrete and prefabricated components, large plate-glass

windows, and open interior spaces). The architectural program, described as Park Service Modern, functionally integrated overall site and facility designs to more efficiently manage the circulation needs of increasing numbers of visitors traveling by private automobile. Visitor centers emerged during this period as centralized facilities serving visitor use and park administrative needs (NPS 2000b).

Everglades National Park, together with other selected parks in the national park system, became test sites and eventual showcases of Mission 66 planning and design principles. Renowned NPS architect, Cecil Doty, designed the complex of public use buildings at Flamingo and incorporated modern design elements such as the use of concrete block, flat roofs, swirling concrete ramps, and terraces supported by thin columns. Key stone, a locally procured building material, was also used. The first phase of construction began in 1956 with the Flamingo visitor center, administrative offices, guest lodge, employee housing, and support infrastructure. Additional site development occurred through the mid-1960s (NPS 2000b; NPS 2009b).

In 2005, Flamingo was battered by hurricanes Katrina and Wilma, and visitor services and facilities were closed for an extended period. Several buildings were completely destroyed, including the amphitheater, picnic and campground comfort stations, camp tender's residence, and several housing units. The amphitheater and comfort stations were reconstructed in 2008. In 2006, the state historic preservation office concurred with the finding of the *Flamingo Commercial Services Plan* regarding the national register eligibility of the visitor center, service station, 1950s–1960s staff and concessioner housing buildings, and the maintenance area boat canopy. The Florida state historic preservation officer also added the fish cleaning station as a contributing structure. However, other properties such as the marina store, maintenance buildings, lodge, and duplex cottages were considered ineligible largely because of extensive storm damage and/or previous alterations that compromised their integrity. The lodge, portions of the maintenance buildings, and the duplex cottages were demolished in 2009. Despite the loss of numerous key landscape features, elements of the historic Mission 66 cultural landscape continue to retain integrity (NPS 2011a). A cultural landscape inventory and historic structures report for all contributing buildings and structures in the Flamingo Mission 66 Developed Area were completed in 2011.

Other Mission 66 Buildings and Structures. The Shark Valley observation tower is identified as another outstanding expression of Mission 66 aesthetics and design principles in the park. The ca. 1964 modernistic 65-foot-tall tower with distinctive spiral access ramp is constructed of formed concrete. An associated round concrete restroom/service building is adjacent to the tower. About half-way along the tram tour route, the tower provides visitors with expansive views into the surrounding sawgrass marsh of Shark Valley. Despite some alterations to the restroom building and missing glass from the top lookout room (closed to the public), the structure retains a high level of integrity (Brian Coffey, NPS Southeast Regional Office, memo to Steve Whissen, NPS Denver Service Center, 2005). Although a formal determination of national register eligibility for Shark Valley has not been completed, a historic structure report is underway that will provide adequate documentation to assist a formal eligibility determination.

The Royal Palm visitor center has been substantially altered since its original construction, and it no longer reflects its earlier association with the Mission 66 period. Among the alterations are a new gable roof, removal of original windows, and the addition of glass block in several areas of the building.

Pine Island was developed as a residential and maintenance area during Mission 66. These one-story ranch style buildings with carports are on a wide cul-de-sac, and exhibit a variety

of architectural plans and materials. Some of the buildings, damaged by hurricane Andrew in 1992, have had their original gabled roofs replaced with new hipped roofs. A one-story, flat-roofed Mission 66 camp tender's residence is also adjacent to the Long Pine Key campground. The maintenance facilities at Pine Island retain a high degree of integrity. Although formal determinations of national register eligibility have not been completed, the area may be eligible to the National Register as a district, which would include the residences, maintenance buildings, roads and circulation networks, and other landscape features.

Other minor developments along the main park road are also considered potentially eligible for the national register. A project scheduled to begin in 2013 will document and assess all Mission 66 resources in the park as part of a parkwide Mission 66 national register district. Although the Gulf Coast developed area was constructed during the Mission 66 period, this area (including the boat basin, seawall, visitor center, and three park housing units) was determined ineligible for the national register due to its lack of inherent significance and diminished integrity.

East Everglades Island Camps. Several former camps are on the hammocks and tree islands of the East Everglades; they were used by hunters and various airboat tour companies (New South 2010). These properties came into NPS ownership in 2002. Camp structures include bunkhouses, sheds, outhouses, and other features that are generally in poor condition and in some instances present visitor safety issues and environmental hazards. Most of the simple wood-frame buildings and structures were constructed from inexpensive building materials such as plywood, corrugated metal, and rolled asphalt. Some contain furniture and appliances, and discarded debris (e.g., generators, propane tanks, auto batteries, and other trash) is commonly strewn about the sites.

Along with park staff, NPS Southeast Regional Office historian Brian Coffey examined nine of the campsites in 2004 to provide a preliminary assessment of their historical significance. With the exception of the Duck Camp (constructed ca. 1950), the camps are thought to be less than 50 years old. The abandoned Duck Camp was formerly used by the Miami Rod and Gun Club, and is considered the only camp possibly eligible for the National Register of Historic Places. The camp includes a large bunkhouse and a cluster of outbuildings that could be adapted for site interpretation and exhibit space. Coffey noted that the long history of human use of the tree islands, from prehistoric occupation to the modern hunting and airboat camps, was likely to be more historically important than any current expression of vernacular architecture (NPS 2004a).

Tamiami Trail and Airboat Operations. In 2005 cultural resources investigations were conducted in support of the proposed construction of a bridge on Tamiami Trail (Highway 41) by the U.S. Army Corps of Engineers. The purpose of the project is to restore more natural water flow to the northeast portion of Shark River Slough. The highway has acted as a barrier, impeding the north-to-south flow of fresh water from entering Everglades National Park. The bridge construction project is part of long-term restoration objectives for the Modified Waters Delivery project (New South Associates 2006).

A phase I archeological survey did not identify archeological material within the test areas. However, the following historic sites and structures were investigated in the project area and evaluated for eligibility for the National Register of Historic Places:

Tamiami Trail and Canal—The Tamiami Trail was completed in 1928 to provide an overland connection between Miami and Tampa. Construction of the highway took 13 years and represents a major engineering feat. The Tamiami Trail and the adjacent canal that was dredged as part of the highway construction

effort are both recommended eligible for the National Register of Historic Places. The Florida state historic preservation office has concurred with the overall eligibility recommendation; however, portions of the canal north of the East Everglades area have been altered and no longer retain integrity.

Coopertown Airboats—The Coopertown establishment is a privately operated airboat operation and restaurant along Tamiami Trail. The property has been in operation since the 1940s, and it was determined eligible for the national register; the state historic preservation office has concurred with the determination.

Airboat Association of Florida—This nonprofit conservation organization was established in 1951. The association's operations are on private property along Tamiami Trail and include a clubhouse, caretaker's home, and grounds. A site survey was conducted in 2009 (New South) and the property's historic structures were considered eligible for the national register. The Gladesmen Study (New South 2010) also recommended that the property be considered eligible as a traditional cultural property.

Gator Park—Gator Park is a privately operated airboat operation along Tamiami Trail. The property includes a concrete block building thought to have been constructed in the 1950s as a gas station, a nonhistoric outbuilding, a campground, a wildlife show area, and airboat docking facilities. The property was determined ineligible for the national register.

Climate Change. Increased storm frequency and intensity along with rising sea levels are anticipated consequences of climate change. Increasing storms and high winds have the potential to adversely impact historic structures, diminishing their architectural and historical integrity as character-defining structural and architectural features are damaged or irreparably lost.

CULTURAL LANDSCAPES

By NPS definition, a cultural landscape is a reflection of human adaptation and use of natural resources and is often expressed in the way land is organized and divided, patterns of settlement, land use, systems of circulation, and the types of structures that are built. The character of a cultural landscape is defined both by physical materials such as roads, buildings, walls, and vegetation, and by use reflecting cultural values and traditions (NPS-28).

Cultural landscapes typically fall into one or more of the following four categories:

Historic designed landscapes—Landscapes deliberately and/or artistically created in conformance with recognized styles.

Historic vernacular landscapes—Landscapes that reflect patterns of settlement, land use, and development over time, often conveying insights into a peoples' values and attitudes toward the land. Vernacular landscapes are commonly the result of informal or unplanned development, and they can be found in large rural areas and small suburban and urban districts.

Historic sites—Landscapes significant for association with important events, activities, and individuals (e.g., battlefields, presidential homes, etc.).

Ethnographic landscapes—Landscapes associated with contemporary groups that are typically used or valued in traditional ways.

Cultural landscape inventories have been initiated or programmed for some of the park's historic sites and districts. More comprehensive cultural landscape reports may be prepared in the future that includes recommendations for management and treatment of significant landscapes. The 2011 cultural landscape inventory for the Flamingo Mission 66 developed area documents the history and evolution of site development and analyzes landscape features and patterns to

assess whether they contribute to the landscape's historical significance in the context of Mission 66 design principles. A comparison of existing resources and conditions with historic maps, photographs, and other records assisted the evaluation of landscape integrity. Among the factors documented in the report are natural systems and features, spatial organization, vegetation, patterns of access and circulation, constructed water features, views and vistas, buildings and structures, and small-scale features (NPS 2011a).

The Nike Missile Base (HM-69) has been determined to be a cultural landscape, and a cultural landscape inventory has been completed (NPS 2011b). Other potentially significant cultural landscapes may be associated with the Ingraham Highway historic district, designed remnants of the former Royal Palm State Park (including elements constructed by the Civilian Conservation Corps during the 1930s), and archeological districts and ethnographic resources. The level of integrity among these landscape resources is expected to vary according to the nature and extent of subsequent development disturbance and other environmental factors at these locations. Also recent work in the Ten Thousand Islands area suggests shell works sites are also important cultural landscapes.

Elements potentially contributing to the significance of cultural landscapes in the park include vegetation types (e.g., trees and other plantings placed as part of original site designs), overall site organization and spatial relationships, patterns of circulation, and small-scale features (e.g., walkways, walls, ditches). Continuing efforts to identify and evaluate cultural landscapes in accordance with the criteria of national register significance will further the park's comprehensive cultural resource management objectives and be an important consideration for any new development proposal affecting the park's historic and cultural resources.

Climate Change. Increased storm frequency and intensity along with rising sea levels are anticipated consequences of climate change. Increasing storms and high winds have the potential to adversely impact cultural landscapes, diminishing the integrity of landscape features (spatial organization, land use patterns, circulation systems, topography, vegetation, and other character-defining elements).

ETHNOGRAPHIC RESOURCES

Ethnographic resources are defined by the National Park Service as

> 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. (NPS-28)

Ethnographic resources typically hold significance for traditionally associated groups whose sense of purpose, existence as a community, and development as an ethnically distinctive people are closely linked to particular resources and places. The groups for whom ethnographic resources hold significance may include park neighbors, traditional residents, and former residents who have moved from the area but maintain their former attachments. Ethnographic resources may include burial locations; places important for subsistence and spiritual/ceremonial purposes; plant materials and procurement areas; migration and travel routes; and sites associated with events, beliefs, and traditional stories.

During the 18th and 19th centuries, the pressures of European expansion and intertribal conflicts forced members of the Creek Nation (identified as the Seminole during the 18th century) to leave their ancestral homelands in southern Georgia and Alabama and resettle further south in remote areas of Florida. The Seminole Wars of the

first half of the 19th century resulted in the dramatic depopulation of the Seminole people. Those surviving tribal members who resisted relocation to Oklahoma reservations took refuge among the protective hammocks and swamplands of present-day Everglades National Park and Big Cypress National Preserve. The Seminole in Florida have been divided into two separate federally recognized nations: the Seminole Tribe of Florida and the Miccosukee Tribe of Indians of Florida. These tribes were federally recognized in 1957 and 1962, respectively. The Seminole Nation of Oklahoma represents the descendants of tribal members who relocated to Oklahoma from Florida following the Seminole Wars. The Council of the Original Miccosukee Simanolee Nation Aboriginal People represents nonfederally recognized tribal members. Everglades National Park managers consult with the Council of the Original Miccosukee Simanolee Nation Aboriginal People despite its nonfederally recognized status; NPS staff respects the tribe's ancestral ties to the Everglades and the tribe's interests/issues as public stakeholders.

Some ethnographic resources in the park have particular significance to the culturally associated tribes. Park staff regularly consult with the associated tribes regarding issues of mutual interest. Ongoing consultation is important to ensure appropriate management of ethnographic resources and to ensure that resources are not inadvertently disturbed by park-related activities and proposed development. The locations of these ethnographic resources are not publicly disclosed in efforts to respect tribal preservation and privacy concerns.

The Miccosukees are generally reluctant to share certain aspects of their culture and traditions with those outside the tribe, and they have relied on nontribal spokesmen to represent them in consultations. Because of the tribal concern for maintaining confidentiality, park managers are occasionally challenged to protect ethnographic resources when information may be limited regarding the presence, nature, and location of these resources. However, the tribe regards all archeological sites that may retain tribal/ cultural associations (e.g., middens, village mound sites, burial locations) as having cultural and/or sacred importance, and the tribe believes that these sites should be protected and left undisturbed. The Miccosukees have a repatriation plan that outlines the protocols for the repatriation of human remains and associated funerary objects, sacred objects, and objects of cultural patrimony found in Florida. The tribe also claims cultural affiliation with the ancestral Calusa Indians who formerly inhabited the Everglades; therefore the tribe retains repatriation interests for cultural materials determined to be of Calusa origin (NPS 2007b, appendix G).

Recent ethnographic investigations have also identified the importance of the Everglades to the "modern Gladesmen" culture, a group comprised for the most part of Anglo-American settlers in south Florida who have historically subsisted on the resources of the wetland environment. The unique folk customs, independent lifeways, and identity of the Gladesmen have been passed down through several generations. Many Gladesmen were skilled at navigating the difficult waterways of the interior Everglades in small skiffs. They hunted and fished for extended periods, living in temporary encampments. The Gladesmen were often valued as guides by explorers and researchers because of their keen observations of nature and knowledge of the Everglades ecosystem (New South Associates 2009). Many of the traditions acquired by the historic Gladesmen are reflected in the lifeways of modern Gladesmen.

An ethnographic study and evaluation of Gladesmen traditional cultural properties (which are ethnographic resources meeting the criteria of significance for the National Register of Historic Places) was conducted in 2008 for the U.S. Army Corps of Engineers for the *Comprehensive Everglades Restoration Plan* and the CERP Master Recreation Plan. A literature review and oral interviews with

selected members of the modern Gladesmen folk culture were carried out as part of the investigations. Thirteen properties associated with the Gladesmen culture were identified within three broad classifications: commercial sites, noncommercial sites, and waterways/ road systems; several sites represent hunting and fishing camps and the sites of commercial airboat operations. Two sites were recommended eligible as traditional cultural properties (New South Associates 2010)—one (the Airboat Association of Florida site) is adjacent to the park.

The Gladesmen sites identified by the above investigations are outside Everglades National Park. However, the campsites, waterways, roads, etc., reflect similar historical patterns of use to those associated with the East Everglades Addition tree islands and other areas within the park. As such, the National Park Service will evaluate the ethnographic importance of sites associated with the Gladesmen culture in the park as part of overall cultural resource management considerations.

The National Park Service has initiated an ethnographic overview to identify and characterize the broad range of ethnographic resources in the park. An ethnographic/ visitor use study of the East Everglades Addition will also begin in the near future.

Climate Change. Increased storm frequency and intensity along with rising sea levels are anticipated consequences of climate change. Damaging storms and erosion could adversely impact ethnographic resources and places important to the park's culturally associated peoples. Some terrestrial sites/ resources may be at risk of submersion as sea levels rise.

Museum Collections

Museum collections from several south Florida NPS units (Everglades, Biscayne, and Dry Tortugas national parks; Big Cypress National Preserve; and De Soto National Memorial) are stored at the South Florida Collections Management Center. The center currently occupies portions of the Daniel Beard Center and the Robertson Building in the park's Pine Island District. Most of the museum archival materials are stored in the Robertson Building where research offices are also housed. The combined collection from these five NPS units is estimated at more than 6 million objects—including natural history specimens; historic and ethnographic artifacts; artwork; and a large archival collection of documents, photographs, audio and video tapes, and films.

The NPS Southeast Archeological Center in Tallahassee, Florida, provides curatorial storage for most of the estimated 1.8 million archeological objects and artifacts collected from the south Florida parks. The Southeast Archeological Center's collection management facility meets NPS standards for the protection, storage, and use of archeological collections (NPS 2007b).

Although the SFCMC staff has implemented numerous physical improvements and management strategies to improve conditions for the museum collections, the South Florida Collections Management Center does not meet the full range of NPS environmental standards for the storage of museum collections. The facilities lack a fire suppression system and do not have sufficient space to properly store the collections or accommodate new acquisitions. Specialized equipment is also required to ensure the long-term preservation of the collections in the hot and humid environment of south Florida. The heating, ventilation and air-conditioning (HVAC) system has not provided adequate protection against mold growth, which has presented risks to staff health and the collections. However, the park has installed desiccant systems at the Beard Center and Robertson Building to help control relative humidity and curtail the growth of molds. Although the HVAC system maintains temperatures within the acceptable range for collection storage, maintaining proper humidity levels and preventing wide-scale humidity fluctuations has been problematic.

Some collection items have incurred damage from pest infestations. There is also inadequate work space for staff and researchers (NPS 2007b).

Everglades National Park currently provides personnel and administrative support for the South Florida Collections Management Center. The park curator was formerly responsible for all collections management, but is now assisted by additional staff (permanent registrar; permanent archivist; permanent, subject to furlough, archives technician; term museum technician; and other annually funded temporary personnel). The need for adequate museum collections staff was identified as an essential requirement to ensure the proper management and documentation of the collections and to address the large backlog of uncataloged and unprocessed collection items (NPS 2007b).

The Collection Management Plan, South Florida Parks, 2007 presented recommendations for remedial actions and long-term treatment and management of the SFCMC collections. The plan noted that it would not be cost-effective to enlarge the existing facility and mitigate existing problems and deficiencies. Rather, the plan recommended the construction of a new state-of-the-art curatorial facility. The NPS Southeast Archeological Center is anticipated to remain the primary repository for archeological items from the various park units (NPS 2007b).

In accordance with the NPS National Museum Storage Strategy (approved by Congress in 2007) the Collection Management Plan supported the retention of a centralized collections facility under a partnership agreement among the south Florida parks to achieve the most cost-effective and efficient operations. However, the plan recognized that the current South Florida Collections Management Center is inadequate and emphasized the need for all south Florida parks to commit funds, staffing, and other assistance to support effective operations (NPS 2007b).

VISITOR EXPERIENCE AND OPPORTUNITIES

Everglades National Park is a public park for the benefit and enjoyment of the people. More than 85% of the park consists of a vast, wetland wilderness (1.3 million acres of more than 1.5 million acres total). The limited developed areas are either near the park boundaries or along the main park road from the Ernest F. Coe Visitor Center to Flamingo.

Most of the park is set apart as a permanent wilderness, preserving essential primitive conditions that include the natural abundance, diversity, behavior, and ecological integrity of the flora and fauna (see chapter 1). The unique wilderness character, the water resources, and the wildlife of the park are fundamental to the purpose and significance of the Everglades. The National Park Service believes that the park should be managed to maintain the unique character of the Everglades and allow visitor opportunities that are related to its purpose and significance, including the following:

- boating (motorboats, canoes, and kayaks)
- wildlife viewing experiences throughout the park, both in frontcountry and backcountry areas
- access to frontcountry recreation for visitors unable to explore the vast backcountry of the park by boat
- access to backcountry for visitors interested in solitude and primitive recreation
- frontcountry and backcountry camping opportunities
- education focused on the unique natural and cultural heritage of the park (diverse ecosystems and wildlife, historical water flows, human history)
- opportunities for visitors to understand the complex flow of water from Lake Okeechobee through the Everglades in both historic and current contexts

- opportunities for visitors to understand adaptive management measures applied to protect the park's unique subtropical natural and cultural resources and visitor experience

This section focuses on the opportunities and experiences available to visitors at Everglades National Park.

Primary Interpretive Themes

The National Park Service believes that a key component of the Everglades experience includes opportunities to learn about the park's primary interpretive themes—the ideas and concepts about the Everglades that are the core of all interpretive programs and media (see "Primary Interpretive Themes" in chapter 1).

Information, Interpretation, and Education

Everglades National Park provides a varied array of educational and interpretive opportunities to help visitors experience the park. The following section details some of the opportunities available at the park.

Visitor Centers and Visitor Contact Stations. Everglades National Park has several visitor centers and contact stations to provide visitors with orientation, interpretation, and educational information and opportunities.

Ernest F. Coe Visitor Center—The Ernest F. Coe Visitor Center is just inside the main park entrance near Homestead, and this is the closest visitor center to the Miami area. The visitor center offers a wealth of information about the park and the natural and human history of the area. Open year-round and with rangers and volunteers to answer questions, the visitor center provides educational displays, informational brochures, and orientation films. The Ernest F. Coe Visitor Center often has special art exhibits on display from local artists. A variety of educational items and souvenirs are available in the adjoining bookstore. The visitor center is a short distance from many popular hiking trails (NPS 2009k).

Royal Palm Visitor Contact Station—The Royal Palm visitor contact station has a limited staff presence, some interpretive exhibits, a bookstore, and storage space used by the park staff.

Gulf Coast Visitor Center—The Gulf Coast Visitor Center is 5 miles south of Tamiami Trail in Everglades City and serves as the gateway for exploring Ten Thousand Islands, a maze of mangrove islands and waterways that extends to Flamingo and Florida Bay. The visitor center offers educational displays, orientation films, informational brochures, and backcountry permits. Boat tours and canoe rentals are also available (NPS 2009k).

Flamingo Visitor Center—The Flamingo Visitor Center is about 38 miles south of the park entrance at the southern end of the Florida peninsula. Flamingo offers educational displays, informational brochures, and backcountry permits. Campground facilities, a marina store, and a public boat ramp are nearby. There are several hiking and canoeing trails in the area. Canoe, kayak, and bicycle rentals are available at the marina store, as are boat tours.

Shark Valley Visitor Contact Station—The Shark Valley Visitor contact station is on Tamiami Trail (Highway 41), about 25 miles west of the Florida Turnpike. Shark Valley offers educational displays, a park video, an underwater camera, and informational brochures. Guided tram tours, bicycle rentals, snacks, and soft drinks are available from Shark Valley Tram Tours, Inc. Two short walking trails are near the main tram loop.

Chekika—Formerly a state recreation area and now a part of the park, Chekika is a free day use area open seasonally (December–April) from dawn to dusk. Chekika is prone to

flooding during the summer. It has a picnic area with a lawn, tables, and several shelters shaded by tall tropical hardwood trees. This patch of higher and drier ground is known as a hammock, or tree island. The park provides portable restrooms and drinking water. Chekika has a short hiking trail along a boardwalk that crosses a sawgrass wetland and climbs onto the hardwood hammock. Chekika also serves as a jumping-off point for cyclists looking to bike along the paved roads and canal banks in the park's East Everglades Addition (Leposky 2009). During the winter, on-site volunteers help maintain the facilities.

Guided Tours and Ranger Programs. Guided tours and ranger programs are available to the public from many park locations. Ranger programs are available during both the wet and dry seasons, with programs varying depending on the season. The park offers ranger programs through the Shark Valley visitor contact station, the Gulf Coast Visitor Center, the Flamingo Visitor Center, and the Royal Palm visitor contact station. Most of the ranger-guided programs are available during the winter (December-April) and vary in availability throughout the week.

Royal Palm Contact Station and Ernest Coe Visitor Center—Many ranger-guided programs are offered at Royal Palm and Long Pine Key, including coffee with a ranger, nature walks at the many interpretive trails in the area, bike tours, a car caravan, a gator walk, and an evening program. Interpretive videos are available at the Ernest F. Coe Visitor Center. Once a month, an after-dark Nocturnal Encounters program is offered to families and interested visitors. These visitor centers also offer limited interpretation of the ongoing restoration efforts in the Hole-in-the-Donut area.

The Ernest F. Coe Visitor Center offers a slough slog to visitors. This off-trail hike gives a hands-on view of the River of Grass and reveals the hidden world of a cypress dome (NPS 2009b).

Tours of the historic Nike Missile Base site are offered daily during the winter season. The guided tours interpret the site's role in the Cold War defense system in south Florida.

Gulf Coast—The Gulf Coast Visitor Center offers ranger-led programs including boat tours, canoe trips of varying degrees of difficulty, nature walks, bike tours, and an Everglades-at-night program (NPS 2009b). The Gulf Coast boat tour of Ten Thousand Islands departs from the Gulf Coast marina area. Tours operate every day, year-round.

Flamingo—Flamingo area boat tours explore the Whitewater Bay backcountry and Florida Bay. Flamingo offers a varied slate of ranger-led activities, including canoe trips, bird and botany walks, nature walks, educational talks about the park, a car caravan to points along the main park road, and an evening program (NPS 2009l).

Florida Bay—Numerous commercial tours operate within Florida Bay. These include eco tours, canoe/kayak tours, and, predominantly, fishing tours into the bay. Some of these tours originate outside the park.

Shark Valley—Shark Valley Tram Tours offers two-hour, naturalist-led tours through the northern region of Everglades National Park. Visitors on the open air tour are introduced to the River of Grass and the wildlife inhabiting it. At the midway point of the trip, visitors can stroll up the spiral ramp and platform of the Shark Valley observation tower for a panoramic view of the heart of the Everglades (Shark Valley Tram Tours 2010). Shark Valley also offers multiple ranger-led bike tours and nature walks (NPS 2009b).

Airboat Tours—Airboat tours in the East Everglades Addition are available through commercial operations along the Tamiami Trail. Four airboat tour companies operate within the park: Coopertown, Everglades Safari, Gator Park, and Everglade Airboat Tours.

Environmental Education Program. Since the early 1970s, teachers have been partnering with Everglades National Park's Education Program to help prepare students to play a role in preserving and protecting this fragile wetland. In winter the park offers free, ranger-led, curriculum-based programs to the students of south Florida, as well as teacher training. Other environmental education programs include the following:

Shark Valley— **S**tudents board an open-air tram for a 15-mile round trip with a ranger. Pre-visit preparation reinforces the concepts of water flow, food chains, native cultures, flora and fauna.

Royal Palm / Long Pine Key— Rangers guide students on a walking tour of the Anhinga Trail boardwalk. Teachers pair up with rangers to teach the students about the park's fragile habitats.

Camp Program at Hidden Lake and Loop Road Education Centers— During overnight and multiday stays, students participate in activities such as dry and wet hikes, canoeing, evening programs, star gazing, archeology or Miccosukee Indian study, journaling and artistic expression, water debate, and a tram trip.

Recreational Activities

Visitors to Everglades National Park value the resources that relate to the park's purpose and significance—the protected natural ecosystem of the Everglades and its unique qualities, including its flora and fauna; the scenic landscape; and the vast expanses of wilderness unmarked by human development. Unsurprisingly, locations and destinations within the park that allow these types of experiences are popular. The Anhinga Trail with its abundant wildlife, Shark Valley tram tours that take visitors into the sawgrass prairie and educate them about the landscape, and boat tours out of the Gulf Coast and Flamingo that explore the extensive waters of Ten Thousand Islands and Florida Bay all cater to the desires of park visitors (NPS 2008b).

Visitors value the Everglades for its quiet and peaceful terrain and the prospect of finding solitude amongst the mangroves or in the River of Grass (NPS 2008b). The numerous water trails throughout the park allow visitors to explore the park's extensive backcountry by motorboat, canoe, or kayak. Florida Bay and Ten Thousand Islands are marine environments that provide excellent boating and fishing options for those seeking solitude and adventure. The park's most fundamental resource is the ecosystem itself, and its value is reflected in the desires and actions of visitors to the park.

The diverse habitats of the Everglades offer visitors a plethora of activities that include hiking, canoeing, kayaking, boating, biking, fresh and saltwater fishing, and camping in the expansive wilderness (NPS 2009k). Recreational activities can vary greatly across different areas of the park and are detailed in the following sections.

Hiking. Everglades National Park offers a variety of hiking opportunities that allow visitors to explore the diverse habitats of the park (NPS 2009k). From half-mile, self-guided boardwalks, to 7.5-mile single-track dirt paths, to the 15-mile Shark Valley tram loop, every district in the park provides hiking options except for the Gulf Coast district. Flamingo, in particular, provides miles of hiking options, with the Coastal Prairie Trail among the most popular in the park. The main park road provides access to numerous interpretive boardwalks and hikes in the Pine Island district, including Long Pine Key Trail, another of the park's popular hikes. During the wet season, access to hiking trails in the park may be limited in areas that become submerged.

Bicycle Opportunities. Bicycle travel is permitted on park roads open to motor vehicles and on the 7-mile Long Pine Key nature trail, on which bicycle use is specifically permitted. Bicycle rentals are

available at Flamingo, and there are two trails in the area that currently allow bicycling—the Snake Bight Trail and Rowdy Bend Trail (NPS 2009h). Visitors can bike the 15-mile Shark Valley tram loop, and bicycle rentals are available at the Shark Valley Tram Tour facility.

Camping. The park offers both frontcountry and backcountry camping opportunities. Visitors can stay at developed frontcountry sites with amenities such as restrooms, water, and RV hookups. Frontcountry campsites in the park are all accessible by car, accommodate tents and RVs, and offer both individual and group settings.

Backcountry camping at the park allows visitors to experience the park's vast wilderness. The park has 47 backcountry campsites that are accessed by canoe, kayak, or motorboat, though a few can be accessed by hikers. Visitors can select between a variety of ground sites, beach sites, and elevated camping platforms called chickees (NPS 2009c). There are backcountry campsites throughout the park in Florida Bay, the Ten Thousand Islands, Whitewater Bay, and Pine Island area.

A backcountry permit is required for all wilderness campsites. Permits are only issued the day before or the day of the start of a camping trip. Permits are not issued over the telephone. The majority of backcountry permits are issued from the visitor centers at Flamingo and the Gulf Coast site in Everglades City for visits into the park's marine backcountry. A small number of permits are issued for park freshwater areas from the park headquarters building in Homestead (NPS 2009k).

Fishing. One-third of Everglades National Park is covered by water, creating excellent boating and fishing opportunities. Snapper, sea trout, redfish, bass, and bluegill are plentiful. Saltwater fishing areas include Florida Bay, Ten Thousand Islands, and elsewhere in the park's coastal zone. Florida Bay is a world-renowned tarpon fishery. Freshwater and saltwater fishing require separate Florida fishing licenses. No commercial fishing is permitted in Everglades National Park (NPS 2009k). No spearfishing is permitted.

Airboating. Commercial airboating opportunities are available in the East Everglades Addition. Four companies provide airboat tours (Coopertown, Gator Park, Everglades Safari Park, and Everglade Airboat Tours). The first three companies identified own land within the authorized park boundary and operate their businesses from these sites. On their properties the land uses are for parking, a restaurant, gift shop/ticket office, restrooms, fenced wildlife areas with walking paths, wildlife show areas, and in the case of Coopertown, a private residence and at Gator Park an RV campground and borrow pit/lake. The last business listed (Everglade Airboat Tours) does not own land in the park and operates tours from the public airboat launch site adjacent to the Coopertown property. This site and a launch site north of Chekika along SW 237th Avenue also provide private airboat access into the East Everglades Addition. Private airboating is not permitted in the park outside the East Everglades Addition.

The study "Airboat/ORV Trail Inventory for the East Everglades Addition Lands" (University of Georgia 2006) documented evidence of substantial activity in the northern half of the Addition. The study compared aerial photographic evidence of airboat trails from 1994, 1999, and 2003 and determined that airboat trails are declining in number and extent over time. Narrow, "single pass" airboat trails tend to be short lived, although there is a network of wider trails formed through repeated use that remains relatively stable over time. (The results of this study are discussed in more detail in the "Wilderness Character" section of this chapter.)

Boating. Visitors can explore Florida Bay, Whitewater Bay, and Ten Thousand Islands by motorboat, canoe, or kayak. Each area has its own characteristics and habitats to explore.

Boating in the waters of the park is for the skilled. Treacherous passes cut through long banks of mud and seagrass, separating the basins of the shallow coast in Florida Bay. Other areas, especially in Ten Thousand Islands, have many oyster reefs and sandbars. Safely exploring this region while protecting the sensitive underwater habitats requires the ability to read the water. Shallow areas are rarely marked. Visitors should know the draft (depth) and limits of their boat and have the ability to read and use nautical charts (NPS 2009k).

Patterns and levels of boat use in the park are documented in a January 2009 study titled "Aerial Survey of Boater Use in Everglades National Park." This study is discussed further in the following "Visitor Use" section of this chapter.

The Wilderness Waterway is a 99-mile water trail open to motorboaters and canoe/kayak users. The Wilderness Waterway begins at the Gulf Coast and winds through mazes of mangrove-lined creeks and bays before ending at Flamingo. The waterway is minimally marked and can be difficult to navigate; it should be used only by experienced boaters. Permits for Wilderness Waterway can be acquired at the Flamingo and Gulf Coast visitor centers.

Paddling—There are many opportunities to explore the park's natural beauty in canoes and kayaks. Both the Flamingo and the Gulf Coast districts offer multiple water trails designated for paddle-use only. Backcountry campsites provide paddlers with destinations for overnight trips.

The Wilderness Waterway is used by canoers and kayakers; it requires at least eight days of paddling to complete the entire 99-mile trail from the Gulf Coast to Flamingo.

Florida Bay—Recommended motorboat routes in Florida Bay are currently identified on National Oceanic and Atmospheric Administration charts and in the *Florida Bay Map and Guide*. Florida Bay has scattered channel/access route markings and limited idle-speed/no wake areas, but there is unrestricted boat access throughout most of Florida Bay. No recreational use is permitted in wildlife habitat protection areas throughout the bay to protect nesting and rookery areas. All of the keys in Florida Bay are closed to recreational uses except for North Nest, Little Rabbit, Carl Ross, and Bradley keys. Crocodile Sanctuary (Little Madeira Bay and numerous other connected ponds and creeks) is closed to public access.

In 2011, a pole/troll nonmotorized boating zone was implemented for Snake Bight in Florida Bay.

Motor Vehicle Access. Transportation to and within the park is primarily by private vehicle or vessel. There are numerous regional public transportation routes within Miami-Dade County, some of which extend to the Homestead/Florida City area. None of these routes access the park, and there are no approved plans to extend these routes to the park.

In 2004 a study was conducted for the National Park Service of the feasibility and cost of several options for alternative transportation to the park (HTNB 2005). These options included connections between the Miami-Homestead gateway area to (1) the main park entrance along the main park road and then all the way to Flamingo, and (2) Tamiami Trail destinations along the park's northern boundary. These options have been incorporated into the action alternatives in this plan.

Climate Change. Since at least the mid-2000s, park managers have been carefully considering, in the context of climate change, how to (and whether to) construct or upgrade visitor and operational facilities in flood-prone zones. For example, fixed docks have been replaced with floating docks or removable platforms, and NPS staff housing at Flamingo has been replaced with elevated/hardened/re-locatable units that are more resistant to sea level rise and storms.

Recreational opportunities for visitors, such as birding, fishing, and boating, could change if water levels and species shift in terms of area, or if species' population levels change.

VISITOR USE

Annual and Seasonal Visitation

This section focuses on visitor use characteristics at Everglades National Park—how many people visit the park and when, where they come from, how long they stay, and how weather can affect visitation. Following park establishment in 1947, visitation climbed rapidly, topping more than a million visitors per year in 1964. The highest yearly recreation visitation, 1.53 million visitors, was recorded in 1972. Visitor use declined sharply over the next decade, eventually dropping to 550,000 in 1982; the lowest in two decades. Annual recreation visitor use increased again thereafter, averaging about 1,005,000 during 1990–2011 (NPS 2012a).

The cycle of increasing and declining visitation has been repeated several times during the park's existence, reflecting the influences of economic climate, fuel prices, and weather, particularly severe tropical storms that discourage leisure travel. Annual recreation visitation dropped to 850,000 in 2005 following hurricanes Katrina and Wilma. Damage caused by those storms caused the only overnight lodging accommodations in the park (at Flamingo) to close, and the storms also affected campground support facilities there. As a result, overnight visitor use to the park dropped by 80%. A commercial services plan for Flamingo was completed in conjunction with the GMP planning effort. This plan will guide redevelopment of Flamingo, including redevelopment of overnight lodging, enhanced visitor opportunities, and expanded services such as tours, food/ beverage, and recreational equipment rentals (NPS 2012a).

Note that the reported visitor use figures capture most, though not all of the recreation visitor use at the park. This is because the following types of use are not counted: visitors taking commercial airboat tours offered by four companies in the East Everglades Addition, private airboat users, dispersed land-based use in remote areas not tracked by traffic counters, and fishing and sport boats entering the park from coastal waters. (The latter type of use has increased in recent years; see next paragraph). A lack of data precludes statistically reliable estimates; however, park staff believe the unreported use is in the range of 300,000 to 450,000 visitors per year (Supervisory Planner Fred Herling, Everglades National Park, pers. comm. with Ron Dutton 2009).

An "Aerial Survey of Boater Use in Everglades National Park" conducted in 2008 (J. S. Ault et al.) indicates that boater use in Everglades National Park has more than doubled during the last three decades, and that boats are entering the park from additional points of origin such as through the Florida Keys and from the Naples and Marco Island area to the north. This finding is consistent with the number of recreational vessels registered in the south Florida region more than doubling during the last three decades. Other studies of tourism and recreational fishing and boating activity in the Florida Keys, including Florida Bay, also support boat-based entry into the park from adjacent areas of the Keys. In fact, the majority of boating and fishing use in the Keys, including charter and guided fishing, occurs offshore and in the near-shore flats areas outside the park. These areas would not be directly affected by management actions associated with the GMP (Leeworthy and Wiley 1997; Leeworthy et al. 2010; and Fedler 2013).

Overnight visitors, including backcountry campers using chickees, accounted for about 85,800 of the total reported recreation visitation. Overnight use has declined substantially following hurricanes Katrina and Wilma.

Recreation visitation to the Everglades is highly seasonal. Peak monthly visitation,

typically in the 130,000 to 150,000 range, occurs in February or March. Monthly visitation is typically the lowest in September, when 30,000 to 50,000 visitors come to the park (see figure 7). Seasonal weather differences are a major influence on recreation use, with heat and mosquitoes discouraging visitation during the summer; the tropical storm season deterring tourism to south Florida in the fall and thereby visitor use to the park; and pleasant, mild winters promoting "snowbird" migration and increased visitor use during that time of year. Contrary to the rest of the park, Florida Bay visitation is highest during the summer when the weather conditions for boating and waterborne recreation are best.

The general seasonal pattern in overall recreation visitation applies to overnight use as well (figure 8). Whereas monthly visitation during the high season is about three times the visitation during the low season, the ratio for overnight stays during the high season is in the range of 10 to 15 times higher than overnight stays during the low season. Stays at Flamingo Lodge historically accounted for about 30% to 35% of the total overnight use at the park. Frontcountry tent camping (individual and group), backcountry camping, and RV camping accounted for about equal shares of the remainder. Overnight lodging has not been available in Flamingo since the existing Flamingo Lodge was damaged by tropical storm Katrina.

As shown in figure 9, recreation use at Everglades varies substantially from year to year, with adverse weather (tropical storms/ hurricanes in particular), being among the most influential factors in that variation. The extent of this influence depends on the frequency, severity, timing, and location of storms, as well as the aftereffects in terms of damage to park facilities and access routes (both internal and external to the park). Relatively mild storms have little effect on visitation. Major storms such as Andrew, Katrina, and Wilma can cause substantial damage to facilities within and outside the park. Annual recreation use declined by approximately 25% in the wake of tropical storms Katrina and Wilma (figure 9), and that effect has lingered with the continued lack of available overnight lodging and certain other services at Flamingo. Although not suffering the same degree of damage to facilities as occurred at Flamingo, substantial reductions in recreation visitor use also occurred elsewhere in the park.

More recently, visitation levels have increased at Royal Palm, the main entrance, and Shark Valley, while the number of recreation visitors at Everglades City and the number of boat visits continue to decline.

Visitor Origin and Length of Stay

Year-round residents of Florida are the single largest group of visitors (about 25%) to Everglades National Park. Extended stay/seasonal residents account for about 10% of all visits, while vacationers from Michigan, Pennsylvania, Indiana, and New York collectively account for roughly another 20%. Travelers from the remaining states, whether in Florida for an extended stay or shorter vacation, also account for about 25% of the recreation visits. The remaining visitors to the Everglades, about 20%, are international, drawn by south Florida's favorable international reputation for climate, beaches, outdoor recreation, and tourism opportunities, and lifestyle and culture. Everglades National Park is both a contributor to and a beneficiary of that reputation. Canadians, Germans, French, Dutch, and British nationals account for about 80% of international visitors.

Most recreation use in the Everglades (75% in 2008) is day use. Among day users, the duration of stay is relatively long, with about half of day users staying five hours or longer. Many day visitors to the Everglades also spent one or more nights in the area outside the park, either with friends or relatives, at vacation homes, or in local lodging accommodations. Of the 25% who stayed a day or longer, most characterized their visit as

one or two days. However, 11% of all visitors stayed three days or longer (NPS 2008).

The 2008 visitor survey (NPS 2008), conducted only among users on the mainland portion of the park, revealed the following notable visitation characteristics:

- the top five sites visited—Shark Valley, Royal Palm area / Anhinga Trail, Flamingo, the Ernest F. Coe Visitor Center, and the Gulf Coast Visitor Center / Ten Thousand Islands area [Note: these results reflect a "snapshot in time" during two one-week periods and may not reflect overall general visitor use patterns over time.]
- approximately 35% to 40% of the parties responding to the survey reported two or more entries to the park during their visit [Note: the multiple entries could be during the same day, on different days, or via different entry points, e.g., Shark Valley and the main entrance.]
- more than 20% indicated that visiting Everglades National Park was the primary reason for their trip to south Florida
- adults between the ages of 51 and 75 accounted for more than half of the users surveyed

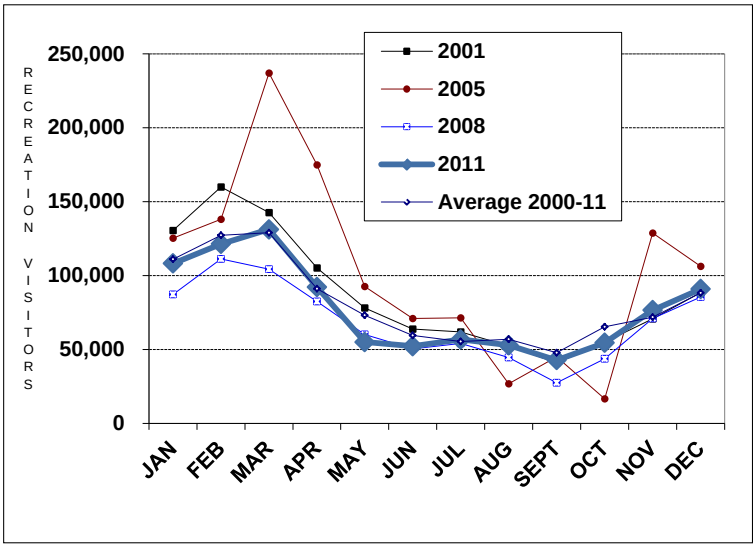
Climate Change. Climate change might affect seasonal use patterns at the park. Differences in the timing and level of precipitation, drought, sea level changes, and changes in tropical storm patterns could influence seasonal migration and access for dispersed recreation. Climate change might also affect the vegetation and wildlife resources that draw many visitors to the park.

REGIONAL SOCIOECONOMIC ENVIRONMENT

Introduction

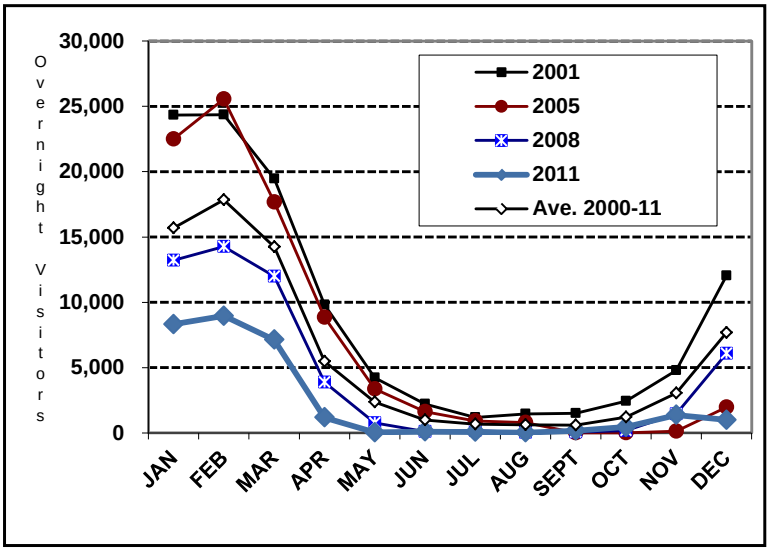
The park's vast area provides many interfaces with adjacent land use and the nearby communities. The park and the adjacent lands and nearby communities are the socioeconomic region of influence for this assessment. The region of influence extends from metropolitan urbanized Miami-Dade County on the east, to the Gulf Coast on the west (Collier County), and south to include the mid-Florida keys (Monroe County). Because economic and demographic data are generally available at the county level, data are typically presented for Collier, Miami-Dade, and Monroe counties in this document. Nearby land uses around the park include farming, forests, orchards, and nurseries for landscape plants; industrial, rural, and suburban scale development; environmental restoration areas; undeveloped natural areas; transportation corridors; and the coastal waters of the Gulf of Mexico and Florida Bay.

Most of the park, including most of Florida Bay and the uninhabited keys and coastal areas along the Gulf of Mexico, is in Monroe County. Extensive commercial and residential development, much of it focused on tourists and seasonal residents, exists on the larger keys adjacent to the park's southern boundary in Florida Bay.



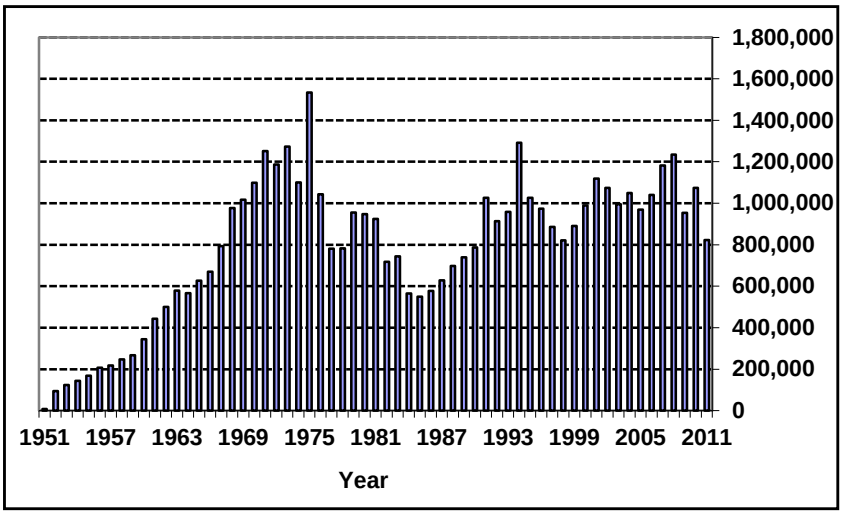
(*Source:* NPS 2012b)

FIGURE 7. MONTHLY RECREATION VISITATION AT EVERGLADES NATIONAL PARK



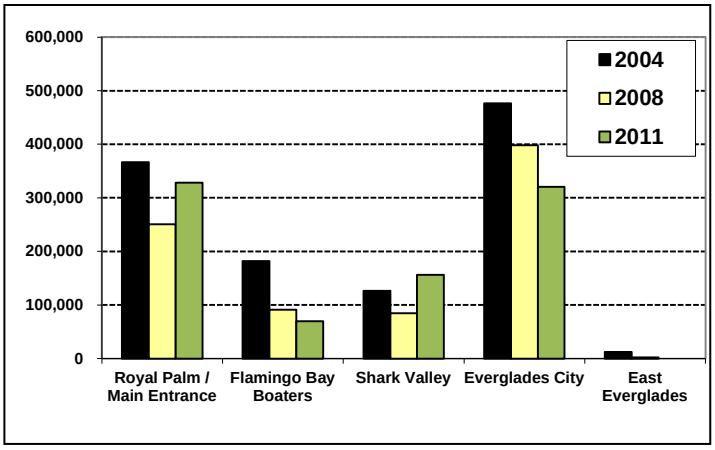
(*Source:* NPS 2012b)

FIGURE 8. MONTHLY OVERNIGHT VISITOR USE AT EVERGLADES NATIONAL PARK



(*Source:* NPS 2012a)

FIGURE 9. RECREATION VISITS BY YEAR TO EVERGLADES NATIONAL PARK



(*Source:* NPS 2009b)

FIGURE 10. RECREATION VISITS TO KEY DESTINATIONS BEFORE (2004) AND FOLLOWING (2008) HURRICANES KATRINA AND WILMA

The eastern portion of the park, including the East Everglades Addition, is in southwestern Miami-Dade County. Miami-Dade County, along with neighboring Broward County and Palm Beach County further north, form the Miami-Fort Lauderdale-Pompano Beach Metropolitan Statistical Area. This entire metropolitan area serves as a gateway for visitors to Everglades National Park from the east. However, Homestead and Florida City are the closest towns to the park headquarters, the main entrance, and Flamingo. Although the core of the Miami area is urbanized, a substantial amount of farm, undeveloped, and rural residential land remains near the park, acting as a buffer between the park and the urban Miami area. However, much of this land also has been converted in recent years to accommodate new suburban development.

The far northwestern portion of the park is in Collier County, which also comprises the Naples-Marco Island Metropolitan Statistical Area. The community of Everglades City is the immediate gateway to the northwest portion of the park—including some of the Ten Thousand Islands area and the Wilderness Waterway. Naples, the major gateway community to the park for the west coast of Florida, is northwest of Everglades City.

The northern boundary of the park, moving from east to west, is comprised of water conservation areas associated with the *Comprehensive Everglades Restoration Plan*, the southern portion of the Miccosukee Indian Reservation, the southern portion of Big Cypress National Preserve, and the southern boundary of other public and private properties. With the exception of the Miccosukee Indian Reservation and Miccosukee Reserved Area, little residential or commercial development exists along the park's northern perimeter.

Population

Between 1990 and 2000, Florida gained more than 3.0 million residents, with a further gain of 2.8 million residents between 2000 and 2010.These gains ranked Florida among the most rapidly growing states in terms of population growth over the past two decades. In 2010, Florida's population of 18,801,311 ranked fourth in the nation behind California, Texas, and New York (U.S. Census 2010).

From 2000 to 2010, Florida's population increased by 2.8 million people—the third highest among the states. Net migration of nearly 2.0 million residents from other states and nations, accounted for nearly 85% of the state's population growth. Among the other states, only Texas gained more than 1.0 million residents via migration. Most domestic migrants to Florida came from New York.

In 2010, the three-county region of the park contained nearly 2.9 million residents, about one of every six of the state's residents. Most of this population is concentrated along the east coast in Miami-Dade County (2.5 million). Collier County had more than 321,000 residents, and Monroe County had approximately 73,000 inhabitants (table 15).

Substantial population growth has occurred in Collier and Miami-Dade counties since 1990. Miami-Dade County registered a population increase of 559,341 residents, or 29% between 1990 and 2010. Although lower in number than the population gains in Miami, the gateway communities of Florida City and Homestead grew faster; Florida City's population increased by 87% (to more than 11,000) and Homestead's population more than doubled (to 60,512). The rapid population growth resulted in the subdivision and development of much farm land east of the park to more urban uses.

Collier County's population more than doubled between 1990 and 2010, a net gain of 169,421 residents that raised the county's population above 321,000. Most of the residential development to house this growth occurred in unincorporated areas of the county around Naples. Everglades City, the community nearest the park in the northwest portion of the park, had 400 residents in 2010.

Some new year-round and seasonal housing is being developed in the Everglades City area.

Monroe County, which includes the Florida Keys, has a limited amount of privately owned developable land. As a result, its resident population is substantially lower than Collier and Miami-Dade counties, approaching 80,000 in 2000. Growth continued through 2004. However, the county lost nearly 6,500 residents in the years following hurricanes Katrina and Wilma in 2005, which resulted in major property damage in the keys.

A portion of the Miccosukee Reserved Area borders the park on its northern boundary. The reserved area is the center of the Miccosukee population. The tribe reports approximately 650 enrolled members, although it is unclear how many members live in the reserved area (Miccosukee Tribe 2008).

In addition to its year-round residents, south Florida experiences a substantial seasonal population influx of "snow birds" escaping winter in the more northerly states and attracted by the region's favorable winter climate. (Snowbirds generally are elderly, mostly retired, individuals who spend at least 30 consecutive days somewhere else. Some snowbirds may be considered seasonal or temporary residents, particularly if they rent apartments or own second homes.) A 2005 study from the University of Florida estimated more than 800,000 snowbirds in Florida at the peak of the winter season. That estimate likely translates to several million snowbirds during the season (Smith and House 2006 and 2007). Miami, Fort

TABLE 15. RESIDENT POPULATION OF COUNTIES AND SELECTED CITIES AND TOWNS NEAR EVERGLADES NATIONAL PARK

Area	1990	2000	2010	Total Change 1990–2010	Total % Change 1990–2010
Collier County	152,099	251,377	321,520	169,421	111%
Everglades City	321	479	400	79	25%
Naples	19,505	20,976	19,537	32	0%
Miami-Dade County	1,937,094	2,253,362	2,496,435	559,341	29%
Florida City	6,011	7,843	11,245	5,234	87%
Homestead	28,387	31,909	60,512	32,125	113%
Miami	358,548	362,470	399,457	40,909	11%
Monroe County	78,024	79,589	73,090	-4,934	-6%
Islamorada	7,083	6,846	6,119	-964	-14%
Key West	24,832	25,478	24,649	-183	-1%
Three-County Region	2,167,217	2,584,328	2,891,045	723,828	33%
Florida	12,937,926	15,982,378	18,801,311	5,863,385	45%

Source: U.S. Census Bureau 2000 and 2011a

Lauderdale, Palm Beach, Naples and the Florida Keys are among the more popular destinations for snowbirds. The timing of this influx corresponds to periods of higher visitor use at the park.

Another seasonal population influx occurs in conjunction with the region's agricultural industry and its demand for labor, much of which is met by migrant farm workers. A study conducted in 2000 estimated more than 35,000 such workers and family members in Collier and Miami-Dade counties (Larson 2000). Many of these workers worked on large farming operations east and northwest of the park. Visitor use profiles do not indicate if the migrant farm worker population generates substantial visitor use to the park. Furthermore, the migrant farm worker population is likely declining because of the conversion of farm lands to residential and commercial development in recent years. According to the 2007 Census of Agriculture, the combined acreage of land in farms in the three counties declined by 94,000 acres (or 35%) in the five-year period 2002 to 2007 (USDA 2009).

Tourists are another population category for the park, with Miami and south Florida being a major tourism and convention destination for international and domestic visitors. Approximately 12 million overnight visitors are estimated to come to south Florida each year, with a record 13.4 million visitors in 2011. South Florida is also a major departure point for the vacation cruise industry; approximately 7.7 million passengers sailed from Miami and Fort Lauderdale in 2011 (Greater Miami Convention and Visitors Bureau 2012). Many of these passengers extend their stay in the Miami area, arriving before or staying after their cruise to take in other sights, attractions, and activities, including visits to the park. Clients booked by cruise lines and travel agents are a major market for the commercial airboat operators in the East Everglades Addition.

These recreational opportunities, including wildlife viewing, fishing, bicycling, nature study, access to scenic views, and other environmental resources in the park contribute to the appeal of the region for these seasonal residents and visitors, as well as vacation/second home development that is an integral part of the economy.

Economic Overview

As measured by the number of full- and part-time jobs, the size of the economies for the three counties mirrors their population, ranging in 2010 from 1.42 million in Miami-Dade County to 53,885 in Monroe County. Total employment across the three counties exceeded 1.64 million in 2010 (see table 16). Before the beginning of the national economic recession in late 2007, the regional economy had expanded along with population growth since the year 2000, with a net gain of 234,093 jobs registered in the three counties. From 2000 to 2007, metropolitan Miami-Dade County posted the largest net gains, 178,496 jobs. The number of jobs based in Collier County increased by more than one-third during that same period. Even though its population declined during that period, Monroe County registered a net gain of 3,449 jobs. In part, that increase reflected activity associated with post tropical storms Katrina and Wilma reconstruction.

There are both similarities and differences among the three counties in terms of economic composition and diversity. None of the three are heavily industrialized. Rather, their economies tend to be more service and trade-oriented (table 17). Compared to the nation, state, or other two counties, Miami-Dade County's economy is more heavily concentrated in the transportation (because of the seaport and airport), wholesale and retail trade, and education and health care sectors. Tourism, outdoor recreation, snowbird migration, and the many older residents in the county all contribute to that pattern.

Monroe County was a minor contributor to the overall number of jobs in the region,

accounting for only about 3.3% of the regional total in 2010. The distribution of jobs, by major industry, in Monroe County reflects the economy's strong dependence on tourism. More than 20% of the county's jobs were in the accommodations and food services sector.

High percentages of jobs in other services, including the recreation and entertainment, information, finance, insurance, real estate, and government sectors, also occurred in Monroe County. There were relatively fewer jobs in manufacturing, education, and health care sectors in the county—the latter in part likely a reflection of the availability of these services in Miami-Dade County.

The rapid population growth and associated new housing and commercial development that have been an important economic driver in Collier County is evident in employment data showing that the construction and information, finance, insurance, and real estate sectors combined to account for more than 24% of all jobs (compared to less than 18% nationally). The share of jobs in the food services and accommodations sector was also higher than either the nation or Miami-Dade County, but not to the same degree as in Monroe County.

South Florida's strong economy in the 1990s and early 2000s contributed to unemployment being consistently below statewide and national levels. In 2000 the unemployment rates for the three counties ranged from 2.9% for Monroe County to 5.1% for Miami-Dade County, with statewide unemployment at 3.8% of the labor force. Despite expansion of the labor force by more than 1.2 million workers between 2000 and 2007, unemployment remained low across the region and state through 2007 because economic growth fueled labor demand. The number of unemployed actually declined in Miami-Dade and Monroe counties during that period. Collier County experienced a slight increase in the number of unemployed and unemployment rates, but this occurred against a backdrop of a 120% increase in resident population.

Labor market conditions in the region declined markedly during the recent national economic recession, precipitated by a slowdown in new construction, and tourism and vacation travel, two important segments of the regional economy (table 18).

TABLE 16: TOTAL FULL-TIME AND PART-TIME EMPLOYMENT, 2000 AND 2010

Area	2000	2010	Absolute Change	Percent Change
Collier County	144,498	171,740	27,242	18.9%
Miami-Dade County	1,276,003	1, 416,227	140,224	11.0%
Monroe County	53,639	53,885	246	0.5%
Three-county Total	**1,474,140**	**1, 641,852**	**167,712**	**11.4%**
Florida	**8,933,114**	**9,866,177**	**933,063**	**10.4%**

Source: U.S. Bureau of Economic Analysis 2012

TABLE 17: EMPLOYMENT BY MAJOR INDUSTRIAL CATEGORY, 2010

	Collier	Miami-Dade	Monroe	Florida	U.S.
Goods-Producing					
Natural Resources and Mining	4.1%	0.7%	3.1%	1.7%	2.7%
Construction	7.2%	4.2%	7.9%	5.2%	5.1%
Manufacturing	1.8%	2.9%	0.7%	3.5%	7.0%
Subtotal	*13.0%*	*7.8%*	*9.4%*	*10.3%*	*14.9%*
Services-Producing					
Transportation	1.6%	5.6%	2.3%	3.0%	3.2%
Information, Finance, Insurance, Real Estate	17.3%	12.3%	12.3%	13.2%	11.7%
Wholesale and Retail Trade	13.7%	15.6%	12.4%	14.6%	13.7%
Education and Health Care	11.7%	13.9%	6.6%	13.1%	13.4%
Accommodation & Food Services	9.4%	7.2%	20.5%	8.0%	7.0%
Other Services*	25.4%	26.5%	22.4%	25.5%	21.9%
Subtotal	*79.1%*	*81.2%*	*76.4%*	*77.5%*	*70.8%*
Government	7.9%	11.%	14.2%	12.3%	14.3%
Total	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***

* Includes professional and technical services, management of companies, administrative and waste services, arts, entertainment and recreation, and other services

Source: Derived from U.S. Bureau of Economic Analysis 2012

Employment data indicate that more than 66,000 jobs were lost in the region during the period of the recession, officially dated from December 2007 through June 2009 (NBER 2010). This figure includes more than 10,000 construction jobs lost in Collier County due to the dramatic slowdown in new residential development. In the wake of those job losses, unemployment rates more than doubled, reaching double-digit levels in Collier and Miami-Dade counties.

In 2010, more than 170,000 prospective workers were unemployed, representing an increase of more than 113,000 unemployed as compared to 2007. Although high levels of unemployment persist, the three-county region has since realized gains in employment that offset more than 40% of the earlier declines.

Income and Poverty

In 2000, the total personal income of residents in the three-county area was $70.9 billion, $57.9 billion of which accrued to residents of Miami-Dade County. By 2010, total personal income of the three counties had climbed to $114.4 billion—an increase of 61.4% and 4 percentage points higher than the 57.3% increase registered statewide (table 19).

TABLE 18. UNEMPLOYMENT AND UNEMPLOYMENT RATES FOR SELECTED PERIODS

	2007		2010		2011	
	Unemployed	Unemp. Rate	Unemployed	Unemp. Rate	Unemployed	Unemp. Rate
Collier County	6,523	4.3%	16,751	11.6%	15,269	10.3%
Miami-Dade County	52,538	4.4%	153,926	12.5%	142,836	11.3%
Monroe County	1,186	2.7%	3,260	7.1%	3,001	6.4%
Florida	371,641	4.1%	1,030,146	11.3%	970,362	10.5%

[Note: Unemp. = unemployment]
Source: U.S. Bureau of Labor Statistics 2012

TABLE 19. TOTAL PERSONAL INCOME, 2000 AND 2010

Area	2000	2010	Total Income % Change 2000–2010	Population % Change 2000–2010
Collier County	$ 10,011,970,000	$ 18,650,524,000	86.3%	28%
Miami-Dade County	$ 57,922,341,000	$ 91,410,768,000	57.8%	11%
Monroe County	$ 2,941,452,000	$ 4,304,355,000	46.3%	-8%
Three-County Total	$ 70,875,763,000	$114,365,647,000	61.4%	12%
Florida	$457,539,355,000	$719,828,478,000	57.3%	18%

Source: Bureau of Economic Analysis 2012

In 2010, the three counties together accounted for nearly 16% of the total statewide personal income. Personal income growth in all three counties outpaced the combined effects of population growth and general inflation during the period, indicating an improvement in general economic welfare among residents. Among the three counties, and despite a reduction of more than $2.3 billion in income between 2008 and 2009, Collier County had the largest relative increase, more than 86%, to $18.6 billion.

Nonearned income in the form of dividends, interest, rent, and personal current transfers are important sources of income for local residents. Nationally, nonearned income accounted for 35% of the total personal income in 2010 (table 20). The comparable share for the state was 46%. However, in both Monroe and Collier counties, nonearned income accounted for more than half of the total personal income. In other words, the resident populations of those two counties derived more income from investments, government retirement receipts, and Medicare and Medicaid than was paid to all workers employed in the respective counties at the time. The contribution of nonearned income to total income in Miami-Dade County was midway between the statewide and national averages. The high levels of nonearned income are an indication of the relatively large retired and seasonal populations living near the park.

The favorable economic conditions present across much of the region in the years preceding the recent recession are reflected in local per capita personal incomes (PCPI) and

the local incidence of poverty (tables 21 and 22). (PCPI is the total personal income divided by the total resident population of an area. Personal income includes income from all sources—wages, investments, social security, etc.).

PCPI for Florida, which was below that national average in 2000, was nearly the same as the national average by 2007. However, the recessionary effects on personal income were relatively heavier in Florida than elsewhere across the nation, such that statewide PCPI in 2010 lagged the national average by 5%. As a result of strong gains in personal income over between 2000 and 2007, Collier and Monroe counties ranked first and second in terms of PCPI among Florida's 67 counties in 2010. Miami-Dade County's per capita personal income of $36,520, although below the corresponding statewide and national averages, represented a narrowing of the gap compared to previous years, ranking it 25th.

TABLE 20. COMPOSITION OF TOTAL PERSONAL INCOME, 2010

	Collier	Miami-Dade	Monroe	Florida	U.S.
Net Labor Earnings	32%	61%	46%	55%	65%
Dividends, Interest and Rent	55%	17%	42%	25%	17%
Personal Current Transfers	13%	23%	12%	21%	18%
Total Personal Income	100%	100%	100%	100%	100%

Source: Bureau of Economic Analysis, 2012

TABLE 21. PER CAPITA PERSONAL INCOME

Area	2000	2010	% Change 2000–2010	% of Florida Average 2010	CARC* 2000–2010
Collier County	$39,412	$57,788	46.6%	151%	3.9%
Miami-Dade County	$25,639	$36,520	42.4%	96%	3.6%
Monroe County	$37,028	$58,799	58.8%	154%	7%
Florida	$28,512	$38,210	34.0%	100%	3.0%
United States	$29,847	$39,937	33.8%	105%	3.0%

* CARC = Compounded Annual Rate of Change

Source: U.S. Bureau of Economic Analysis 2012

TABLE 22. MEDIAN HOUSEHOLD INCOME AND INCIDENCE OF POVERTY, 2010

	Collier County	Miami-Dade County	Monroe County	Florida	United States
Individuals in Poverty (% of Residents)	15.7	20.3	12.6	16.5	15.3
Median Household Income	$53,341	$40,145	$50,388	$47,802	$50,046

Source: U.S. Census Bureau 2011c

Prior to the recession, poverty rates in Collier and Monroe counties had consistently been lower than the rates for Florida and the United States during the past two decades, while those in Miami-Dade County had been slightly above the state and national rates. Poverty rates have climbed across the nation in the wake of the recession. In 2010, the poverty rate in Monroe County was 12.6% and in Collier County was 15.7%, which compared favorably to a statewide rate of 16.5% and a national rate of 15.3%. The poverty rate in Miami-Dade County was 20.3% (table 22). That same year, the median household income in Collier County of $53,541 was 12% above the statewide average, while that in Miami-Dade County was 16% below the statewide average. Collier County's median household income was fifth-highest among Florida's 67 counties. Monroe County ranked eighth among Florida's counties in terms of median household income.

Selected Demographic, Social, and Economic Characteristics

In 2010, residents of the three-county area tended to be older than the general population in the nation (37.2 years), with median ages ranging from 38.2 years in Miami-Dade County to 46.9 years in Collier County (table 23). The percentages of residents 62 years and older in these counties are also higher than the national average, although Miami-Dade and Monroe counties were below the statewide average.

Labor force participation rates among those residents 16 and older range from 52.7% in Collier County to 63.9% in Monroe County, the former another reflection of the older population in the county. Labor force participation in Miami-Dade County is below the national average, but slightly above the statewide average.

TABLE 23. SELECTED DEMOGRAPHIC DATA, 2010

	Median Age (years)	Persons 62 Years & Older	Labor Force Participation (16 & older)	Race: Nonwhite
Collier County	46.9	30.9%	52.7%	16.1%
Miami-Dade County	38.2	17.0%	61.1%	26.2%
Monroe County	46.4	17.1%	63.9%	10.5%
Florida	40.7	20.9%	60.0%	25.0%
United States	37.2	16.2%	63.9%	27.6%

Source: U.S. Census Bureau 2011a, b

The resident populations of all three counties are predominately white, with minority populations ranging from a low of 10.5% in Monroe County to a high of 26.2% in Miami-Dade County. Minorities in Miami-Dade County comprise a larger share of the total population than do minorities in either the state or nation. Blacks, African Americans, and Asians are the predominant minorities in all three counties. Approximately 6,600 American Indians reside in the three-county region (Census 2011), most of whom live in Miami-Dade County.

Economic Contributions of Everglades National Park

The park is an element of the overall tourism/recreation/visitor economy of south Florida. Spending by visitors to the park; NPS personnel; and capital outlays, research,

environmental restoration, and operating and maintenance expenditures by the National Park Service and other entities support local businesses and generate tax revenues, which help support the state and local government. Although sustaining the local economy is not an explicit objective of the National Park Service or the park in developing the GMP, support for a healthy ecosystem and the related recreational opportunities that are then possible, such as sport fishing and wildlife viewing, are consistent with the park's mission and ultimately contribute economic support to the local and regional economy.

The importance of tourism and recreation to Monroe County's economy has been shown in a number of studies. One recent study estimated nearly 3.3 million person-trips and 13.9 million person-days of visitation to the Florida Keys in 2007–2008. The economic contributions associated with those trips supported an estimated 32,017 jobs and $970.3 million in annual income; the former representing approximately 60% of all jobs and the latter about 44% of all income in the county. (Leeworthy et al. 2010) A more focused study of the economic contributions attributable to fishing in the Florida Keys flats area estimated that 1.8 million fishing days occurred in the Florida Keys in 2012, supporting 7,536 jobs and $229.1 million in income in southern Florida (Fedler 2013). An earlier study estimated that recreational pursuits of Monroe County residents in the Florida Keys supported approximately 2.8% of the total income and more than 2,400 jobs in the county (Leeworthy and Wiley 1997). Other results from the three studies showed that the majority of all activity and spending occurred in Key West and the Lower Keys and that recreational and sport fishing accounted for approximately 10% of all recreation in the Keys. None of these three studies reported results for the portion of the Keys and Florida Bay located within the park, but data in the 2010 Leeworthy study indicates that flats and backcountry fishing in the upper keys, which includes the portion of Florida Bay in the park represents less than 1.0% of all fishing in the Keys/Flats, or approximately 0.1% of the total recreation use.

Visitor Spending. The peak recreation visitation reported at Everglades National Park was 1,534,328 visitors in 1972. Over the 22-year period 1990–2011, recreation use of the park has fluctuated dramatically, from about 820,000 to 1,300,000 recreational visits, averaging approximately 1,005,000 (not including visitors associated with private and commercial airboat operations based in the East Everglades Addition). Overnight visitors to the park, including backcountry campers using the chickees, historically accounted for over 100,000 of the annual visits. However, weather, hurricanes in particular, have a dramatic influence on visitation as is evident in figure 11, which displays the declines in visitation following hurricane Andrew in 1992 and hurricanes Katrina and Wilma in 2005. Overnight visitor use declined sharply in the wake of damages to the lodging and camping facilities at Flamingo caused by the latter two storms, averaging less than 39,000 visits annually over the five-year period (2007–2011).

A study of the economic contributions of units of the national park system, based on visitor origin, length of stay, type of overnight accommodations, and typical spending of park visitors, estimated total annual visitor spending of $136.5 million associated with recreation visits to the park in 2010 (Stynes 2011). The total includes entry fees collected by the park; outlays for accommodations, fuel, food and beverage purchases; boat, canoe, and other equipment rentals; and other miscellaneous expenditures. The latter include purchases made at the visitor center bookstores operated by the Everglades Association. The Everglades Association is a nonprofit cooperating association that supports education, interpretation, and research in the park and three nearby NPS units.

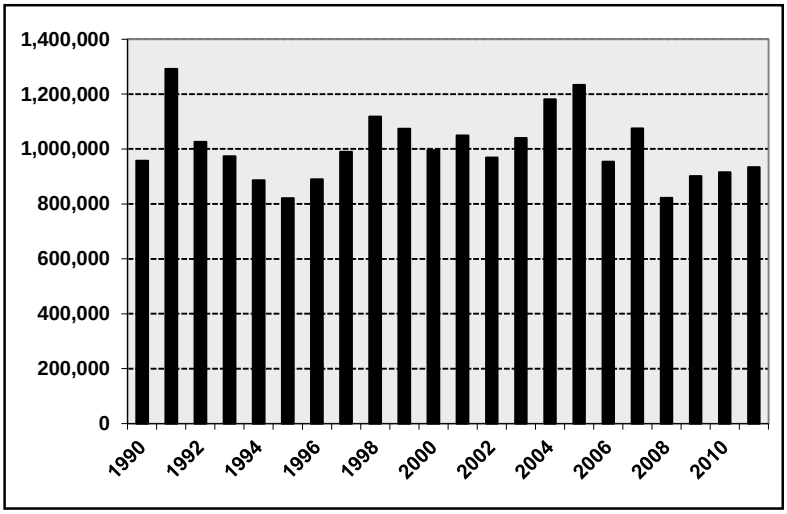


FIGURE 11. ANNUAL RECREATION VISITS TO EVERGLADES NATIONAL PARK, 1990–2011

The bulk of spending was by nonlocal visitors staying overnight in area motels and hotels and camping. Guide and outfitter fees also account for substantial visitor spending, particularly in the Upper Keys (Fedler 2013; Leeworthy et al. 2010).

The visitor spending supported an estimated 1,956 jobs, with an estimated annual income of $72.2 million in the regional economy. These estimates may not fully account for the seasonal employment and income effects associated with the private and commercial airboat and associated recreation/ entertainment operations operating in the East Everglades Addition. These four operations have a combined seasonal peak employment of 50 to 60 jobs.

Although the jobs supported by park visitor spending represent only about 0.1% of the total regional employment, the visitor spending and jobs supported are important to many businesses near the key activity centers, e.g., those in Everglades City and the Florida Keys, as well as to the concession operations and fishing guides whose livelihoods are tied to the park. The park recognizes the important contributions of recreational and other public use in the park to the local economy, quality of life of residents, and to the attraction of the area to visitors.

- Many of the jobs supported by the visitor spending are associated with commercial services/concessions in the park. Such services include canoe, kayak, and bicycle rentals; a marina with convenience store/bait shop; concession-managed RV and tent campground facilities; boat and tram tours; limited food and beverage sales; and books/educational materials/ souvenir/gift sales. Other jobs supported by the spending include eco-tours and canoe/kayak tour operators who operate in the park under commercial use authorizations. Commercial fishing *per se* is not permitted in the park, however fishing by individuals using professional guides and outfitters, who also operate under commercial use authorizations, is permitted. The number of commercial use authorizations has varied between 350 and 400 during the past several years. Many fishing guides and tour operators who work in the area are seasonal and come from outside south Florida.

- **Park Operations and Maintenance.** The annual budget for NPS operations at Everglades National Park also contributes to the regional economy, as spending for utilities, supplies, and services support additional business sales, jobs, and income. Spending of their income by NPS employees also stimulates the economy and generates tax revenues to help support state and local governments. These effects are in addition to those associated with visitor spending.

The annual base operating budget at the park for fiscal year (FY) 2011 was $17.0 million. The base budget was supplemented by donations; funding for equipment purchases and specific construction and environmental monitoring and restoration projects, including this management plan; fees from concessions; and a portion of the entry and camping fees. That budget supported 181 full-time-equivalent employees in 2011. The NPS payroll and normal park operations spending support an estimated 104 additional jobs and labor income of $4.2 million within the region (Stynes 2011). Communities in all three counties realize economic benefits from the park's operation because of the geographic distribution of the key law enforcement, maintenance, and visitor centers/contact stations.

In addition to park staff, supplemental funds support a variety of contractors who provide construction, maintenance, and other services to the park, as well as scientific researchers with other organizations. Estimates of the number of jobs supported by such spending are not available, but the number is likely substantial given that such spending totaled more than $15 million in FY 2010.

Partner organizations provide additional benefits to the regional economy in the form of purchases of goods and services to support their research, educational, community outreach, and other missions conducted in support of the park, as well as the spending by members and guests at events and activities hosted by the organizations. In addition, a cadre of volunteers numbering 1,536 in FY 2011 provided 65,022 hours, or 32.0 FTE employees, of support for park operations, maintenance, interpretation, and other visitor services. The economic value of that volunteer effort is nearly $1.4 million.

Payments in Lieu of Taxes. As a result of the federal lands included in the park, all three counties receive payments in lieu of taxes (or PILT). Administered by the Department of Interior, the PILT program distributes payments to county governments containing qualified federal lands within their boundaries, with such payments helping to offset the diminished property tax receipts resulting from federal ownership. Payments are based on the level of funding appropriated by Congress, the number of acres of qualified lands in a county, population, and several other factors. For FY 2012, PILT payments to the three counties were $1,275,089 to Collier County, $853,512 to Miami-Dade County, and $1,122,390 to Monroe County (USDI 2012).

PARK OPERATIONS

Commercial Visitor Services

Commercial services are in the developed locations of the park and provide a variety of services to visitors.

Flamingo. The Flamingo area has the most commercial visitor services of any area in the park. Commercial services here include, or have included in the past, a restaurant; a marina with an adjoining gift shop; commercial boat tours; canoe, kayak, and bicycle rentals; and guest lodging. A commercial services plan for Flamingo was approved in 2008 and an environmental assessment evaluated the impacts of facility improvements at Flamingo. Although a decision document (Finding of No Significant Impact) was issued in 2008, several factors have required the National Park Service to reassess decisions regarding the nature of proposed development at Flamingo. These

factors include current and anticipated federal funding levels, improved under-standing of what would make a viable concessions contract at Flamingo, and the site's susceptibility to major storm events and sea level rise.

This reassessment led to issuance of a revised plan in 2012 to more accurately reflect implementation of portions of the *Flamingo Commercial Services Plan* that have not already been implemented.

Commercial Airboating in the East Everglades Addition. Currently, four commercial airboat businesses operate in the East Everglades Addition, largely independently, with little real oversight or guidance from the National Park Service. The park's 1991 Land Protection Plan determined that private ownership was inconsistent with the intent of the 1989 Expansion Act and ecosystem restoration efforts. Thus, acquisition of all private properties has been a priority since 1989. In 2012 Congress appropriated funds to acquire the remaining privately owned parcels in the East Everglades Addition, including the commercial airboat sites along Tamiami Trail. In addition to addressing real estate acquisition, any continuing commercial airboat operations must do so under terms of a new concessions contract, consistent with the 1989 Expansion Act provisions related to commercial airboating (see "Commercial Airboating" subsection under the "Special Mandates" section in chapter 1) and other applicable laws and policies. Information on recreational aspects of commercial airboating is included in the "Visitor Experience and Opportunities—Recreational Activities" section of this chapter.

Facilities and Infrastructure

Infrastructure at Everglades National Park includes a diverse set of facilities or assets, such as structures, roads, parking areas, picnic areas, utility and wastewater systems, maintained landscapes, campgrounds, and communication systems. Increased operational requirements, reduced funding, and lapsed staff positions have caused the staff to defer routine maintenance of some facilities. Deferred maintenance is work that should ideally have been done at specific times but was not, primarily due to budget constraints. Deferred maintenance often leads to costly repairs over time.

The National Park Service monitors deferred maintenance in park units using the Facility Management Software System. The National Park Service is striving to reduce the deferred maintenance backlog throughout the national park system by prioritizing and funding projects through various sources, including the Federal Lands Recreation Enhancement Act. The park updates information relating to the condition and importance of its assets daily in the facility management tracking system.

Structures. Everglades National Park staff members are responsible for maintaining about 157 buildings, 14 of which are historic. Examples include visitor centers, administrative buildings, ranger and visitor contact stations, maintenance shops, employee residences, and a marina. Additionally, the park maintains frontcountry and backcountry (e.g., chickees and associated restrooms) campsites throughout the park.

Some of the facilities in the park are outdated, obsolete, and/or are reaching the end of their useful life. The shortcomings of particular facilities are noted below.

- The Key Largo ranger station is a wood frame structure that is 80 years old and functionally obsolete.

- The Florida Bay Interagency Science Center is composed of three buildings (an office building, a leased wet lab, and a dormitory), which provide support for the science functions. The office building received extensive maintenance and rehabilitation in

2009–10 and is considered to be in good condition. The other two buildings are scheduled to be removed from the site, after two modular precast concrete buildings are in place.

- The South Florida Collections Management Center is in portions of the Daniel Beard Center and the Robertson Building. The former was built in the 1960s, and the latter was built in the 1950s. Neither was designed for museum collection preservation. The collections storage is currently substandard and inadequate in terms of its operational efficiency, size, and preservation standards, and the building lacks public spaces for the exhibition of the collection.

- The Shark Valley visitor contact station is undersized, outdated, and inefficient. It is scheduled for replacement in and will be relocated to the east end of the Shark Valley visitor complex.

- The Tamiami ranger station is old, in poor condition, and is not centrally located.

- The Gulf Coast visitor, concessions, and operation facilities are outdated, too small, energy inefficient, and generally at the end of their useful life, and they do not meet the flood or storm codes. The facilities' shortcomings and conditions cause operational inefficiencies and a near-continuous maintenance burden. There is an old waste disposal site that covers a large portion of the open grassy area north of the visitor center parking lot, which may limit flexibility regarding site improvements.

- East Everglades administrative and operational activities (e.g., ranger, fire, maintenance, etc.) operate out of adapted former residences within the East Everglades Addition. These structures are not well-suited to park operational uses, which leads to operational inefficiencies.

- The facilities at Chekika are sufficient as a visitor day use destination, although they would need to be updated for camping.

Roads. The park manages and maintains all road rights-of-way in the park. The primary vehicle travel corridor through Everglades National Park is the main park road. The main park road is an extension of State Highway 9336 (Ingraham Highway) that runs 38 miles from the park entrance to the Flamingo visitor area. It provides access to many park attractions, including interpretive trails, hiking trails, campgrounds, picnic areas, boat launches, and canoe trails. The other roads in the park are connector, special purpose, or administrative roads.

In the Pine Island district, the main park road provides access to sites such as the Ernest F. Coe Visitor Center, Pine Island, Long Pine Key, the Royal Palm Visitor Center, the Hidden Lake Education Center, and the Daniel Beard Center.

The Tamiami Trail (Highway 41), which provides access to the Shark Valley visitor contact station, is a federal highway just outside the park's north boundary. At Shark Valley, tram tours are available along the 15-mile tram loop, which is only accessible to trams, bicycle and foot traffic, and administrative vehicles.

The Chekika visitor area is accessible from SW 168th Street, which enters the park from Krome Avenue. These two former county roads, SW 168th Street and SW 237th Avenue, are now within the park as a result of the East Everglades Addition. These roads have not yet been turned over to Everglades National Park but are maintained by the park.

County roads provide access to the Gulf Coast Visitor Center from Tamiami Trail. These roads also continue to Chokoloskee, which has many facilities and attractions.

Hiking Trails. Everglades National Park includes more than a dozen hiking and interpretive trails, ranging in length from 0.5 mile to 15.0 miles. The main park road provides access to many short boardwalk hikes in the sawgrass prairie that expose visitors to the River of Grass ecosystem; some of these hikes include Anhinga Trail, Pa-hay-okee Overlook, and the Mahogany Hammock. The Flamingo area offers visitors the most options for hiking, with nine trails of varying difficulty and development. Of the Flamingo trails, the Coastal Prairie Trail is the most popular. The trails vary in terms of terrain, habitat, and interpretive opportunities. Although most trails are for hiking only, bicycles are permitted on some of the more developed trails in the park. The Pine Island and Flamingo districts offer the most hiking trails in the park, but Shark Valley and Chekika also have a couple of options. There are no hiking trails in the Gulf Coast district. During the wet season, access to hiking trails in the park may be limited in areas that become submerged.

Water Trails. In addition to hiking trails, there are many opportunities to explore the park's natural beauty in canoes and kayaks. Visitors can explore Florida Bay, Whitewater Bay, and Ten Thousand Islands by motorboat, canoe, or kayak. The Ten Thousand Islands are a labyrinth of water and mangroves. The islands harbor an abundance of life, and the shallows serve as nursery grounds for countless marine species. The islands also provide multiple opportunities for canoe and kayak trips (some jointly on Big Cypress National Preserve lands), including the Turner River, Halfway Creek, Sandfly Island, and East River canoe trails (NPS 2009d).

The Flamingo area has many water trails available to canoe and kayak users. These include the Hells Bay Canoe Trail, the Noble Hammock Canoe Trail, the West Lake Canoe Trail, the Mud Lake Canoe Trail, and the Bear Lake Canoe Trail. Flamingo also provides access to Florida Bay and Whitewater Bay. Both of these bays are popular destinations for motorboaters. Florida Bay has some boundary and channel/access route markings, and Whitewater Bay also has some minimal route markings.

The Wilderness Waterway is a 99-mile water trail that meanders through miles of backcountry from the Gulf Coast to Flamingo. There are numerous backcountry campsites along the waterway, and it provides ample opportunities for solitude and exploration of the park's backcountry waters. The waterway is open to motorboats, canoes, and kayaks, but some portions are designated as idle speed, no-wake areas. The waterway is minimally marked and can be difficult to navigate. Multiple paddle trails spur off the Wilderness Waterway.

Campgrounds and Campsites. The park's campgrounds and campsites are described below.

Frontcountry Camping— The Long Pine Key Campground is 7 miles from the main entrance, just off the main road. It has 108 drive-up sites for tents and RVs, including one group site. There are restrooms, water, and a sewer dump station with fresh water fill, but no showers or hookups. A picnic area is nearby, with fire grates and restrooms. A pond for fishing, an amphitheater for winter programs, and several hiking trails are also in the area (NPS 2009i).

Flamingo Campground— The Flamingo Campground is at the end of the main park road in Flamingo. It has 234 drive-in sites (55 with a view of the water), 3 walk-up group sites (on the water's edge), and 40 walk-up sites (9 on the water's edge). It also provides cold water showers, two dump stations, picnic tables, grills, and an amphitheater for winter programs. Electrical hookups were installed in the RV area (T-loop) in 2010. Flamingo has several hiking trails and canoe trails, and

opportunities for saltwater fishing are plentiful (NPS 2009f).

There is currently no camping permitted at Chekika; it is open as a seasonal, day use area only.

Backcountry Camping— Everglades National Park has nearly 50 backcountry campsites throughout the park, which include a variety of ground sites, beach sites, and elevated camping platforms (chickees). Backcountry sites generally consist of a chickee and primitive restroom. Most sites are accessible by canoe, kayak, or motorboat, though a few may be reached by hikers. None of the park's backcountry sites are available by car. Backcountry sites are concentrated mostly in the Ten Thousand Islands region and around Whitewater Bay. There are multiple campsites in Florida Bay and two off the Old Ingraham Highway, south of Royal Palm.

Boat Launches and Marina. There are three public motorboat launches in the park. There are two at Flamingo—one to enter the Buttonwood Canal and one to enter Florida Bay. The third launch at West Lake is for small boats (motors under 6 horsepower). There are public airboat launches (for use by eligible individuals only) at the Coopertown airboating facility and one just north of Chekika in the East Everglades Addition.

In addition to these launches, the park also has nonpublic launches at the Tamiami ranger station, Frog City, and Pine Island for airboats used by park rangers and researchers.

The marina at Flamingo is used by park staff, commercial boat tours, and the public. The marina at the Gulf Coast Visitor Center is used only by park staff and commercial boat tours and is not accessible to public vessels.

Accessible Facilities. The Ernest F. Coe Visitor Center has telephone headsets with volume control that provide audio description of an interpretive display. The theater displays the park's orientation film and other films with open captions. Assistive listening devices are available upon request for use in interpretive programs (NPS 2009g).

The Shark Valley and Gulf Coast visitor centers offer assistive listening devices on request for interpretive programs. The park's orientation film is also available with closed captions, upon request. Interpretive programs and visitor center displays, whenever possible, have been made accessible to visitors with limited hearing capacities (NPS 2009g).

The Ernest F. Coe, Royal Palm, Flamingo, Shark Valley, and Gulf Coast visitor centers are all wheelchair accessible via ramp or elevator. The parking lots at each of the visitor centers also contain accessible parking spaces that are clearly identified. Wheelchairs are available on loan on a first-come, first-served basis at Royal Palm, Flamingo, and Shark Valley visitor facilities (NPS 2009j).

The many wheelchair-accessible trails have a firm and stable surface (paved or boardwalk). The following are wheelchair accessible and less than 0.75 mile in distance:

- Anhinga Trail
- Gumbo Limbo Trail
- Pineland Trail
- Pa-hay-okee Overlook
- Mahogany Hammock Trail
- West Lake Trail
- Bobcat Hammock

Other trails at Long Pine Key and Flamingo used to be two-track roads. These may be muddy or passable depending on the season. The Long Pine Key and Flamingo frontcountry campgrounds both have accessible campsites. Each contains wheelchair accessible restrooms. The parking lot has clearly identified accessible parking spaces (NPS 2009j).

One backcountry site is accessible to visitors with mobility impairments—the Pearl Bay Chickee; this area is about a 4-hour canoe trip

away from the main park road. It features handrails, a canoe dock, and an accessible chemical toilet (NPS 2009j).

Many of the concession-led boat tours from Flamingo and the Gulf Coast Visitor Center are wheelchair accessible. The Shark Valley tram tour is accessible as well; trams contain a ramp for wheelchairs. The tour includes a stop at an observation tower with a steep ramp; it may be accessible with assistance (NPS 2009j).

The Ernest F. Coe Visitor Center, at the park entrance near Homestead, presents audio recordings of the Everglades environment. There are also various tactile opportunities to experience the wildlife displays. The restroom and theatre signs are available in Braille. The Flamingo Visitor Center contains a museum exhibit with both print and audio displays. The Shark Valley visitor contact station and Gulf Coast Visitor Center offer a touch table for tactile opportunities. The restroom signs are in Braille (NPS 2009m).

Operational Facilities. The park's main administrative offices are in the park headquarters, the Krome Center in Homestead, and Pine Island. The National Park Service owns all of the structures in the park with the exception of a building at Pine Island owned by the Everglades National Park Natural History Association. The main maintenance facility at the park is at Pine Island. There are maintenance facilities for the Gulf Coast (Everglades City), Tamiami (Northeast District), and Flamingo. There is also a maintenance storage building at Chekika in the East Everglades.

Climate Change. As mentioned earlier, park managers have been carefully considering, in the context of climate change, how to (and whether to) construct or upgrade visitor and operational facilities in flood-prone zones. Current projections for sea level rise during the life of this plan (20–30 years) do not exceed 7–9 inches, although rising sea levels could be exacerbated by storm surges. Sea level rise is not projected to be so severe that park facilities would become unusable, provided that new and replacement facilities continue to be planned and designed with climate change in mind. Examples include specifying hurricane-resistant structures, elevated structures, floating structures, temporary structures, mobile structures, and structures that can be disassembled and relocated.

IMPACT TOPICS ELIMINATED FROM DETAILED ANALYSIS IN THIS PLAN

AIR QUALITY

Everglades National Park enjoys a class I clean air status. Lands with this designation are subject to the most stringent regulations. Very limited increases in pollution are permitted in the vicinity. This high air quality is a valuable park resource, enhancing visitation by providing clean air and high visibility to match the unique ecosystem experience. The Clean Air Act of 1963 (42 USC 7401) requires federal land managers to protect air quality, and NPS *Management Policies 2006* direct air quality to be analyzed when planning park projects and activities. None of the actions described in this management plan would violate any air quality standard or result in a cumulative net increase of any criteria pollutant under federal or state ambient air quality standards. Implementation of any of the alternatives described in this management plan would have negligible effects on air quality, and the park's class I air quality would be unaffected.

FEDERAL SPECIAL STATUS SPECIES (SELECTED SPECIES)

The following federally threatened or endangered species were dismissed from detailed analysis: red-cockaded woodpecker, Cape Sable seaside sparrow, Audubon's crested caracara, Stock Island tree snail, Schaus swallowtail butterfly, crenulate lead-plant , Garber's spurge, and Johnson's seagrass. Please see table 10 in chapter 4, "Federal Special Status Species" subsection, for the reasons these species were dismissed. Information for retained and dismissed species was combined into this one table for ease of review by agencies having jurisdiction over these species.

NIGHT SKIES

In accordance with section 4.10 of NPS *Management Policies 2006*, the National Park Service strives to preserve natural lightscapes, which are natural resources and values that exist in the absence of human-caused light. At Everglades National Park, the National Park Service strives to limit the use of artificial outdoor lighting to that which is necessary for basic safety requirements, ensure that all outdoor lighting is shielded to the maximum extent possible, and keep light on the intended subject and out of the night sky. The actions proposed in the alternatives would not affect the existing exterior lighting of park developments, visitor centers, or parking areas.

More lighting would be used for localized facility upgrades within existing developed areas and in at least one new location. Impacts would be negligible to minor because the lights would be shielded, directed to keep light on the intended subject, and localized. As a result, light would not adversely affect the night sky elsewhere in the park.

PRIME AND UNIQUE FARMLANDS

Prime farmland has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops. Unique agricultural land is land other than prime farmland that is used for production of specific high-value food and fiber crops. Both categories require that the land is available for farming uses. Lands within the park are not available for farming and therefore do not meet the definitions.

FLOODPLAINS

Executive Order 11988 instructs federal agencies to avoid, to the extent possible, the long- and short-term, adverse impacts associated with the occupancy and modification of floodplains and wetlands, and to avoid direct or indirect support of development in floodplains and wetlands wherever there is a practicable alternative. Director's Order 77-2 (NPS 2002a) addresses development in floodplains.

Topography throughout the park is characterized by low elevation and broad areas of very low relief (less than 10 feet above sea level). This places the entire park within the 100-year floodplain. South Florida's canals, levees, and water control structures were created to manage and drain excess water from this vast floodplain during periods of high water. Water levels in the coastal canals are kept low during the wet season to allow for storage and conveyance of floodwaters. The canals and levees are managed to protect developed and agricultural areas surrounding the park from flooding and to control water elevations.

Since the establishment of Everglades National Park in 1947, the park's mission has been to preserve resources, including hydrologic conditions within the park and the south Florida ecosystem. Because the park, as a whole, lies in the 100-year floodplain, park facility development, rehabilitation, or reconstruction in the floodplain has been the only practicable alternative. Therefore, most park infrastructure and facilities are at risk of flooding during hurricanes or other major storms. For Everglades National Park, this means considering risk and protection of visitors, park staff, museum collections, concessioners, property, and essential infrastructure when making management decisions.

Floodplains have not been delineated for the park by the Federal Emergency Management Agency through the National Flood Insurance Program. Floodplains within the park have been altered over time and would experience no more than negligible adverse effects by the actions of the alternatives; actions taken in floodplains would be short-term and support long-term floodplain functions. In accordance with Executive Order 11988: "Floodplain Management" and Director's Order 77-2: *Floodplain Management*, a Floodplain Statement of Findings for the Gulf Coast development area (only) is included in appendix F of this document. Other infrastructure in the park exists in floodplains, but an assessment determined that there is no practicable alternative to leaving the infrastructure in place because nearly the entire park is in a floodplain. It was also determined that appropriate impact minimization efforts have been made, such as elevating structures on piers and implementing evacuation preparedness plans.

ENERGY EFFICIENCY AND CONSERVATION POTENTIAL

Under any alternative, the National Park Service would continue to implement its policies of reducing costs, eliminating waste, and conserving resources by using energy-efficient and cost-effective technology. The National Park Service would continue to look for energy-saving opportunities in all aspects of national park operations. Because the National Park Service would promote energy efficiency under any alternative, this impact topic was dismissed from further consideration in this document.

INDIAN TRUST RESOURCES

Secretarial Order 3175 requires that any anticipated impacts on Indian trust resources from a proposed project or action by Department of the Interior agencies be explicitly addressed in environmental documents. The federal Indian trust responsibility is a legally enforceable fiduciary obligation on the part of the United States to protect tribal lands, assets, resources, and treaty rights, and it represents a duty to carry

out the mandates of federal law with respect to American Indian and Alaska Native tribes.

None of the actions that might be implemented as a result of the plan alternatives would change any existing conditions or practices concerning American Indian treaty or statutory rights or cultural interests that the tribes traditionally associated with the park maintain in relation to the park. However, such recognition does not translate into the creation of a trust resource because these actions take place in the context of preserving and managing the resources for the benefit of all Americans as required by the Organic Act and subsequent legislation. There are no Indian trust resources as defined in the order in the park. Therefore, this topic was dismissed from further consideration.

ENVIRONMENTAL JUSTICE

Environmental justice is defined as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies (USEPA 1998). Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," tasks "each Federal agency [to] make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high adverse human health and environmental effects of its programs, policies, and activities on minority populations and low-income populations." The memorandum accompanying Executive Order 12898 identifies four important ways to consider environmental justice under the National Environmental Policy Act.

1. "Each Federal agency should analyze the environmental effects, including human health, economic, and social effects of Federal actions, including effects on minority populations, low-income populations, and Indian tribes, when such analysis is required by the National Environmental Policy Act.
2. Mitigation measures identified as part of a NEPA assessment or a "Record of Decision" (ROD), should, whenever feasible, address significant and adverse environmental effects of proposed federal actions on minority populations, low-income populations, and Indian tribes.
3. Each Federal agency must provide opportunities for effective community participation in the NEPA process, including identifying potential effects and mitigation in consultation with affected communities and improving the accessibility of public meetings, crucial documents, and notices.
4. Review of NEPA compliance (such as EPA's review under section 309 of the Clean Air Act) must ensure that the lead agency preparing NEPA analyses has appropriately analyzed environmental effects on minority populations, low-income populations, or Indian tribes, including human health, social, and economic effects."

In addition, Executive Order 13175, "Consultation and Coordination with Indian Tribal Governments," directs federal agencies to (1) establish regular and meaningful consultation and collaboration with Indian tribal officials in the development of federal policies that have tribal implications; (2) strengthen federal government-to-government relation-ships with Indian tribes; and (3) reduce the imposition of unfunded mandates upon Indian tribes.

Addressing environmental justice concerns begins with the effective community participation in the NEPA process. Throughout the planning process, the park staff and planning team actively solicited public participation as part of the planning process; prepared and distributed multiple newsletters; met with various interest groups; and gave equal consideration to input from all persons regardless of age, race, income status, or other socioeconomic or demographic factors.

Consideration of environmental justice concerns continues with a determination of the existence of potentially affected publics in proximity to a federally proposed action. If a potentially affected population is identified, the assessment focuses on whether the action would result in disproportionately high and adverse impacts. In the case of the park, an analysis of demographic and income data from the 2000 Census indicates that the prevalence of racial and ethnic minorities in Collier and Monroe counties, as well as individuals below the poverty thresholds, was generally comparable to the statewide averages. The share of minority and low-income residents in areas closest to the park, for example Everglades City, was below the statewide averages. As a result, the planning team concluded that a potentially affected population for environmental justice concerns is not present in those two counties.

The percentages of non-Indian racial and ethnic minorities and individuals in poverty in the Miami-Fort Lauderdale Consolidated Metropolitan Statistical Area were higher than for Florida as a whole, satisfying the threshold for a potentially affected environmental justice population. However, no residential areas of concentrated low-income and non-Indian minority populations are adjacent to or near the park. That fact, combined with the lack of boundary adjustments or establishment of major new road access to the park, again resulted in the conclusion that a potentially affected population for environmental justice concerns is not present with respect to this plan.

Under the two executive orders cited above, federally recognized Indian tribes and reservations close to federally managed lands automatically have status as a potentially affected population. There are no tribally owned lands or mineral resources, or lands or minerals held in trust for Indian tribes by the federal government within the park. However, the Tamiami Trail Reservation Area (Miccosukee Reserved Area), one of three reservations of the Miccosukee Tribe of Indians of Florida, is adjacent to the park, just west of Shark Valley. The Tamiami Trail Reservation Area, currently the site of most tribal operations, a tribal cultural center, and the homes of many tribal members (Miccosukee Tribe 2010). The Krome Avenue Reservation Area is northeast of the park, at the intersection of Krome Avenue and Tamiami Trail. This reservation is the site of the Casino at Miccosukee Resort and Gaming Center and the Miccosukee Tobacco Shop.

Park management and staff engage in an ongoing government-to-government consultation effort with the Miccosukee Tribe. This effort provides opportunities to address issues of concern to either party, including those that might fall within the scope of environmental justice. None of the alternatives propose boundary adjustments, major changes in road access, or other actions that could result in disproportionately higher and adverse effects on human health or environmental effects on the Miccosukee Tribe or individual members, although some effects on traditional use might occur due to changes in management in the East Everglades (see the "Cultural Resources" section).

Based on the conclusions presented above, environmental justice was dismissed as an impact topic receiving detailed analysis in "Chapter 4: Environmental Consequences."

ECOLOGICALLY CRITICAL AREAS, WILD AND SCENIC RIVERS, OTHER UNIQUE NATURAL AREAS

Everglades National Park is by its very nature both an ecologically critical area and a unique natural area. Impacts to the park and its resources are discussed in detail in the various impact topics included in chapter 5, so this topic is not discussed as a separate topic.

There are no wild and scenic river designations within the national park. Therefore, this topic was dismissed from detailed analysis.

CARBON FOOTPRINT

For the purpose of this planning effort, "carbon footprint" is defined as the sum of all emissions of carbon dioxide and other greenhouse gases (e.g., methane and ozone) that would result from implementation of the action alternatives. Understanding the carbon footprint of each alternative is important for determining its contribution to climate change.

It has been determined that the action alternatives described in this document would emit only a negligible amount of greenhouse gases that contribute to climate change; therefore, this impact topic has been dismissed from detailed analysis in this document. The reasons for dismissing this impact topic are that (1) no new road construction is proposed under any alternative, and (2) changes to facilities are largely in-kind and should have an overall benefit due to newer sustainable building practices. Because of the negligible amount of greenhouse gas emissions that would result from each alternative, a quantitative measurement of their carbon footprint was determined by the planning team not to be practicable.

CONFORMITY WITH LAND USE PLANS

The actions included in this document are compatible and not in conflict with local land use plans because the project seeks to restore environmental conditions and improve the quality of life and recreational access in the park. Therefore this topic was not analyzed in detail in this document.

PUBLIC HEALTH AND SAFETY

The proposed developments and actions in the alternatives would not result in any identifiable adverse impacts on human health or safety. Therefore this topic was dismissed from further analysis.