Chapter 3: Affected Environment and Environmental Consequences

This chapter analyzes the environmental impacts that would occur as a result of implementing the alternatives for the proposed project. Topics analyzed in this chapter include air quality, soils, hydrology and water quality, vegetation, wildlife and their habitats, special status species and their habitats, cultural resources, wilderness character, visitor use and experience, land use, and park operations.

GENERAL ANALYSIS METHODS

Effects were evaluated for each retained impact topic in terms of type, context, duration, and intensity. Type describes whether impacts are beneficial or adverse:

- *Beneficial*: A positive change in the condition or appearance of the resource or a change that moves the resource toward a desired condition.
- *Adverse*: A change that moves the resource away from a desired condition or detracts from its appearance or condition.
- *Direct*: An effect caused by an action and occurs in the same time and place.
- *Indirect*: An effect caused by an action but is later in time or farther removed in distance, but is still reasonably foreseeable.

Context describes the area or location in which the impact will occur, such as site-specific, local, regional, or even broader. The methods description for each impact topic identifies the geographic area considered. The geographic area analyzed differs by impact topic analyzed is therefore defined within each section.

Duration describes the length of time an effect will occur, either short-term or long-term. The definition of short-term and long-term impacts differs by impact topic analyzed is therefore defined within each section.

Intensity describes the degree, level, or strength of an impact. For this analysis, intensity was categorized into negligible, minor, moderate, and major. Intensity definitions are provided for each impact topic analyzed in this environmental assessment.

Under Alternatives A and B, the boundaries of the four FMUs are the same. See Figures 4 and 16.

CUMULATIVE EFFECTS ANALYSIS METHOD

The Council on Environmental Quality (1978) regulations for implementing the National Environmental Policy Act requires the assessment of cumulative impacts in the decision-making process for federal actions. Cumulative impact "is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions" (Title 40, *Code of Federal Regulations,* Part 1508.7). Cumulative impacts were considered for both the no action and action alternative.

Cumulative impacts were determined by combining the impacts of each alternative with other past, present, and reasonably foreseeable future actions. Therefore, it was necessary to identify other past, ongoing, and reasonably foreseeable future actions in Everglades National Park and the surrounding region. Other actions with the potential to have a cumulative effect in conjunction with the fire management plan alternatives were identified in Chapter 1: Purpose and Need for Action under the heading "Relationship to Other Plans and Policies."

Only plans and projects that would have effects on the resource being evaluated are considered in the assessment of cumulative effects for each respective impact topic. The cumulative effects analysis for both alternatives evaluates the effects of the other plans and projects on that particular resource, adds the effects identified by the management alternative, and then identifies the total cumulative effect, including the degree the management alternative contributes to the overall cumulative effect.

CLIMATE CHANGE AND SEA LEVEL RISE

Climate change and the resulting sea level rise are affecting all of South Florida, especially low-lying areas. For the past 2,500 years, South Florida has experienced an average rate or relative sea level rise of about 1.5 inches per century (Miami-Dade CCATF 2008). This gradual sea level rise allowed for areas to stabilize and expand with the rising sea level. Since 1932, relative sea level rise has increased six-fold due to regional changes in the density and circulation of North Atlantic shallow and deep waters (Wanless and Vlaswinkel 2005).

The 2001 report of the United Nations sponsored Intergovernmental Panel on Climate Change projected an additional sea level rise over the coming century of one to three feet (median sea level rise of two feet) (Miami-Dade CCATF 2008). The 2007 Intergovernmental Panel on Climate Change report projected a somewhat lower level, but it did not incorporate the substantially accelerated melting being observed in the Greenland Ice Sheet (Miami-Dade CCATF 2008). Recent changes occurring in the Arctic Ocean and Greenland mean that global warming and sea level rise would happen much more rapidly than recently projected (Miami-Dade CCATF 2008). Recent model projections of future ice melt for Greenland by 2040 have already occurred (Miami-Dade CCATF 2008). As a result, the Intergovernmental Panel on Climate Change report underestimates the amount of sea level rise likely to occur in this century (Miami-Dade CCATF 2008).

In the Antarctic, there is no inherent reason why the impacts of global warming should follow the pattern of the Arctic Ocean (Miami-Dade CCATF 2008). Nevertheless, there was a gradual loss of pack ice through the last half of the twentieth century, but a slight expansion in the past decade (as anticipated by climate models); about a 12 percent increase in the flow rate of 300 glaciers around the margin of Antarctica between 1993 and 2003; and a substantial increase in summer snow melt in both marginal and interior areas of the ice sheet since 2005 (Miami-Dade CCATF 2008). Antarctica is a critical unknown to future projections; however, it is showing distinctive early signatures of accelerated ice release (Miami-Dade CCATF 2008).

The *Second Report and Initial Recommendations* published by the Miami-Dade Climate Change Advisory Task Force states that global warming would result in many changes to the natural environment, "including changing atmospheric circulation and temperature patterns, changes in rainfall and severe weather, changes in biologic community distribution, increased extinction rates, changes in disease and pest distribution, and changes in sea level" (Miami-Dade CCATF 2008). While all these environmental impacts would affect South Florida and Everglades National Park within the next century, the key concern would be rising sea level, "with a very high likelihood" that the sea level would rise an additional 1.5 feet in the next 50 years and a cumulative total of three to five feet within a century (Miami-Dade CCATF 2008).

While slowing the rate of sea level rise is beyond the resources of the park, monitoring sea level change and evaluating and predicting impacts on the park's landscape is a valid management issue. Freshwater marshes and brackish estuaries are under constant threat of inundation by the sea. Given the low relief of the park, this rise would significantly alter much of the marsh landscape protected at the park.

The Intergovernmental Panel on Climate Change is considered the foremost authority for climate change worldwide. The Intergovernmental Panel on Climate Change is a scientific intergovernmental body set up by the World Meteorological Organization and the United Nations Environment Programme to "provide the decision-makers and other interested in climate change with an objective source of information about climate change" (IPCC 2009). "The Intergovernmental Panel on Climate Change does not conduct any research nor does it monitor climate related data or parameters. Its role is to assess on a comprehensive, objective, open, and transparent basis the latest scientific, technical and socio-economic literature produced worldwide relevant to the

understanding of the risk of human-induced climate change, its observed and projected impacts and options for adaptation and motivation" (IPCC 2009).

Locally, the Miami-Dade County Climate Change Advisory Task Force was established in 2006 with the charge of identifying potential future climate change impacts to Miami-Dade County and providing ongoing recommendations regarding mitigation and adaptation measures to respond to climate change (Miami-Dade County 2009). The Climate Change Advisory Task Force's 25 appointed members represent a diverse, multidisciplinary and highly knowledgeable group of individuals, including the Superintendent of Everglades National Park (Miami-Dade County 2009). Since Everglades National park is located largely within Miami-Dade County, the advice of the Climate Change Advisory Task Force applies to the park's resources.

A two-foot sea level rise by the end of the century, as projected in the 2001 Intergovernmental Panel on Climate Change report, would drastically change the landscape of South Florida and Everglades National park (Miami-Dade CCATF 2008). Spring high tides would be +4.5 to 5 feet above present mean sea level; storm surges would be higher; barrier islands, fill islands, and low-lying mainland areas would be frequently flooded; salt water intrusion would restrict available freshwater resources; and drainage would be more sluggish (Miami-Dade CCATF 2008). Based on the Miami-Dade County Climate Change Advisory Task Force 2008 report, it is anticipated that sea level within the next century would rise substantially more than the Intergovernmental Panel on Climate Change's projected two feet. Many respected scientists, as documented in the Climate Change Advisory Task Force's 2008 report, now see a likely sea level rise of at least 1.5 feet in the next 50 years and a total of at least three to five feet by the end of the century, with the potential for a larger rise. With this scenario, spring high tides would be at +6 to +8 feet (Miami-Dade CCATF 2008). This estimate also does not take into account the possibility of a catastrophically rapid melt of land-bound ice from Greenland, and it makes no assumptions about Antarctica (Miami-Dade CCATF 2008). The Intergovernmental Panel on Climate Change revised estimates are being prepared; therefore, current estimates must be taken into account in the analysis of the fire management plan alternatives.

It is important to note that climate change and sea level rise research is not an exact science and there is not a complete consensus on the estimates, as shown in the two Intergovernmental Panel on Climate Change reports and the Miami-Dade County Climate Change Advisory Task Force report referenced above. The lack of qualitative information about climate change effects adds to the difficulty of predicting how these impacts will be realized in the park; for example, mangrove forests may be affected by sea level rise, and storm frequency and intensity may affect cultural resources and visitor amenities. However, alternatives that improve natural resource conditions more, particularly hazardous fuel management (Alternative B), would be expected to provide greater beneficial impacts than those that improve natural resource conditions to a lesser degree. The range of variability in the potential effects of climate change is large in comparison to what is known about the future under an altered climate regime in the park in particular, even if larger-scale climatic patterns are accurately predicted for the Atlantic Coast. Therefore, the potential effects of this dynamic climate on park resources were included in the affected environment section of this chapter. However, these effects are not analyzed in detail in the environmental consequences section under each alternative because of the uncertainty and variability of outcomes within the five-year planning horizon of this environmental assessment and because these impacts are not expected to differ among the alternatives.

REGULATIONS AND POLICIES

Laws, regulations, and policies create a framework for managing resources in Everglades National Park. These also help clarify why a particular impact topic is important to discuss, or help support the reasoning for impact threshold definitions. Laws, regulations, executive orders, policies, and guidance that were considered with regard to implementing a new fire management plan include, but are not limited to, the following.

- Archeological and Historic Preservation Act
- Archeological Resources Protection Act
- Bald and Golden Eagle Protection Act
- Clean Water Act
- Endangered Species Act
- Migratory Bird Treaty Act
- National Environmental Policy Act
- National Historic Preservation Act
- Organic Act
- Executive Order 11593, Protection and Enhancement of the Cultural Environment
- Executive Order 11988, Floodplain Management
- Executive Order 11990, Protection of Wetlands
- Programmatic Memorandum of Agreement among the National Park Service, Advisory Council on Historic Preservation, and National Council of State Historic Preservation Officers (2008)
- Standards regarding archeology and historic preservation, treatment of historic properties, and cultural landscapes (Secretary of the Interior 1983, 1995a, and 1995b).
- NPS Management Policies 2006 (NPS 2006a)
- NPS-28: Cultural Resource Management Guideline (NPS 1998c)
- Director's Order #41: Wilderness Stewardship (NPS 2011b)
- Director's Order #77-1: Wetlands Protection (NPS 2002b, 2011d)
- Director's Order #77-2: Floodplain Management (NPS 2003a)
- Wilderness Act
- National Wilderness Steering Committee, Guidance White Paper Number 2
- National Parks and Recreation Act of 1978 - Public Law 95-625

AIR QUALITY

AFFECTED ENVIRONMENT

Air quality in Everglades National Park is affected by nearby large metropolitan areas (Miami), agricultural practices (burning of fields), power plants, and industry. Prevailing winds from the east carry dust and emissions from the Miami metropolitan area into the park and occasionally affect air quality and visibility. Air quality in Everglades National Park is regulated under the Clean Air Act, Section 590.125 of the Florida Statues, and Section 51-2.006 of the Florida Administrative Code.

Within the Clean Air Act, Congress addressed the need to protect and enhance the quality of the nation's air resources and deal with dangers that air pollution presents to public health and welfare. Most of the nation is identified as class II with regard to air quality protection and enhancement. However, national parks greater than 6,000 acres existing before 1977 were automatically designated as class I, which conveys the highest level of protection and allows very little deterioration of air quality. Everglades National Park is a class I air quality area.

Under the Clean Air Act, the U.S. Environmental Protection Agency established federal standards for pollutants from stationary and mobile sources. Goals include preventing significant deterioration in areas where air quality exceeds national standards, and improving air quality in areas that do not meet standards (known as nonattainment areas).

Federal land managers have an affirmative responsibility to protect the air quality related values of lands in class I areas and to consider whether any proposed major emitting facility within or outside the area would have an adverse impact on such values. As defined by the Federal Land Managers' Air Quality Related Values Workgroup (2008), an air quality related value is "A resource … that may be adversely affected by a change in air quality. The resource may include visibility or a specific scenic, cultural, physical, biological, ecological, or recreational resource … for a particular area."

National Ambient Air Quality Standards

The Clean Air Act requires the U.S. Environmental Protection Agency to set National Ambient Air Quality Standards for pollutants considered harmful to public health and the environment. The Clean Air Act established two types of national air quality standards: primary and secondary. Primary standards set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly. Secondary standards set limits to protect public welfare, including protection against decreased visibility, and damage to animals, crops, vegetation, and buildings. Standards were set for six principal pollutants, called "criteria" pollutants. These standards, most recently updated in 2010 (USEPA 2010), are shown in Table 10.

Table 10: National Ambient Air Quality Standards [a/]

Pollutant	Primary Standards		Secondary Standards	
	Level	Averaging Time	Level	Averaging Time
Carbon monoxide	9 ppm (10 mg/m^3) [b/]	8-hour [c/]	None	
	35 ppm (40 mg/m^3)	1-hour [c/]		
Lead	0.15 µg/m^3 [d/]	Rolling 3-month average	Same as primary	
	1.5 µg/m^3	Quarterly average		
Nitrogen dioxide	53 ppb [e/]	Annual (arithmetic average)	Same as primary	
	100 ppb	1-hour [f/]	None	
Ozone	0.075 ppm (2008 standard)	8-hour [j/]	Same as primary	
	0.08 ppm (1997 standard)	8-hour [k/]		
	0.12 ppm	1-hour [l/]		
Particulate matter (10 microns or less)	150 µg/m^3	24-hour [g/]	Same as primary	
Particulate matter (2.5 microns or less)	15.0 µg/m^3	Annual (arithmetic average) [h/]	Same as primary	
	35 µg/m^3	24-hour [i/]		
Sulfur dioxide	0.03 ppm	Annual (arithmetic average)	0.5 ppm	3-hour [c/]
	0.14 ppm	24-hour [c/]		

a/ Source: U.S. Environmental Protection Agency 2010 (available at: http://www.epa.gov/air/criteria.html).
b/ m^3 = cubic meter. mg = milligram. ppb = parts per billion. ppm = parts per million. µg = microgram.
c/ Not to be exceeded more than once per year.
d/ Final rule signed October 15, 2008.
e/ The official level of the annual nitrogen dioxide standard is 0.053 ppm, equal to 53 ppb, which is shown here for the purpose of clearer comparison to the 1-hour standard.
f/ To attain this standard, the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 0.100 ppm (effective January 22, 2010).
g/ Not to be exceeded more than once per year on average over 3 years.
h/ To attain this standard, the 3-year average of the weighted annual mean concentrations for particulate matter (2.5 microns or less) from single or multiple community-oriented monitors must not exceed 15.0 µg/m^3.
i/ To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 µg/m^3 (effective December 17, 2006).
j/ To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.075 ppm (effective May 27, 2008).
k/ (a) To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm.
(b) The 1997 standard, and the implementation rules for that standard, will remain in place for implementation purposes as U.S. Environmental Protection Agency undertakes rulemaking to address the transition from the 1997 ozone standard to the 2008 ozone standard.
(c) The U.S. Environmental Protection Agency is in the process of reconsidering these standards (set in March 2008).
l/ (a) The U.S. Environmental Protection Agency revoked the 1-hour ozone standard in all areas, although some areas have continuing obligations under that standard ("anti-backsliding").
(b) The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is < 1.

Air Quality Index

As shown in Table 10, the National Ambient Air Quality Standards are technically complex and some are based on long-term annual, quarterly, or rolling averages. To provide timely reporting of air pollution that could pose a risk to human health and to facilitate citizen comprehension, the U.S. Environmental Protection Agency developed the Air Quality Index. The Air Quality Index is reported daily, and focuses on health effects people may experience within a few hours or days after breathing polluted air (USEPA 2009a).

The Air Quality Index includes five of the six criteria pollutants addressed by the National Ambient Air Quality Standards. These include carbon monoxide, nitrogen dioxide, ground-level ozone,

particulate matter, and sulfur dioxide. Lead is not included because rules implemented in the early 1990s forbid the use of lead in automobile gasoline and thereby reduced lead concentrations in outdoor air by 94 percent between 2007 and 1980. As a result, lead emissions usually do not pose a human health risk except near industrial sources such as metals processers, waste incinerators, and glass and cement manufacturers (USEPA 2008). Within the vicinity of Everglades National Park, there are fossil fuel power plants and waste incinerators.

The Air Quality Index scale runs from 0 to 500. A value of 100 generally corresponds to the National Ambient Air Quality Standard for the pollutant, which is set to protect public health. The higher the index value, the greater the level of air pollution and health concern, specifically:

- "Good" is an index value of 0 - 50. Air quality is satisfactory and air pollution poses little or no risk.
- "Moderate" is an index value of 51 - 100. Air quality is acceptable, but one or more pollutants could pose a moderate health concern for a very small number of people.
- "Unhealthy for Sensitive Groups" is an index value of 101 - 150. Although the general public is not likely to be affected, people with lung disease, older adults, and children may experience adverse health effects.
- "Unhealthy" is an index value of 151 - 200. Everyone may begin to experience some adverse health effects, and members of sensitive groups may experience more serious effects.
- "Very Unhealthy" is an index value of 21 - 300. This would trigger a health alert signifying that everyone may experience more serious health effects.
- "Hazardous" is an index value greater than 300. This would trigger health warnings of emergency conditions. The entire population is more likely to be affected (USEPA 2009a and 2009b).

Air quality monitoring values are converted into separate index values for each of the five pollutants. The highest index value among the five is reported as the index value for that day. For example, if a community's Air Quality Index is 130 for ozone and 101 for particulate matter, the value for that day would be announced as 130 for ozone (USEPA 2009a).

The scale for each pollutant is not linear. Thus, an index value of 100 does not indicate twice the pollution of a value of 50, nor does it mean twice as harmful. Pollutant concentrations that correspond to each Air Quality Index category are provided in Technical Assistance Document for the Reporting of Daily Air Quality – the Air Quality Index (USEPA 2009b).

Florida Regulations

The regulation of polluting emissions in Florida occurs primarily through the state implementation plan administered by the Florida Department of Environmental Protection. The state implementation plan is not a discrete document, but instead is a compilation of state regulations, orders, and otherwise enforceable commitments the state uses to ensure compliance with the Clean Air Act.

Open burning, including prescribed burning, is regulated under Section 590.125 of the Florida Statutes. Under state law, the Florida Department of Agriculture and Consumer Services, Florida Forest Service "owns" all fires in the state. Air quality is regulated through their authorization of open burns. As part of the authorization process described in Section 5I-2.006 of the Florida Administrative Code, the applicant must provide a written burn plan or prescription that, among other features, evaluates the anticipated impact of the proposed burn on pertinent smoke-sensitive

areas. An applicant who fulfills the authorization requirements is not liable for damage or injury caused by the fire or resulting smoke unless gross negligence is proven.

Federal facilities, including Everglades National Park, are required to comply with air quality standards to the same extent as nongovernmental entities. This includes meeting all Section 590.125 requirements, including obtaining Florida Forest Service authorization for burns in the park.

Air Quality at Everglades National Park

According to current data on the U.S. Environmental Protection Agency's AirData interactive web site, all counties in Florida, including those in Everglades National Park, are an attainment area for all six criteria pollutants. Everglades National Park lies in portions of Miami-Dade, Monroe, and Collier counties.

The U.S. Environmental Protection Agency calculates a daily Air Quality Index value for Collier and Miami-Dade Counties, based on readings from air quality monitors. Table 11 is the Air Quality Index summary for Collier and Miami-Dade Counties, Florida, showing data from 2003 through 2007. Within Collier and Miami-Dade counties, the majority of days are rated as achieving "good" air quality. Miami-Dade County has more days rated as "moderate" or "unhealthy" than Collier County, but the majority of the time, the air quality index in Miami-Dade County is considered "good." The primary contaminant in Collier County is ground level ozone. Primary contaminants in Miami-Dade County are carbon monoxide, particulates, and ground-level ozone.

Everglades National Park is a designated class I area under the Clean Air Act. Miami-Dade, Monroe, and Collier Counties are all in attainment of ambient air quality standards, with Miami-Dade County classified as an attainment/maintenance area for ozone. Much of the park experiences very little air pollution due to the remote wilderness nature of the majority of the park. Visibility is occasionally diminished by high humidity and salty sea mist in the coastal areas due to the climate. Local sources of pollution are generated by vehicle and motorboat emissions in the park's developed areas and marinas, and vehicles used for park management activities. Visibility and air quality are also affected periodically from unplanned and prescribed fires (planned ignitions) within the park. Everglades National Park coordinates prescribed burning activities through the Florida Forest Service to minimize air quality effects and ensure compliance with state air quality regulations.

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

Table 11: Air Quality Index Summary for Collier and Miami-Dade Counties, Florida, 2006 through 2010[a/]

Parameter	2006	2007	2008	2009	2010
Collier County days of data	365	365	360	365	365
Maximum Air Quality Index value	101	120	100	74	82
Days rated "good"	319 (87%)	309 (85%)	331 (92%)	344 (94%)	350 (96%)
Days rated "moderate"	45 (12%)	55 (15%)	29 (8%)	21 (6%)	15 (4)
Days above "moderate"	1 (<1%)	1 (<1%)	0	0	0
Determining pollutant: days (%)					
Carbon monoxide	0	0	0	0	0
Nitrogen dioxide	0	0	0	0	0
Particulate matter ($PM_{2.5}$ + PM_{10})	148 (41%)	121 (33%)	108 (30%)	233 (64%)	134 (37%)
Ground-level ozone	217 (59%)	244 (67%)	252 (70%)	132 (36%)	231 (63%)
Sulfur dioxide	0	0	0	0	0
Miami-Dade County days of data	365	366	365	365	365
Maximum Air Quality Index value	161	111	147	101	124
Days rated "good"	261 (72%)	286 (78%)	312 (85%)	324 (89%)	327 (90%)
Days rated "moderate"	98 (27%)	75 (21%)	49 (13%)	40 (11%)	36 (10%)
Days rated "unhealthy for sensitive groups"	5 (1%)	4 (1%)	5 (1%)	1 (<1%)	2 (<1%)
Days above "unhealthy for sensitive groups"	1 (<1%)	0	0	0	0
Determining pollutant: days (%)					
Carbon monoxide	0	0	0	0	0
Nitrogen dioxide	11 (3%)	10 (3%)	13 (4%)	8 (2%)	23 (6%)
Particulate matter ($PM_{2.5}$ + PM_{10})	217 (59%)	204 (56%)	202 (55%)	179 (49%)	164 (45%)
Ground-level ozone	137 (38%)	151 (41%)	151 (41%)	178 (49%)	178 (49%
Sulfur dioxide	0	0	0	0	0

a/ Source: Information extracted from the Internet at <http://www.epa.gov/airdata/ad_rep_aqi.html> http://epa.gov/air/data/geosel.html>.

Air quality impacts from unplanned wildfires are distinguished from air quality impacts from prescribed fires because emissions from these two sources in the past were treated separately under the Clean Air Act and state fire regulations (Sandberg et al. 2002). The primary air pollutant from wildfire and prescribed fire is smoke. Prescribed fires in Everglades National Park are designed so that smoke does not move into sensitive areas (including populated areas near Miami). Wildfire may occur at a time when winds could move smoke into populated areas. During large wildfires, nearby air-quality monitoring stations may be turned off, and the data are not included in daily emissions counts.

Smoke contains particulate matter, both PM_{10} and $PM_{2.5}$. It is difficult to measure the effects of smoke on a community, because particulate standards are based on 24-hour and annual average, and smoke plumes may degrade air quality for only a few hours or large wildfires may have smoke plumes that persist for several days or as long as the fire is active. In addition to particulate matter, globally, fires are a significant contributor of carbon dioxide and other greenhouse gasses in the atmosphere (Sandberg et al. 2002), but gas emission are highly dependent on fuel conditions (stage of decomposition, moisture content, and physical arrangement), fire conditions (fire type, fire intensity,

fire severity, and ignition technique), and weather conditions (wind speed and relative humidity during a fire and drying conditions before a fire).

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

Climate Change Effects on Air Quality

Climate change and air quality are closely coupled. Due to climate change, there may be a decline in air quality in cities through changes in dispersion rates of pollutants, the production of ozone and particle pollution, and the strength of emissions from the biosphere, fires, and dust. Alternations in hydrology and vegetation communities, in conjunction with more severe droughts, could alter local air quality through increased dust and more intense and severe fires releasing more particulates and carbon dioxide.

ENVIRONMENTAL CONSEQUENCES

Impact Analysis Methods

This section describes the probable and possible impacts of the alternative actions on the air quality that may occur in Everglades National Park.

Air quality was analyzed for each alternative based on the effects of fire in Everglades National Park. Available information on air quality was evaluated and determined qualitatively based on the professional judgment of NPS staff and consultants, and consideration of park purpose and significance.

The analysis area includes the immediate locations where fire management actions would take place and the surrounding environment where air pollutants may accumulate. For this analysis, treatment activities may occur anywhere in the land areas within the park boundary. Any air quality impacts that originate in the parks and extend to the surrounding regional environment are also addressed.

It is assumed that mitigation measures described in chapter 2 of this environmental assessment would be implemented under the action alternative in accordance with the park's fire management plan. These mitigation measures are intended to minimize impacts of the action alternative on air quality.

Impacts on air quality were evaluated using the process described in "Methods for Analyzing Impacts." Impact threshold definitions are as follows.

Thresholds

Threshold	Definition
Negligible	Impacts would not be detectable or measurable. Visibility would not be affected.
Minor	Impacts would be measurable, but air quality parameters would be within all Class I criteria. Visibility would be within the range of historical conditions.
Moderate	Changes in air quality would be readily apparent, but Class I parameters would be met, with only occasional exceedances. Air quality would be outside historic baselines on a limited basis. Mitigation would be necessary to offset adverse effects and would likely be successful.
Major	Changes in air quality would be readily measurable, and some Class I parameters would be equaled or exceeded for extended periods of time. Extensive mitigation measures would be necessary, and their success would not be assured.
Short-term	Air quality would recover in 7 days or less following the action.
Long-term	Air quality recovery would take more than 7 days following the action.
Imperceptible	The incremental effect contributed by the alternative to the overall cumulative impact is such a small increment that it is impossible or extremely difficult to discern.
Noticeable	The incremental effect contributed by the alternative, while evident and observable, is still relatively small in proportion to the overall cumulative impact.
Appreciable	The incremental effect contributed by the alternative constitutes a large portion of the overall cumulative impact.

ALTERNATIVE A: NO ACTION / CONTINUE CURRENT MANAGEMENT

Impact Analysis

Everglades National Park would continue to coordinate prescribed fire (planned ignition) activities under current management practices operating under the most recent Federal Wildland Fire and National Park Service policies and the existing 1995 fire management plan. The park would continue to work in cooperation with the Florida Forest Service, and would adhere to the requirements of Florida's Prescribed Burning Act.

Under Alternative A, prescribed fire treatments would be planned on an annual basis for hazardous fuel reduction (only allowed outside of designated wilderness; capped at 4.500 acres annually) and exotic vegetation management. Prior to the execution of a prescribed fire, a written burn plan or prescription would be developed that includes such information as a site description and map, the personnel and equipment that would be used, desirable weather conditions, desired fire behavior factors, and emergency protocol (Brenner and Wade 2003). This information would help guarantee that appropriate conditions exist during the implementation of a prescribed fire, which would reduce the likelihood for higher emission amounts and for smoke to migrate to untreated areas. If the prevailing winds were from the west, prescribed fires would be carefully evaluated to consider smoke dispersal. As a result, the effects on air quality from prescribed fire would be short-term, minor, and adverse.

Under Alternative A, a variety of fire management strategies would be available to manage unplanned wildfires, including full suppression, point/zone protection, and monitor/confine/contain. Management of wildfire could affect air quality and visibility in the park and within urban areas depending on location and wind conditions. The effects of wildfire managed with more aggressive suppression strategies would be short- to long-term minor and adverse with the potential for moderate impacts if winds were from the west.

Wildland fire management actions require the use of mechanical equipment (including chain saws, trucks, airboats, off-road vehicles, helicopters, and fixed-wing aircraft for example), which could result in exhaust emissions that may include nitrogen oxides and sulfur dioxides, which are criteria

pollutants. However, these emissions would be intermittent and short-term, lasting only for the duration of fire events and fire management activities. Emissions from the use of mechanical equipment would be small relative to the emissions generated by large wildland or prescribed fires. Due to the temporary and minimal use of equipment, impacts from their use would be short-term negligible and adverse and would have no influence on Miami-Dade County's maintenance status for ozone or attainment status in Collier County.

Unplanned wildfires and prescribed fire would generate smoke and ash, as particulate matter which is a criteria pollutant for which ambient air quality standards are regulated. Impacts on air quality from the generation of smoke under Alternative A would be short-term negligible to moderate (depending on the extent of the fire) and adverse. However, fire management within the park under Alternative A would ultimately reduce the threat of intense or severe future wildfires and result in long-term beneficial effects to air quality.

Smoke from fires used to control exotic vegetation could reduce visibility in the immediate area and be noticeable from surrounding areas, but the resulting adverse impacts would only persist during and immediately following any prescribed fire and would therefore be short-term. The level of intensity would be minor and adverse, but could increase to moderate if a burn was conducted in a very large area due to an increased range of smoke.

Collectively, the combined impacts from all fire actions in the park would be long-term and beneficial as well as short- to long-term, negligible to moderate, and adverse. Adverse impacts could increase to moderate during management of wildland fire depending on the direction of prevailing winds.

Cumulative Impacts

Air quality in Everglades National Park is affected predominantly by outside influences from the Miami metropolitan area and regional fossil-fuel power plants. Adverse impacts of minor to moderate intensity from these air pollutant sources are considered long term because emissions are relatively consistent. Big Cypress National Preserve, to the northwest of Everglades National Park, has a large prescribed fire program that may contribute to a reduction of air quality in the regional area. Prescribed fire in Big Cypress National Preserve may contribute short-term minor to moderate adverse impacts to the air quality of Everglades National Park.

Within the park, exotic plant control includes prescribed fire and the use of herbicides prior to prescribed burning. Research was conducted to determine if air quality is further affected by herbicides when prescribed fire is implemented following chemical treatment of an area. Research concluded that no herbicide residues were detected in the smoke samples from any of the fires in the study (McMahon and Bush 1991). Therefore, effects from the use of herbicides for exotic plant management actions associated with prescribed fires would be short term negligible and adverse and emission levels would not affect the area's attainment status for any of the criteria air pollutants. Smoke from fires used to control exotic vegetation could reduce visibility in the immediate area and be noticeable from surrounding areas, but the resulting adverse impacts would only persist during and immediately following any prescribed fire and would therefore be short-term. The level of intensity would be minor and adverse, but could increase to moderate if a burn was conducted in a very large area due to an increased range of smoke. The exotic plant management program also uses vehicles and aircraft that would generate short-term negligible to moderate adverse cumulative impacts.

Other administrative, recreational, and project activities in Everglades National Park also involve operation of vehicles and construction activities associated with exhaust emissions and the generation of dust. Restoration and resource management plans and projects, including the "Hole-

in-the-Donut" wetland restoration project, would take place in localized portions of the park and exhaust would disperse rapidly. As a result, impacts would be short term negligible and adverse.

Collectively, effects on air quality in the park caused by past, current, and foreseeable future actions would be short- to long-term negligible to moderate adverse.

Alternative A would contribute a negligible amount of exhaust emissions and smoke and ash to these other projects and, in combination with other activities, exhaust emissions and smoke in the park would result in short- and long-term negligible adverse impacts.

When the effects of other past, on-going, and future plans, projects, and activities affecting air quality are combined with the effects under Alternative A, the resulting cumulative effects would be short and long-term, negligible to moderate, and adverse as well as long-term and beneficial. Long-term beneficial and short- to long-term, negligible to minor adverse effects of Alternative A would contribute a noticeable amount to the overall adverse cumulative impact.

Conclusion

Overall, continuation of management actions under Alternative A would result in short-term, minor adverse impacts, and long-term beneficial impacts on air quality in Everglades National Park. When the effects of other past, on-going, and future plans, projects, and activities affecting air quality are combined with the effects under Alternative A, the resulting cumulative effects would be short and long-term, negligible to moderate, and adverse as well as long-term and beneficial. The effects of Alternative Alternative A would contribute a noticeable amount to the overall adverse cumulative impacts.

ALTERNATIVE B: NATIONAL PARK SERVICE PREFERRED ALTERNATIVE

Impact Analysis

Similar to Alternative A, air quality in Everglades National Park would be affected by the burning of prescribed and wildfire, the contribution of emissions of air pollutants from the operation of equipment for mechanical cutting of vegetation, the operation of trucks, airboats, off-road vehicles, helicopters, and fixed-wing aircraft for management activities and aerial reconnaissance, and fire suppression activities.

The effects of wildfire and prescribed fire to air quality would be the same as described for Alternative A and would be short- to long-term, minor to moderate, and adverse depending on wind and fire conditions. However, unlike Alternative A, Alternative B, does not restrict hazardous fuel reduction to an annual maximum of 4,500 treated acres, and it does not limit treatment projects to areas outside of designated wilderness. Instead, annual prescribed fire treatments for hazardous fuel reduction could cover a larger total area, and could occur within designated wilderness. The resulting potential increase in prescribed burning would result in a short-term increase of minor to moderate adverse impacts on air quality, but would further reduce fuels in the park, helping to prevent and manage future unplanned wildfire. A reduction in unplanned wildfire would reduce emissions from fire both locally and regionally and result in long-term beneficial effects to air quality.

The multi-year fuels treatment plan associated with Alternative B includes the potential for mechanical and/or chemical fuel reduction treatments, although as currently configured there are no non-fire treatments proposed in the multi-year fuels treatments plan. However, if these management strategies were to be implemented, the potential impacts on air quality would be short-term, negligible, and adverse. These effects would be related to the emissions from vehicles and power tools used to mechanically thin excess fuel loads. Other than these effects, air quality would not be

affected by the mechanical and/or chemical fuel reduction treatments in the multi-year fuels treatment plan.

Collectively, the combined impacts from all fire actions in the park would be long-term and beneficial, as well as short- to long-term, negligible to minor, and adverse, with potential to increase to moderate depending on the direction of prevailing winds.

Cumulative Impacts

Impacts from other plans, projects, and activities would be the same as described in the no action alternative with short- to long-term negligible to moderate and adverse. Sources of these impacts would include emissions from surrounding areas, resource management actions within the park, and other administrative, recreational, and project activities within Everglades National Park.

When the effects of other past, on-going, and future plans, projects, and activities affecting air quality are combined with the effects under Alternative B, the resulting cumulative effects would be considered short- and long-term, negligible to moderate, and adverse as well as providing long- term cumulative benefits. The effects of Alternative B would contribute a noticeable amount to the overall adverse cumulative impact in addition to a small contribution to long-term benefits.

Conclusion

Overall, management actions under Alternative B would result in long-term benefits and short- to long-term, negligible to minor, and adverse impacts on air quality in Everglades National Park. When the effects of other past, on-going, and future plans, projects, and activities affecting air quality are combined with the effects under Alternative B, the resulting cumulative effects would be short-and long-term, negligible to moderate, and adverse as well as long- term and beneficial. The effects of Alternative B would contribute a noticeable amount to the overall adverse cumulative impact.

SOILS

AFFECTED ENVIRONMENT

Soils in Everglades National Park were formed in different kinds of parent material. Some soil types, such as those found on the Miami Ridge, formed in sandy marine sediments, while other soil types formed in varying amounts of recently accumulated organic material, and still others formed in accumulations of marl (calcium carbonate). The marl formed through precipitation of periphyton from fresh water. All soils in the park are underlined by the Miami Oolite Formation, a hard, porous limestone that produces exposed outcrops in many areas throughout the park.

Topographical relief affected the formation of soils in the park, mainly through its influence on soil-water relationships. Other factors generally associated with topographic relief, such as erosion and temperature, are of minor importance in southern Florida since the park has a nearly level plain with an elevation of 0 to 12 feet. The shallow, mineral soils in the Everglades have a water table within the underlying limestone. Unless a drainage system was installed, the soils in the marshes, sloughs, and prairies within the park are covered with water for long periods.

A periphyton crust forms on the surface of many soil types within the park. Periphyton is a complex association of numerous kinds of algae that are important producers and maintain soil moisture during the dry season. Periphyton may burn during the dry season and, if burned, may expose the soil to higher temperatures and lower moisture. These effects may last for at least a season until the periphyton recovers.

Under dry conditions, soils in the park may catch on fire and the impact of fire depends on the amount of organic matter (mostly entisols and histosols) contained in the soils. Organic soils could catch on fire but this is unlikely as it tends to just smolder out; should organic soil fires burn and result in the loss of peat, changes in soil quantity or structure could result in changes in plant communities.

Within the FMUs, the soils can be generally described as follows.

- FMU 1 – The soils are likely of organic origin, mostly entisols and histosols, and dominated by level, poorly drained marly and thin sandy soils underlain by limestone. Soils along the coast are nearly level to sloping associated with coastal swamps and marshes, with occasional sandy soils, including level, poorly drained coastal marshes and swamps subject to frequent tidal flooding (Brown et al. 1990). These soils are not likely to burn during normal conditions. Isolated peat soils found in hammocks and tree islands may be consumed in dry conditions.
- FMU 2 - The soils are likely of organic origin, mostly histosols, and are dominated by level, poorly drained, thin to deep organic soils that are underlain by marl and/or limestone. Organic matter within these soils has accumulated in a wet environment (Brown et al. 1990). When these soils are dried, the peat within them is subject to subsidence and thinning. Under drought conditions, organic soils could burn. Isolated peat soils found in hammocks and tree islands may be consumed in dry conditions.
- FMU 3 – This FMU is largely a rock outcrop with little soil dominated by nearly level to sloped, excessively drained sands. Soils that are present in FMU 3 are generally in depressions and have little organic content and, thus, do not burn. Isolated peat soils found in hammocks and tree islands may be consumed in dry conditions.

- FMU 4 – Soils in FMU 4 are typically rock outcrop, soils of hammocks, and organic soils in Shark River Slough. They are similar to the soils in FMU 2 and are dominated by level, poorly drained thin to deep organic soil underlain by marl and/or limestone. Organic matter within the soil accumulated in a wet environment (Brown et al. 1990). When these soils are dried, the peat within them is subject to subsidence and thinning. Under drought conditions, organic soils could burn. However, isolated peat soils found in hammocks and tree islands may be consumed in dry conditions.

Climate Change

Climate change may impact the landscape and soil in the Everglades as a result of increased storm intensity and duration. Soil subsidence and accretion could be affected by increased storm intensity (NPS 2009b). Additionally, intrusion of saltwater inland could contribute to coastal erosion, inundation, and changes in wetlands and vegetation across vast areas of south Florida. The rate at which the sea level rises in the future would be an important factor. 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 is localized and does not threaten the Everglades ecosystem.

Soils can also be affected by climate change if hydrological patterns are altered and more droughts, or droughts of greater duration occur. Soils could be exposed to longer drying times. More extensive drying of the soil would cause oxidation, and the soils would be exposed to more severe fires, which would eventually cause soil subsidence. Soil accretion may not keep pace with soil loss in this drier environment.

ENVIRONMENTAL CONSEQUENCES

Impact Analysis Methods

This section describes the probable and possible impacts of the alternative actions on the soils in Everglades National Park. Potential impacts are described in terms of type (are the effects beneficial or adverse), duration (are the effects short-term or long-term), and intensity (negligible, minor, moderate, or major). Descriptions of these thresholds of impacts as they relate to soils are as follows. The geographic area considered for the impact topic consists of the terrestrial portions of Everglades National Park.

It is assumed the mitigation measures described in chapter 2 of this environmental assessment would be implemented under the action alternative in accordance with the park's fire management plan. These mitigation measures are intended to minimize impacts of the action alternative on soil.

Thresholds

Threshold	Definition
Negligible	Soils would not be affected, or the effects on soils would be below or at levels of detection. Any effects on soil productivity or fertility would be slight and would return to normal shortly after completion of project activities. There would be no discernable effect on the rate of soil erosion and/or the ability of the soil to support native vegetation.
Minor	The effects on soils would be detectable, but effects on soil productivity or fertility would be small. There would be no change in the ability of soils to support native vegetation. If mitigation was needed to offset adverse effects, it would be relatively simple to implement and would likely be successful.
Moderate	The effect on soil productivity or fertility would be readily apparent and would result in a change to the soil character over a relatively wide area. The rate of soil erosion and/or the ability of the soil to support vegetation would be appreciably changed. Mitigation would probably be necessary to offset adverse effects and would likely be successful.
Major	The effect on soil productivity or fertility would be readily apparent and would substantially change the character of the soil over a large area in the park. The actions would have substantial, highly noticeable influence on the rate of soil erosion and/or the ability of the soil to support vegetation. Mitigation measures to offset adverse effects would be needed, and their success would not be assured.
Short-term	Impacts to soils would last less than five years
Long-term	Impacts to soils would persist for five or more years.
Imperceptible	The incremental effect contributed by the alternative to the overall cumulative impact is such a small increment that it is impossible or extremely difficult to discern.
Noticeable	The incremental effect contributed by the alternative, while evident and observable, is still relatively small in proportion to the overall cumulative impact.
Appreciable	The incremental effect contributed by the alternative constitutes a large portion of the overall cumulative impact.

ALTERNATIVE A: NO ACTION / CONTINUE CURRENT MANAGEMENT

Impact Analysis

Under normal conditions wildfire and prescribed fire would consume the above ground plant matter but would not burn soils or cause oxidation of soils, and soils would not be adversely affected by fire. Fire returns nutrients to soils that were previously stored in plants (such as calcium and magnesium), and phosphorus would be sequestered by the limestone in the soils. The effects of cycling of nutrients would be short-term and beneficial. The effects of wildfire and prescribed fire on soils under Alternative A would be short-term and beneficial.

Park fire managers attempt to keep wildfire out of hammocks and sloughs during extreme drought conditions when soils are capable of burning. During drought conditions, prescribed fire would not be used. Under drought conditions when wildfires in sloughs and hammocks are possible, fire managers would suppress fires. Fires in organic soils result in loss of peat, potentially exposing rock or another substrate, and can result in a change in the plant community. Wildfires in organic soils are unlikely; if they occur they would have short- and long-term, negligible to moderate adverse impacts.

Fires during the dry season might consume the periphyton crust and may expose soil to higher surface temperatures and lower soil moisture; however, the periphyton mat typically recovers within a year. Implementation of Alternative A would continue to have short-term, negligible to minor adverse effects on the periphyton mat.

Wildland fire management actions include walking, use of wheeled and tracked equipment, and bucket drops, may compact soil in limited areas. Soil compaction from wildland fire management

actions may lower the soil elevation, which could cause temporary ponding. The effects of soil compaction due to wildland fire management actions would be short-term, negligible, and adverse.

Implementation of Alternative A would continue to cause a range of short-term, negligible to moderate adverse effects on soil in Everglades National Park.

Cumulative Impacts

Other past, present, and reasonably foreseeable actions or plans that may affects soils in Everglades National Park include past land uses and alteration of hydrology and drainage. Drainage practices and changes in hydrology to Everglades National Park led to some areas being drier for longer periods of time, which can lead to soil oxidation and subsidence, or if organic soils are dry for longer portions of the year, organic soils would be more susceptible to burning. Drainage practices of the past have had long-term moderate adverse effects on the park's soils.

Restoration of vegetation communities in the park can be accomplished through restoration of natural hydrological conditions through projects under the Comprehensive Everglades Restoration Plan designed to capture, store, treat, and redistribute water through the park. Restoration of hydrological conditions would improve existing soil conditions and prevent over-drying of soil that could lead to organic soil fires or soil subsidence. Restoration of hydrologic conditions and subsequent restoration of natural fire regimes would have a short- and long-term beneficial effect on soil within Everglades National Park.

Exotic plant removal in the park uses a combination of fire, chemical, and mechanical methods, depending on the target species. Mechanical removal of exotic plants may compact soils and alter soil structure and elevation in limited areas. Exotic plant removal would restore native vegetation communities, and soils would be expected to be less susceptible to subsidence or organic soil fires. The effect of exotic plant removal on soils would have short-term, negligible, and adverse effects, with long-term beneficial impacts as well.

When the short-term, negligible adverse, long-term, moderate adverse, and short-and long-term beneficial effects of other past, present, on-going, and future plans, projects and actions affecting soils are combined with the short-term negligible adverse effects of Alternative A, the resulting cumulative effects would be considered short- and long-term, negligible to moderately adverse, and short- and long-term beneficial. The short-term negligible adverse effects of Alternative A would contribute an impercebtible amount to the overall adverse and beneficial cumulative impacts.

Conclusions

Implementation of Alternative A would have short-term, negligible to moderate adverse effects on soils in Everglades National Park. When the effects of other past, present, on-going, and future plans, projects and actions affecting soils are combined with the effects under Alternative A, the resulting cumulative effects would be short- and long-term, negligible to moderately adverse, and short- and long-term beneficial. The short-term, negligible adverse effects of Alternative A would contribute an impercebtible amount to the overall adverse and beneficial cumulative impacts.

ALTERNATIVE B: NATIONAL PARK SERVICE PREFERRED ALTERNATIVE

Impact Analysis

Under Alternative B, planned fires would be used in a much greater area than in Alternative A. In the long term, the increased use of planned fire and reduction in fuel loads would lessen the need for potentially damaging wildfire management actions, thus resulting in short-term, negligible to minor

adverse impacts and long-term benefits to soil. Wildland fire would result in nutrient cycling, and the effects of wildfires during drought conditions may burn organic soils, particularly in hammocks and sloughs, and these fires would be suppressed. Fires may consume periphyton crust, and the adverse effects of burning periphyton crust would be short-term, negligible to minor. Prescribed fires would not be used during drought conditions. Wildland fire management actions may impact soils in limited areas through compression, and the effects of wildland fire management actions would be short-term, negligible, and adverse.

Nutrient cycling in soils would continue to provide short-term beneficial effects under Alternative B to a degree even greater than described in Alternative A.

If planned fires meet fire management goals and strategies designed to maintain a healthy and sustainable ecosystem, there would be a reduced potential for wildfires and a reduced need for potentially damaging wildfire management actions. As such, the potential for organic soil fires would be reduced. Impacts to soils under Alternative B would be short-term, negligible to minor, and adverse, as well as long-term and beneficial.

The multi-year fuels treatment plan associated with Alternative B includes the potential for mechanical and/or chemical fuel reduction treatments, although as currently configured, there are no non-fire treatments proposed in the multi-year fuels treatments plan. However, if these management strategies were to be implemented, the potential impacts on soil would be short-term, negligible, and adverse. These effects would be related to the use of chemicals and equipment (such as equipment to transport people) to control excess vegetative fuel loads. This equipment could potentially compact soils. However, the effects would be minimal because the chemicals used would not be persistent in the environment, nor would there be long-term impacts to soil productivity or health.

Implementation of Alternative B would have short-term, negligible to minor adverse impacts, and long-term beneficial effects on soils in Everglades National Park.

Cumulative Impacts

Impacts associated with other past, present and reasonably foreseeable actions are similar to those described under Alternative A.

FMU 4 would be managed by Everglades National Park. Extensive exotic plant control has occurred and is occurring in FMU 4. The effects of exotic plant control may adversely alter soils and soil structure as described in Alternative A. However, exotic plant removal throughout the park would restore native vegetation communities, and soils would be less susceptible to subsidence or organic soil fires. The effect of exotic plant removal on soils would be short- and long-term minor to moderate adverse, and long-term beneficial.

When the short- and long-term negligible to moderate, and short- and long-term beneficial effects of other past, present, on-going, and future plans, projects and actions affecting soils are combined with the short-term negligible to minor adverse and long-term beneficial effects under Alternative B, collectively, the resulting cumulative effects would be considered short- and long-term, negligible to moderate adverse, and short- and long-term beneficial. The short-term, negligible to minor adverse and long-term beneficial effects of Alternative B would contribute an impercebtible amount to the overall adverse and beneficial cumulative impacts.

Conclusions

Implementation of Alternative B would have short-term, negligible to minor adverse impacts, and long-term beneficial effects on soils in the park. When the effects of other past, present, on-going,

and future plans, projects and actions affecting soils are combined with the effects under Alternative B, the resulting cumulative effects would be short- and long-term, negligible to moderately adverse, while providing short- and long-term benefits. The short-term, negligible to minor adverse impacts and long-term beneficial effects of Alternative B would contribute an impercebtible amount to the overall cumulative impacts.

HYDROLOGY AND WATER QUALITY

AFFECTED ENVIRONMENT

Hydrology

Everglades National Park occupies over 1.5 million acres, of which 98 percent is either permanently or seasonally inundated by water. Historically, one half of the water in Everglades National Park came from the Kissimmee chain lakes and Lake Okeechobee; the other half was provided by rainfall. Today, Everglades National Park is characterized by a unique hydrologic system that includes natural features such as the vast, flat open Everglades wetlands and numerous small and large, natural and artificial, lakes and waterways. Even though the system is highly managed, it is primarily rainfall driven and is strongly influenced by other natural processes such as evapotranspiration. The hydrologic characteristic of the Everglades is that most water is transported overland in slow-moving "sheetflow," which is a shallow (1 to 3-feet deep) and continuous expanse of water during the wet season (generally during the summer and fall) that flows to the coast. As water moves southward toward the coast, it is influenced by seasons and evapotranspiration, and as freshwater inflows to the coast dry up, the water becomes increasingly saline.

The hydrology of Everglades National Park is altered by several factors, including the following:

- drainage projects that changed the hydroperiod;
- diversion of flows;
- impoundment of wetlands;
- alteration of vegetation and wildlife communities;
- degradation of water quality in some areas; and
- invasion of habitats by non-native plants.

Alteration of the park's hydrology may also have altered the fire regimes, making some areas less flammable and other areas drier and thus more flammable. Sawgrass marshes rapidly recover from fire if the water table is high enough to protect the culms or stems, but if the prairies are too dry, fire kills sawgrass and exposes organic soils. Burning of decadent sawgrass marshes would improve hydrologic flows because dead vegetation would be removed; however, burning of organic soils may lower the soil elevation, and create altered hydrology through ponding and changes in vegetation. Alteration of the park's hydrology also reduced freshwater inflow to Florida Bay and the coastal marine communities, but the fire management plan would not substantially alter the freshwater flows to Florida Bay.

Water Quality

Water quality in Everglades National Park is affected by seasonal and long-term changes in rainfall, water levels, and flows (Miller et al. 2004). Low water levels in the marshes and sloughs generally results in ponding and increased major ion and nutrient concentrations because of the enhanced breakdown of organic material and the build-up of waste from aquatic and terrestrial wildlife that concentrate in and near the remaining surface water. Conversely, high water levels and flowing water may decrease concentrations by diluting or flushing major ions and nutrients out of the marsh. Water introduced from runoff of agricultural or urban sources may increase major ion and nutrient concentrations.

Waters of Everglades National Park are designated by the State of Florida as Outstanding Natural Resource Waters (Miller et al. 2004). This designation is intended to protect waters from significant deterioration of water quality. However, because these waters are located downgradient of altered hydrological systems, the waters of Everglades National Park are subject to the effects of upstream water management practices. Water flow and water quality in Everglades National Park are most affected by surface water from canals that drain nutrient-enriched upstream agricultural lands into the park. The Everglades ecosystem evolved under nutrient-poor conditions, particularly extremely low levels of phosphorus. Small increases in phosphorus may alter vegetation (for example, alter from sawgrass dominated to cattail [*Typha* spp.] dominated areas). Cattail dominated areas are subsequently less suitable for native wildlife species. Additionally, cattail communities have an altered fire regime and do not carry fire.

Under the federal Clean Water Act, the State of Florida has the primary authority to review, establish, and revise water quality standards subject to approval by the Environmental Protection Agency. Everglades National Park is assigned a Class III designated use. Designated use for Class III waters is "recreation, propagation, and maintenance of a healthy, well-balanced population of fish and wildlife." In 1991, the United States and the State of Florida entered into a Settlement Agreement to resolve water quality litigation. Following adoption of the Everglades Forever Act in 1994, the parties filed a joint motion to modify the Settlement Agreement. The Settlement Agreement, as modified, requires the following measures to restore and maintain water quality:

- Initiation of a regulatory program designed to reduce total phosphorus loads from agricultural areas to Everglades National Park;
- Construction of treatment wetlands to remove phosphorus before waters enter Everglades National Park;
- Compliance with Class III state water quality standards, including a new numeric phosphorus criterion of 10 parts per billion developed by the State of Florida and reviewed and approved by the Environmental Protection Agency as consistent with Section 303c of the Clean Water Act (NPS 2005b).

Ongoing monitoring will be used to assess changes in water quality (NPS 2005b).

Historically, waters flowed through the Everglades into Florida Bay. As the waters were diverted through canals, freshwater inputs to Florida Bay were reduced, raising salinity in the bay (Van Lent, et al. 1993). Through ongoing restoration efforts, freshwater flows to Florida Bay are being re-established.

Climate Change Effects on Hydrology and Water Quality

Climate change is expected to increase the extent and frequency of coastal flooding 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 would likely alter the nutrient cycling in the Everglades because temperature has a marked effect on biotic and abiotic processes. Floods may alter the natural floodplain timing and distribution in Everglades National Park, leading to changes in vegetation, wildlife habitat, and fire regimes (NPS 2009b).

ENVIRONMENTAL CONSEQUENCES

Impact Analysis Method

This section describes the probable and possible impacts of the alternative actions on the hydrology and water quality that may occur in Everglades National Park.

Hydrology and water quality were analyzed for each alternative based on the effects of fire in Everglades National Park. Available information on surface water resources and water quality was evaluated and determined qualitatively based on the professional judgment of NPS staff and consultants, and consideration of park purpose and significance. The geographic area considered for hydrology and water quality consists of the terrestrial portions of Everglades National Park.

It is assumed the mitigation measures described in chapter 2 of this environmental assessment would be implemented under the action alternative in accordance with the park's fire management plan. These mitigation measures are intended to minimize impacts of the action alternative on hydrology and water quality.

Potential impacts are described in terms of type (are the effects beneficial or adverse), duration (are the effects short-term or long-term), and intensity (negligible, minor, moderate, or major). Impact threshold definitions are as follows.

Thresholds

Threshold	Definition
Negligible	The timing and quantity of flows would be within historical conditions. Impacts to water quality would not be detectable. Water quality parameters would be well within all water quality standards for the designated use of the water.
Minor	The timing and quantity of flows would be within the range of historical conditions, but measurable changes from normal flows would occur. Impacts to water quality would be measurable, but water quality parameters would be well within all water quality standards for the designated use. State water quality and anti-degradation policy would not be violated.
Moderate	The timing and quantity of flows would be outside historic baseline on a limited time and space basis. Changes in water quality would be measurable and readily apparent, but water quality parameters would be within all water quality standards for the designated use. State water quality and anti-degradation policy would not be violated. Mitigation would probably be necessary to offset adverse effects, and would likely be successful.
Major	Flows would be outside the range of historic conditions, and could include flow cessation or flooding. Changes in water quality would be readily measurable, and some quality parameters would periodically approach, equal, or exceed water quality standards. State water quality regulations and anti-degradation policy may be violated. Extensive mitigation measures would be necessary, and their success would not be assured.
Short-term	Following management action, recovery would take less than six months.
Long-term	Following management action, recovery would take longer than six months.
Imperceptible	The incremental effect contributed by the alternative to the overall cumulative impact is such a small increment that it is impossible or extremely difficult to discern.
Noticeable	The incremental effect contributed by the alternative, while evident and observable, is still relatively small in proportion to the overall cumulative impact.
Appreciable	The incremental effect contributed by the alternative constitutes a large portion of the overall cumulative impact.

ALTERNATIVE A: NO ACTION / CONTINUE CURRENT MANAGEMENT

Impact Analysis

Hydrology. Wildfire and prescribed fires under Alternative A could affect hydrology; if fires removed decadent sawgrass, sheetflow would be altered until the sawgrass recovered. Burning vegetation may also reduce resistance to sheet flow, and more water would be transported to other parts adjacent areas, depending on the timing and location of the fire. Vegetation would be expected to recover fairly quickly after fire, and hydrological conditions would return to pre-fire conditions.

Organic soil fires, while rare, could affect soil water storage capacity and could affect ponding in the area. The effects of fires that burned organic soil would be short- and long-term negligible to minor adverse, if ponds are formed where there was sheetflow prior to the fire.

Under Alternative A, prescribed fire activities in FMUs 1, 2, and 3 are limited by wilderness constraints. Within FMU 3, prescribed fire is used outside of designated wilderness areas to replicate a natural fire mosaic. Fire management and prescribed fire activities may affect hydrology by altering vegetation in the vicinity of smash lines or blacklines, and thus altering sheetflow patterns. Depending on the timing and location of the fire, wildland fire management activities are expected to have short-term, negligible to minor, adverse and short-term beneficial effects on hydrology under Alternative A.

Water Quality. Burning vegetation results in the release of nitrogen and other nutrients both in the treatment area and off-site in the form of ash that may be recirculated into plant biomass and cause a temporary increase in nutrient availability. The result may have an adverse or beneficial effect on water quality depending on the water filtering capability of the vegetation. The effects of fires on nutrient cycling and water quality are expected to be short-term and either adverse or beneficial. Fires consume vegetation and return nutrients to the water column that was previously stored in plants (such as calcium and magnesium).

Park fire managers sometimes use aerial ignition devices popularly known as “ping pong balls.” These devices contain potassium permanganate and ethylene glycol. Occasionally a ball will not burn; unignited “ping pong balls” would deteriorate over time and enter surface waters. Water quality may be affected by “ping pong balls” that fail to ignite and degrade over time, but the potential for a measurable difference in water quality is unlikely. Implementation of Alternative A would continue to have short-term negligible adverse effects on water quality from the use of aerial ignition devices.

Drip torches used for ignition use a combination of diesel fuel and gasoline. Most of the fuel volatizes; however, the potential exists for spills although mitigation measure would be expected to prevent or offset adverse effects. Implementation of Alternative A would continue to have short-term, negligible adverse effects on water quality from the use of gasoline/diesel mix and phosphates in torches.

Water quality may be affected by wildland fire management and prescribed fire activities, such as the use of trucks or motorized vehicles that may release small, localized quantities of oil or other petroleum products. Fire suppression activities may also include the use of fire retardant, but this is used only in extreme circumstances, and the retardant used does not contain mobile elements that would be transferred to waters within the park. Class A foam (surfactant) is a substance that resembles dish soap and contains phosphates. Class A foam is technically described as a high foaming hydrocarbon surfactant, organic salts and water, with water comprising more than 50 percent of the foam. If phosphates from class A foam contact water, they could raise the nutrient level in the low-nutrient Everglades system. The addition of nutrients into the Everglades system

would have short-term, negligible to minor adverse impacts on water quality. If used in an upland area, plants would take up the phosphorus from the retardant/foam; however, phosphorus would be sequestered by limestone in the soils (Wright, et al. 2009). Implementation of Alternative A would continue to have short-term negligible to minor adverse impacts on water quality from the use of foam/retardant.

Water drops necessary for fire management activities, are obtained from water sources inside the park, including canals, borrow pits, and natural waters sources. Use of park waters for these efforts ensures water quality of dropped water is not of lower quality than its receiving waters. In addition, air tankers used for water drops must rinse out tanks prior to responding to fires within the park. Impacts from air tankers may be mitigated by not dropping over open water. Continuation of these practices would not affect water quality.

Water quality in the park may be affected by burning through nutrient release, dispersal of small amounts of fuels used in handheld and aerial ignition devices, and fire retardant. Implementation of Alternative A would continue to have short-term, minor adverse effects on water quality in Everglades National Park.

Cumulative Impacts

Other past, present, and reasonably foreseeable actions or plans that may affect hydrology and water quality in Everglades National Park include nutrient loading resulting from past land uses and agricultural practices, alteration of hydrology and drainage, and population growth (see Chapter 1: Connected and Similar Actions for more information on these actions, within and outside the park). These past, on-going, and future projects have and can have short- and long-term minor to moderate adverse effects on hydrology and water quality, although many efforts are underway to mitigate these impacts.

Restoration of natural hydrological conditions and water quality under the umbrella of the Comprehensive Everglades Restoration Plan are designed to capture, store, treat, and redistribute water through the park. Restoration of hydrologic conditions and water quality would impact virtually all other resources in Everglades National Park. In particular, projects under the Comprehensive Everglades Restoration Plan that have the potential to affect hydrology and water quality include Water Conservation Area 3A decompartmentalization, the Everglades Seepage Management project, and C-111 Spreader Canal project. Restoration of hydrologic conditions would have short- and long-term beneficial effects to hydrology of Everglades National Park. Using wetlands to filter water delivered to Everglades National Park under the projects included in the Comprehensive Everglades Restoration Plan would have short- and long-term beneficial effects to water quality in the park.

When the short- and long-term adverse and beneficial effects of other past, on-going, and future plans, projects, and activities affecting hydrology and water quality are combined with the short-term minor adverse to short-term beneficial impacts under Alternative A, the resulting cumulative effect would be considered short- and long-term beneficial. The adverse and beneficial effects of Alternative A would contribute an imperceptible amount to the overall cumulative impact.

Conclusions

Implementation of Alternative A would have short-term, minor, and adverse impacts as well as short-term beneficial effects on water quality and hydrology in Everglades National Park. When the effects of other past, on-going, and future plans, projects, and activities are combined with the impacts under Alternative A, the resulting cumulative effect would be short- and long-term and

beneficial. The adverse and beneficial effects of Alternative A would contribute an imperceptible amount to the overall cumulative impact.

ALTERNATIVE B: NATIONAL PARK SERVICE PREFERRED ALTERNATIVE

Impact Analysis

Under Alternative B, management of wildland fires would be the same as described for Alternative A, although prescribed fire would be used over a greater area. Generally, the effects of wildland fires would have the same effects as described under Alternative A.

Hydrology. Burning of vegetation would have the same effects on sheet flow and hydrology under Alternative B as described under Alternative A, although the spatial extent of impacts as well as benefits would be increased. Increased water movement through recently burned areas would have a short-term, negligible to minor adverse impact, with short-term benefits depending on the timing and location of the fire.

The effect of wildland fire management activities would be expected to have short-term, negligible to minor adverse impacts, with short-term beneficial effects depending on the timing and location of the fire.

Water Quality. Effects on water quality from phosphorus release, nitrogen release, use of aerial ignition devices, and use of gasoline/diesel mix and phosphates in torches would be slightly more but similar to those described for Alternative A because planned ignitions would be more frequent under Alternative B. Implementation of Alternative B would have short-term, minor adverse effects on water quality in Everglades National Park.

The multi-year fuels treatment plan associated with Alternative B includes the potential for mechanical and/or chemical fuel reduction treatments, although as currently configured, there are no non-fire treatments proposed in the multi-year fuels treatments plan. However, if implemented, mechanical fuel reduction would not have measurable effects on hydrology or water quality because substrate disturbance would be negligible to non-existent, and the amount of cut vegetation left on-site would not impede surface water sheet flow. Any chemical use in aquatic habitats would be restricted to herbicides that provide effective control of emergent, shoreline and wetland woody species in or near water, but are specially formulated for use in aquatic applications and break down quickly. Impacts from herbicide treatments would be minor, adverse, and short-term.

Cumulative Impacts

Impacts associated with other past, present, and reasonably foreseeable actions are similar to those described under Alternative A, namely short- and long-term beneficial effects. In addition to the projects included under the Comprehensive Everglades Restoration Plan, the umbrella of the Modified Water Deliveries Project includes several subprojects that would shift water deliveries to rehydrate portions of the East Everglades expansion area. The effects of altering water deliveries would be beneficial for hydrology of the East Everglades in the short- and long-term, and flows would continue into the park. Wetlands filtering waters before entering Everglades National Park would provide short- and long-term beneficial effects on water quality in the park.

When the short- and long-term adverse and beneficial effects of other past, on-going, and future plans, projects, and activities affecting hydrology and water quality are combined with the short-term, minor adverse impacts and short-term beneficial impacts under Alternative B, the resulting cumulative effect would be considered short- and long-term and beneficial. The mixed adverse and

beneficial effects of Alternative B would contribute an imperceptible amount to the overall beneficial cumulative impact.

Conclusions

Implementation of Alternative B would have short-term, minor adverse impacts and short-term benefits on water quality and hydrology in Everglades National Park. When the effects of other past, on-going, and future plans, projects, and activities affecting hydrology and water quality are combined with the impacts under Alternative B, the resulting cumulative effect would be considered short- and long-term and beneficial. The mixed adverse and beneficial effects of Alternative B would contribute an imperceptible amount to the overall beneficial cumulative impacts on hydrology and water quality.

VEGETATION

AFFECTED ENVIRONMENT

In Everglades National Park, topography is critical in defining where plant communities occur. A difference of a few inches of elevation can affect whether an area is flooded or dry and the types of vegetation it will support. Within Everglades National Park, there are eight major native vegetation communities, all of which are influenced by fire. The eight communities include the following:

- Sawgrass Marsh (long hydroperiod wetlands)
- Marl Prairie (short hydroperiod prairies)
- Coastal Prairie
- Pine rocklands
- Hardwood Hammocks and Tree Islands
- Cypress Forests
- Mangrove/Buttonwood Forests
- Sloughs

Four communities (sawgrass marshes, marl prairies, coastal prairies, and pine rocklands) broadly define the FMUs within the park, and the remaining four (hardwood hammocks/tree islands, cypress swamps, mangrove/buttonwood forest, and freshwater slough) are interspersed throughout. Each vegetation community has specific ecological issues and fire management considerations associated with it, as summarized below.

In addition to the native plant communities, exotic plants are present adjacent to, or embedded within native plant communities throughout the park. Exotic plants are a major threat to an ecosystem because they can displace native species, placing the entire ecosystem at risk. Exotic plant species are not treated as a separate vegetation community, but rather these species are embedded within most native plant communities, and descriptions of exotic plants are included in the vegetation descriptions below.

Everglades National Park occupies over 1.5 million acres, 98 percent of which is either permanently or seasonally inundated by water. The National Park Service directed park staff to protect wetlands from adverse impacts wherever practicable (Director's Order 77-1) (NPS 2002b). Any actions that may reduce or degrade wetlands are governed by the Clean Water Act and Rivers and Harbors Act (33 U.S. Code Parts 1344 and 403, respectively). Wetlands in Everglades National Park may burn repeatedly as part of the natural condition. Wetlands are included in the descriptions of vegetation communities below.

Sawgrass Marsh (short or long hydroperiod habitats) (FMUs 1, 2, 3, and 4)

Sawgrass (*Cladium jamaiense*) marshes are one of the most extensive plant communities in Everglades National Park. Sawgrass marshes are long hydroperiod wetlands that tend to occupy sites where the maximum surface water depth is less than four feet and there are annual dry periods.

Due to frequent lightning strikes (as well as human-caused fires), fire is an integral component of the sawgrass marshes. Most species, including sawgrass, will grow vigorously following fire, unless water levels rise rapidly following fire. However, during extreme drought, fires have the potential to burn the organic soil, killing the sawgrass rhizomes, and slowing the regrowth and dominance of the

species (Wade et al. 1980). Depending on biomass accumulation, sawgrass marshes burn on a fire return interval of 3-12 years, limiting invasion of woody species (Wade et al. 1980). In general, wet prairies dominated by sawgrass provide sufficient fuel to sustain a fire when flooded, while wet prairies dominated by other species may not be able to sustain fire under flooded conditions. Sawgrass marshes may be invaded by melaleuca if the sites are disturbed by abnormally intense fires, changes in hydrology, or a combination of factors. There is some research supporting the management of melaleuca with fire, and this approach is currently used in the park (Wade et al. 1980).

Marl Prairie (short hydroperiod prairies) (FMUs 2, 3, and 4)

Marl prairies (short hydroperiod prairies) are named for the shallow marl soils on which they occur. Within Everglades National Park, marl prairies are located on the east and west margins of Shark River Slough and Taylor Slough, where bedrock elevations are slightly higher and hydroperiods are shorter. Marl prairies are seasonally flooded between two and seven months of the year, resulting in seasonal drying of the soils. This vegetation type is characterized by bunch grasses (including muhly grasses [*Muhlenbergia* spp] and love grasses [*Eragrostis* spp.]) and sparse sawgrass growing in shallow soils, with vegetation generally less than one foot tall. The soil surface is often covered with a moderate to well-developed algal mat (periphyton). Marl prairies are intermixed with other vegetation communities including sawgrass marsh, pine rockland, and tree islands.

Some areas of the marl prairies were overdrained and are subject to shrubby plant invasion, including cabbage palm (*Sabal palmetto*) and wax myrtle (*Myrica cerifera*). Exotic trees that may invade marl prairies are known collectively as Australian pine, melaleuca, and Brazilian pepper. Fires sustain marl prairies by pruning back invading native and exotic shrub and tree species. Irregular vegetation cover, areas of open bedrock, and occasional pockets of standing water generally result in patchy burns, except under severe burning conditions. Under dry conditions, periphyton will burn and carry a smoldering fire across poorly vegetated areas to unburned patches of fuel. Fire return intervals are between 3 and 12 years and the marl prairie vegetation typically recovers within one or two years after wildfire.

Coastal Prairies (FMU 1)

Coastal prairies occur in the saline brackish zones on the western portion of the park and are frequently surrounded by mangrove/buttonwood forests or, on the inland edge, by freshwater marsh. During much of the year, most coastal prairie areas are inundated with water; however, at the height of the annual dry period, water levels usually drop below the surface. Coastal prairies cover approximately 115, 100 acres, and make up about 12 percent of Everglades National Park (NPS 2006b).

Despite standing water, coastal prairies burn readily when adequate fuel protrudes above the water surface and weather conditions are conducive. Fires in the coastal prairies are typically started by lightning and move through the coastal prairies until water levels or lack of vegetation cause them to naturally burn out. Fires in the coastal prairies may occasionally impact the fringes of buttonwood and mangrove forests, but are quickly extinguished in the sparse mangrove understory. In Everglades National Park, naturally occurring coastal prairie fires have not been suppressed since the 1970s due to recognition of the importance of this natural disturbance in maintaining this ecosystem, although full suppression can be considered if resources are threatened. Fire return intervals in coastal prairies depend on biomass accumulation, but are generally between 2 and 10 years. Prescribed fire is also used in coastal prairies for control of the exotic Old World climbing fern and Brazilian pepper populations as well as a means of fuel reduction.

Pine Rocklands (FMU 3)

The pine rocklands of Everglades National Park are the largest remaining example of an ecosystem that formerly extended along the Atlantic Coastal Ridge from Ft. Lauderdale to Long Pine Key. Pine rocklands are globally imperiled and extremely limited in distribution. The largest remnant of pine rocklands in the United States is located within the park on Long Pine Key. Pine rocklands are fire-maintained and contain one of the most diverse plant communities of south Florida. Pine rocklands consist of an overstory of open canopy South Florida slash pine of multiple age classes, and a diverse understory of shrubs, herbaceous plants, and palm, including a mosaic of hardwood hammocks and marl prairie finger glades.

In fire-maintained pine rocklands, crown fires are rare because of spacing between pine trees, but surface fires are common and occur every few years. Under natural conditions, pine needles, grasses and forbs (broad-leaved herbaceous plants) are the major carriers of fire in the understory of pine rocklands. The open canopy allows for the rapid drying of fuels, so that fires are possible even hours after rain. Regeneration of grasses and forbs in the understory is so vigorous, as well as needle cast, that within one year of a burn enough fuels are present to sustain a new fire. Although hardwood species are naturally present within pine rocklands, fire prevents these hardwood species from increasing in cover, invading the mid-story, and causing fuel loadings that would cause crown fires in the pine trees. If hardwood trees become dense in the pine rocklands, herbaceous diversity may decline due to shading. The fire return intervals in pine rocklands depend on biomass accumulation, but are generally between three and seven years. Pine rocklands are also susceptible to exotic plant invasion, which is increased when strong winds and natural disturbances cause overstory damage and subsequent stimulation of the midstory and herbaceous growth. Fire is the natural disturbance that prevents the formation of a dense overstory as well as the succession of pine rockland to hardwood hammock.

Brazilian pepper may invade pine rocklands in the absence of fire and develop dense stands that suppress native understory grasses, resulting in lower fine fuel loads and thus altering the fire regime of the native plant community.

Hardwood Hammocks and Tree Islands (FMUs 1, 2, 3, and 4)

Hardwood hammocks and tree islands can be found throughout Everglades National Park, including in the sloughs and freshwater prairies, pine rocklands, and coastal prairies. Hammocks are composed primarily of tropical broad-leaved hardwood trees and shrubs. Tree islands are areas at slightly higher elevation than the surrounding prairie that support tropical and/or temperate hardwood trees and shrubs. During wet periods, higher soil moisture in hardwood hammocks and tree islands act as a natural fire break from the surrounding fire-dependent vegetation and prevent fire from penetrating into hammocks.

Figure 21: Tree Island (Aerial View)

Under natural conditions, hardwood hammocks rarely burn. The historical fire return intervals for hardwood hammocks are not well known because hammocks are generally fire resistant and burn only during severe drought conditions when the soil moisture is low. Dry-season ground fires may burn the organic soil down to bedrock, killing all vegetation. Due to loss of hammocks in developed areas outside the park, those remaining in the park are of special importance. Wildfires have caused a substantial loss in the size and number of individual tree islands within the park over the last 50-100 years. Consequently, hammocks and tree islands in the park may require fire protection even from natural fire events. Many plants within hardwood hammocks are not fire-adapted and will be susceptible to fire.

Cypress Forests (FMUs 2, 3, and 4)

Cypress (*Taxodium spp.*) is a deciduous conifer that can survive in standing water. Cypress trees may grow in domes (larger trees in the middle of a depression in the limestone bedrock, with smaller trees around the perimeter), strands (in an elongated linear shape parallel to the flow of water - which is uncommon in the park), or on drier land scattered within fire-adapted prairies (known as sparse dwarf cypress). All cypress forests are dominated by cypress trees and occur on sites that are, or were, flooded for at least part of the year.

Figure 22: Cypress Forest

Cypress ecosystems require fire and fluctuating water levels for their establishment and maintenance. Fires in cypress communities remove less fire-tolerant species, providing reduced competition for seedling establishment (Wade et al. 1980). In addition, cypress seedlings are established in saturated, but not flooded soils (Ewel 1990). Dwarf cypress woodlands, with a grassy understory, have likely experienced fire, so the impact of a total fire exclusion strategy in this vegetation type is unknown (Myers 2000). Dwarf cypress woodlands typically burn with the same frequency as the surrounding graminoid communities, between 3- and 12-year intervals. Cypress domes are nearly closed canopies with limited understory vegetation (due to canopy cover and longer hydroperiod within the dome), but have enough soil to support a variety of hardwoods. Without fire, cypress domes likely become increasingly dominated by hardwoods and convert to bayheads and mixed swamps. Fire return intervals in cypress domes are longer than the surrounding graminoid vegetation, but there is not a well-documented fire return interval for cypress domes (Myers 2000). Cypress strands are rare in Everglades National Park, and normally have standing water. Cypress strands and cypress domes will occasionally burn during extreme drought conditions when the organic soils in the center are exposed. If the organic soils burn, the large cypress trees may be killed, altering the vegetation structure and subsequent plant development (Myers 2000).

Mangrove/Buttonwood Forests (FMU 1)

Mangroves are tropical trees that are adapted to salt water and the rigors of tides. Mangrove forests are found along tropical and subtropical coasts with weak wave action. Four species of mangroves occur in Everglades National Park. White mangrove and buttonwood are generally adjacent to freshwater marshes, red mangrove (*Rhizophora mangle*) is found primarily along open water channels, and black mangrove (*Avicennia germinans*) is most common in areas of high salinity. Although mangroves occasionally become established in other Gulf Coast states, extensive forests found along the southwestern coast of Florida are not found anywhere else in the United States. Fire and frost are important determinants of how far inland mangrove forests extend. Mangrove and buttonwood usually merge into marsh vegetation along the gradient from saltwater to freshwater. Although fire may occasionally burn through a mangrove forest that was killed by frost or hurricane

damage, fire normally has no role in mangrove forests. Lightning strikes occur in mangrove forests and will start fires, but the fires do not burn more than a tenth to one acre before burning out.

Sloughs (FMUs 2 and 4)

A slough is an elongated natural drainage channel that sits at lower elevation and remains flooded nearly year-round. Everglades National Park has two distinct sloughs; the larger Shark River Slough, also known as the "River of Grass," located on the west and the smaller, narrower Taylor Slough to its east. Slough communities include aquatic, floating leaved, and emergent plants. Because sloughs are wet much of the year and vegetation is sparse, they have historically acted as natural firebreaks in south Florida. Under severe dry conditions, the organic soils underlying sloughs may dry out and enable ground fires that have the potential to consume organic material and result in changes to the vegetation communities. There is no known frequency with which these organic fires may occur.

Climate Change Effects on Vegetation

The effects of climate change could include increased temperatures and alterations in precipitation that could impact vegetation composition in Everglades National Park by reducing the duration of the wet season and increasing the evaporation rates. Vegetation species may experience range expansions and contractions. If increased periods of drought were to occur, some species that are dependent on wetlands or those impacted by compounding factors such as fire, may be adversely affected (NPS 2009b). 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. Components of the unique plant assemblage represent the interface between the subtropical and temperate zone, which may shift according to water conditions and availability. Plant/animal interactions, such as pollination, seed dispersal, and forage availability, may be disrupted. 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.

ENVIRONMENTAL CONSEQUENCES

Impact Analysis Methods

This section describes the probable and possible impacts of the alternative actions on the vegetation communities within Everglades National Park. Vegetation communities were analyzed for each alternative based on the effects of fire on the communities, and within FMUs in which that vegetation type occurred.

Analyses of the potential intensity of impacts to vegetation were derived from the professional judgment of NPS staff and a review of the literature. Descriptions of these thresholds of impacts as they relate to vegetation are as follows. Geographic areas considered for this impact topic are the FMUs described in chapter 2 of this environmental assessment.

It is assumed the mitigation measures described in chapter 2 of this environmental assessment, intended to minimize impacts of the action alternative on vegetation, would be implemented under the action alternative and the analyses of effects include the implementation of mitigation measures.

Thresholds

Threshold	Definition
Negligible	Effects on individual plants, plant populations, or functional processes are not observable. Disturbance does not result in changes to plant community structure or composition, beyond what would occur through natural processes.
Minor	Impacts are detectable, but not apparent. Damage to individual plants is restricted to herbs and small shrubs and does not affect below-ground plant structures. Changes in community structure and composition are restricted to the herbaceous and low-shrub layer. Post-disturbance plant communities quickly return to pre-disturbance conditions.
Moderate	Impacts are apparent. Damage to above-ground structures is extensive for herbs, shrubs, and saplings. Significant changes in plant community structure and composition occur in the understory and midstory. Post-disturbance plant communities retain many characteristics of pre-disturbance communities, but differences persist for several years.
Major	Impacts are obvious without close inspection. Plant damage extends to below-ground structures (e.g., roots). Changes in community structure include all vegetation strata. Changes in species composition are dramatic because of species loss/recruitment or invasion of new species. Post-disturbance plant communities may not resemble pre-disturbance communities even after several years or decades.
Short-term	Impacts to vegetation would occur only during the management action and effects would last less than five years
Long-term	Impacts would persist for five or more years.
Imperceptible	The incremental effect contributed by the alternative to the overall cumulative impact is such a small increment that it is impossible or extremely difficult to discern.
Noticeable	The incremental effect contributed by the alternative, while evident and observable, is still relatively small in proportion to the overall cumulative impact.
Appreciable	The incremental effect contributed by the alternative constitutes a large portion of the overall cumulative impact.

ALTERNATIVE A: NO ACTION / CONTINUE CURRENT MANAGEMENT

Impact Analysis

Most vegetation communities within Everglades National Park evolved in the presence of fire, and it is therefore assumed that perpetuating or recreating a natural fire regime would benefit vegetation communities. Wildfire in the park may occur through lightning strikes starting fires, or may occur through human causes, and initial assessment of fires does not always distinguish ignition sources. All unplanned ignitions, regardless of ignition source will hereafter be considered wildfires. Prescribed fires are carefully planned to achieve park management objectives. The types of impacts on vegetation caused by prescribed and unplanned wildfire are similar, although the degrees of effects can vary with fire intensity, which varies in response to season, wind, air temperature, relative humidity, fuel composition, elevation, and other local variables. The effects of prescribed burning on vegetation can be mitigated through careful planning and implementation.

Adverse effects of wildfire on vegetation communities may occur if fire burns during weather conditions that would remove or diminish vegetation communities (for example, during drought conditions or during conditions when soil and fuel moisture is low, and does not prevent fire spread to hammocks or tree islands). Fire intensity or fire severity may also adversely affect vegetation communities if all above-ground vegetation is burned and plants cannot resprout or reestablish from the seed bank, due to altered soils or hydrology.

Wildfire management actions, including fire suppression activities, may be required as part of the response to wildfire and prescribed fire, and impacts could include removal of vegetation for control lines, use of natural openings for helicopter landing areas, and personnel and equipment that could compact the soils and temporarily trample or remove vegetation. Minimum impact suppression tactics would be used in the park, including in wilderness areas to mitigate these effects. It is assumed that wildfire management actions, including fire suppression activities, would remove smaller areas of vegetation relative to unplanned wildfires or prescribed fires; whole vegetation communities would not be removed, and the vegetation would recover rapidly after the wildfire management actions are complete. The effects of fire suppression actions on all vegetation communities are short-term, negligible to minor, and adverse.

Mechanical clearing in some areas may be required to protect structures and boundaries, or may be used for exotic plant management under the exotic vegetation management plan. Mechanical clearing planned for hazardous fuel reduction is limited by wilderness constraints, and would not be allowed after expiration of the categorical exclusion in 2015. Mechanical clearing would result in the removal of small areas of vegetation, not removal of whole vegetation communities, and personnel and equipment may compact soil and temporarily trample or remove vegetation in localized areas. The effects of mechanical clearing on vegetation communities, if it occurs, would be short-term, negligible, and adverse.

Beneficial effects of prescribed fire (and wildfire) on vegetation communities include the maintenance of ecological function and values of the native communities. Prescribed fire can replace the role of natural fire in maintaining fire dependent plants and communities where habitat fragmentation and alteration has changed the natural fire regime. Under appropriate conditions wildfires are important for fire-adapted communities. Beneficial effects from fire management include:

- Prescribed fire is used to reduce hazardous fuel loads that contribute to the potential for catastrophic wildfire. Without prescribed fire or wildfire, fuel would continue to accumulate, increasing the risk of catastrophic unplanned wildfire that could allow significant vegetation community alteration, and substantial, adverse habitat alternation or degradation may occur.
- Management of some species of exotic plants. Without prescribed fire and wildfire, exotic plants such as Old World climbing fern and Brazilian pepper would continue to invade and displace native plant communities. Loss of native plant communities degrades the habitat required by these native species and communities, thereby reducing their potential for survival and recovery in the wild.
- Restoration and maintenance of historical habitat succession conditions.
- Enhancement of the diversity of plant and animal assemblages.

The absence of wildfire and/or prescribed fire, as a result of random influences that control the natural fire regime, could result in long-term minor to moderate adverse impacts to communities that would be subject to more intense fires due to increased fuel loads and subsequent potential changes as a result of succession. The limited use of prescribed fire under Alternative A, combined with a lack of wildfire would potentially lead to these adverse effects.

Fire occurs in all FMUs and fire is managed differently within each FMU, depending on the vegetation communities present within the FMU, constraints imposed by wilderness, and other resources to be protected. The effect to each vegetation community is considered for prescribed fire, wildfire, wildfire operations, and mechanical clearing activities.

Sawgrass Marsh (long hydroperiod wetlands). Under Alternative A, prescribed fire is primarily used to manage exotic species with some hazardous fuel reduction. Prescribed fires for other reasons, including hazardous fuel reduction, are limited due to the use of categorical exclusions and wilderness restrictions as described in Alternative A.

In most sawgrass marshes, prescribed fire is accomplished using aerial ignition techniques. The effects of prescribed fire on sawgrass marshes under Alternative A would be long-term and beneficial.

Wildfires would be managed using an appropriate fire management strategy. During normal conditions, following fire, sawgrass would resprout rapidly if hydrological conditions were correct, sometimes resprouting within a few days. Wildfires under Alternative A would have long-term beneficial impacts on sawgrass marshes under certain conditions.

During extreme drought, wildfires could cause organic soils to burn and could result in changes in topography, which could lead to the sawgrass marsh changing to other vegetation communities. During an extreme drought, wildfires in sawgrass marsh would be suppressed. The effects of fire suppression activities on sawgrass marshes under Alternative A would be short-term, negligible and adverse. However, prevention of organic soil fires using suppression techniques would have long-term beneficial effects on sawgrass marshes.

Marl Prairies (short-term hydroperiod prairies). Under Alternative A, prescribed fire is primarily used to manage exotic species with some hazardous fuel reduction. Prescribed fires for other reasons, including hazardous fuel reduction, are limited due to the use of categorical exclusions and wilderness restrictions as described in Alternative A. Because marl prairies are sparsely vegetated, fires only occur when sufficient biomass is present.

Prescribed burning maintains the vegetation community of marl prairie, controls woody encroachment, rejuvenates the grasses, maintains diversity, and promotes vegetation reproduction. The effects of prescribed fire on marl prairies under Alternative A would be long-term beneficial.

Fires would be suppressed in marl prairies if there was a threat of organic soil fire, or if fire approached a hammock, although hammock soil moisture may prevent it from burning even though the surrounding vegetation is burning. Fire suppression actions would cause minor effects through damage or removal of vegetation, but these effects would be on a much smaller scale than the effects of wildfire. Fire suppression in marl prairies under Alternative A would have short-term negligible to minor adverse effects.

Coastal Prairies. Coastal prairies within the park would continue to be treated by prescribed fire under Alternative A as described in chapter 2. The purpose of prescribed fire in the coastal prairie is to restore and maintain these vegetation communities, control shrub invasion of mangrove and buttonwood, and also control exotic invasive vegetation where initial treatment from the park's exotic vegetation management program has taken place, such as areas with Brazilian pepper and Old World climbing fern. Prescribed fire kills exotic seedlings, prevents shrub encroachment, and promotes plant growth in coastal prairies. Prescribed fire in coastal prairies would have long-term beneficial effects.

The Alternative A description in chapter 2 presents the management options and decision process for determining the response to an unplanned ignition in coastal prairies as well as the other vegetation communities. Wildfire management actions, if they occurred under Alternative A would have short-term, negligible adverse effects on coastal prairies.

Pine Rocklands. Fire is essential for maintaining pine rockland communities; complete fire exclusion would lead to loss of this vegetation community. The use of prescribed fire in pine rocklands is limited and described for Alternative A in chapter 2. Under Alternative A, pine block AA and the fire blocks around Long Pine Key campground, Pine Island housing area, and the Boy Scout camp would be burned on three year intervals, and the remaining fire blocks would not be burned. Where it would be allowed to be implemented under Alternative A, prescribed fire would have long-term beneficial effects on restoration of pine rocklands.

Fire suppression in pine rocklands would occur if wildfires did not meet park management goals or where the fire threatened structures. Wildfire management actions (including suppression actions) in pine rocklands may result in limited vegetation damage. Wildfire management actions (including suppression actions) in the pine rocklands under Alternative A would have short-term minor adverse effects.

Hardwood Hammocks and Tree Islands. Prescribed fire is not used within hardwood hammocks or tree islands. The goal for these communities is to keep fire out and keep these vegetation features at their historic size. Burning areas around the hammocks controls and reduces the fuel load surrounding the hammocks, thus helping protect them from wildfires by reducing the risk that a wildfire would enter the hammock.

Prescribed fire to protect hammocks or tree islands would not be used unless soil and fuel moisture in the hammock were high enough to prevent fire spread into hammocks. Where it would be allowed to be implemented under Alternative A, prescribed fire would have long-term beneficial impacts from burning fuels around hammocks.

During dry conditions wildfire has the potential to move into hardwood hammocks. Fires in hardwood hammocks would cause the loss of species diversity and stature and loss of complexity due to loss of plants. During drought conditions, fires approaching hardwood hammocks are suppressed. Wildfire management actions in hardwood hammocks would be different than those for grasslands, and include cutting lines into them to allow access, trampling, and soil compaction. Cutting lines, mop-ups, and bucket drops also would result in changing the canopy coverage, opening gaps that change the way sunlight enters these closed-canopy forests. Wildfire management actions in hardwood hammocks would have short- to long-term minor to moderate adverse effects.

Cypress Forests. Under Alternative A, prescribed fires would continue to be performed in cypress forest in FMU 2 in the mixed cypress and pines area, in FMU 3 in the scattered cypress domes in Taylor Slough between Taylor Slough and the eastern park boundary, and south of the Main Park Road. Prescribed burning maintains this vegetation community and prevents encroachment of woody species and exotic species. Prescribed fire in cypress forests under Alternative A would have long-term beneficial impacts on cypress forests.

Wildfire in cypress forests under Alternative A could happen anywhere cypress exists as long as there is available fuel. This would include, for example, the southwest pines area of FMU 3; in FMU 3 in the scattered domes in Taylor Slough, between Taylor Slough and the eastern park boundary, and south of the Main Park Road. Wildfire in the cypress forest (not cypress domes or strands) vegetation community can prevent encroachment of woody species. Wildfire in cypress forests under Alternative A would have long-term beneficial impacts on cypress forests under certain conditions.

Cypress domes and strands are used as fire breaks as an indirect wildfire containment strategy. Unplanned ignitions would be managed, following the available management strategies described for Alternative A. In some instances, wildfire management tactics such as bucket drops would be used.

Bucket drops may smash plants or open holes in canopies. Wildfire operations in cypress domes and strands under Alternative A would have short-term, negligible to minor adverse effects.

Mangrove/Buttonwood Forests. The park would not perform prescribed burns in mangrove / buttonwood forests. However, the potential would exist for some scorching of mangroves where they border coastal prairies undergoing prescribed burns. Should this happen, fire would not change the structure of mangrove/buttonwood forests, and canopy openings on the fringes would be recolonized from the adjacent forest. There would be short-term negligible adverse effects to mangrove forests from prescribed fire in coastal prairies.

Wildfires do not carry in mangroves. Lightning strikes scorch and kill trees within an approximately 15-foot diameter circle; however, mangroves do not carry fire beyond an individual strike because they do not burn unless dead (for example, following a major hurricane or frost event that killed trees). There are no fire management operations in mangroves.

Sloughs. Sloughs are the wettest of the freshwater Everglades communities; under normal conditions, slough vegetation habitats generally will not burn. Because sloughs are wet, it is an extremely rare event to have fire move through these areas.

During an extreme drought, a wildfire could ignite the organic soils of a slough, but the park would suppress fires under this situation. Organic soil fires could lead to loss of vegetation and substrate. This would change the community structure and result in open areas and ponding where different communities would arise. Fires in sloughs would be managed with an appropriate strategy as described for Alternative A. If bucket drops were used during drought conditions, this could result in a localized disruption of vegetation and soil. The effects of wildfire suppression during drought conditions in sloughs would be short- and long-term, and negligible to moderately adverse.

Cumulative Impacts

Other past, present, and reasonably foreseeable actions or plans that may affect vegetation in Everglades National Park include past land uses and agricultural practices, alteration of hydrology and drainage, population growth, and removal of similar vegetation communities outside the park due to development (see Chapter 1: Connected and Similar Actions for more information on these actions within and outside the park).

Population growth outside the park removed most similar vegetation communities, for example pine rocklands and hardwood hammocks and, therefore, protection of these habitats within the park is critical. Restoration of vegetation communities in the park can be accomplished through restoration of natural hydrological conditions through projects under the umbrella of the Comprehensive Everglades Restoration Plan designed to capture, store, treat, and redistribute water through the park. Restoration of hydrological conditions, in conjunction with exotic plant removal as described above, would restore native vegetation communities that can then be managed under a more natural fire regime. Restoration of hydrologic conditions and subsequent restoration of natural fire regimes would have a short- and long-term beneficial effect on vegetation communities within Everglades National Park.

Within the park, exotic animals are being actively managed, and control of exotic animals may result in an increased number of personnel looking for, trapping, and disposing of exotic animals. Increased foot and vehicle traffic during removal of exotic animals such as Burmese pythons and feral pigs would have short-term, negligible to minor adverse impacts to vegetation communities.

When short-term negligible to minor impacts to vegetation due to exotic animal removal and other long-term beneficial impacts to restored vegetation through better hydrological and fire conditions

are combined with the short-and long-term, negligible to moderately adverse, and the long-term beneficial fire management effects to vegetation under Alternative A, the resulting cumulative effect would be considered short- and long-term and beneficial. The long-term beneficial effects of Alternative A would contribute an imperceptible amount to the overall long-term beneficial cumulative impacts.

Conclusions

Prescribed fire for fire-adapted vegetation communities would be used to replicate a natural fire regime and fire mosaic. The effects of prescribed fire under Alternative A would be long-term and beneficial for vegetation communities in sawgrass marsh, marl prairie, coastal prairie, pine rocklands and cypress forests. Prescribed fire would not be used in vegetation communities of hardwood hammocks/tree islands, mangrove/buttonwood forests, and sloughs. Prescribed fire adjacent to these communities may provide protection and prevent catastrophic wildfire from entering hardwood hammocks/tree islands, mangrove/buttonwood forests, or sloughs (if sloughs are dry enough to burn).

Prescribed fire would remove or reduce the cover of exotic plant species within all FMUs, depending on the species. The effect of prescribed fire on native vegetation communities from the removal of exotic plants would be long-term and beneficial for native plant communities. However, the use of prescribed fire would not be allowed following expiration of the Categorical Exclusion in 2015, except for management of exotic plants. In the absence of prescribed fire, and if wildfire does not occur due to random forces, there could be long-term minor to moderate adverse effects if communities dependent on fire were to experience unwanted succession as a result of the absence of fire.

Wildfire is beneficial for fire prone native vegetation communities, and the effects of wildfire in sawgrass marsh, marl prairie, coastal prairie, pine rockland and cypress forests would be long-term and beneficial under certain conditions. Wildfire does not occur in hardwood hammocks/tree islands, mangrove/buttonwood forests, and sloughs under normal conditions. If fire occurs in these non-fire prone communities during drought conditions, the effects of wildfire would be short- and long-term, minor to moderate, and adverse.

Wildfire management actions may affect vegetation communities through damaging or removing native vegetation communities, but the effects of wildfire operations and the fire itself would benefit vegetation communities through protection from catastrophic fire, buildup of biomass, and through stimulation of new plant growth. The effects of wildfire management actions would be short- and long-term, negligible to minor, and adverse for native vegetation communities.

When the adverse and beneficial cumulative impacts to vegetation are combined with the effects to vegetation under Alternative A, the resulting cumulative effect would be considered short- and long-term and beneficial. The adverse and beneficial effects of Alternative A would contribute an imperceptible amount to the overall long-term beneficial cumulative impacts.

ALTERNATIVE B: NATIONAL PARK SERVICE PREFERRED ALTERNATIVE

Impact Analysis

Under Alternative B, the general beneficial and adverse effects of prescribed and wildfire, and the short-term adverse effects of wildfire management actions are the same as described for Alternative A. Alternative B would allow more prescribed fire than Alternative A, and potentially less severe wildfires and less damaging wildfire management actions would occur under Alternative B than Alternative A due to a reduction in fuel loads as a result of prescribed fire implementation. The

increased use of prescribed fire in all communities under Alternative B would have additional beneficial effects when compared to Alternative A because the risk of intense wildfire would be reduced, as well as a less likely need for widespread fire suppression actions. Under Alternative B, Long Pine Key pine blocks would be burned to create a mosaic pattern of vegetation and adjacent blocks would not be burned.

Although mechanical and/or chemical treatments are not described or currently planned for any of the communities presented below, the multi-year fuels treatment plan associated with Alternative B does include the potential for mechanical and/or chemical treatments to reduce excess fuel loads in locations where the use of planned ignitions would not be feasible. Such treatments, if implemented, would be on a small scale due to the few areas where planned ignitions would not be feasible that would also need fuel reductions. Thus, the adverse impacts on any vegetation in such areas would be short-term and negligible with long-term benefits occurring as the potential for intense wildfire would be reduced.

Sawgrass Marsh (long hydroperiod wetlands). In FMU 2, the frequency of prescribed fire would increase to break up the fuel continuity and reduce woody encroachment under Alternative B. Under Alternative B, prescribed fire would mimic previous natural fire patterns and replace natural fire the park lost in FMU 2. Under Alternative B, prescribed fire would take place in sawgrass marshes in FMUs 2, 3 and 4 in accordance with the Cape Sable seaside sparrow management plan and other strategies described for Alternative B. Prescribed fire would also be used in areas where exotic vegetation was treated in FMUs 2 and 4 to maintain or restore native sawgrass marsh habitat. Because wildland and prescribed fire would be used to mimic natural fire conditions in sawgrass marsh, the effect of wildland and prescribed fire under Alternative B would be long-term and beneficial.

During extreme droughts, wildfires would be suppressed to prevent organic soil fires. Wildfire management actions during drought conditions in sawgrass marshes would have short-term, minor adverse effects. Protection of organic soils through wildfire management actions in sawgrass marshes would have long-term beneficial effects.

Marl Prairies (Short-term hydroperiod prairies). Under Alternative B, prescribed fire would be carried out within FMUs 2, 3, and 4 in accordance with the Cape Sable seaside sparrow management plan. The effects of prescribed fire in marl prairies under Alternative B would be long-term beneficial.

The frequency of unplanned wildfires may decrease as a result of increased planned wildfires and potentially damaging wildfire management actions may decrease under Alternative B. Wildfires in marl prairies would have long-term beneficial effects under certain conditions.

Potentially damaging wildfire management actions would have short-term negligible to minor adverse effects to marl prairies under Alternative B.

Coastal Prairies. Prescribed fire in coastal prairies would be the same as described under Alternative A. The effects of prescribed fire in coastal prairies under Alternative B would restore natural fire regimes and the effects would be long-term beneficial.

Management of wildfire would be the same in coastal prairies under Alternative B as described for Alternative A and the effects would be the same.

Wildfire management actions in coastal prairies would be used to protect important park resources as described in Alternative A. Wildfire management actions under Alternative B would have short-term negligible adverse effects.

Pine Rocklands. Under Alternative B, adjacent Long Pine Key pine blocks would not be burned within one year of each other, to allow understory plants used by butterflies to recover and be recolonized by butterflies (see the "Special Status Species" section in chapter 3). The effects of prescribed fire on pine rocklands under Alternative B would be long-term and beneficial. Wildfires in sawgrass marshes to the west may move into the unit. Wildfire in the pine rocklands would be evaluated and the tactics used to respond would be consistent with the management strategies presented in chapter 2.

Wildfire operations including suppression actions in pine rocklands under Alternative B would be as described for Alternative A. The effects of wildfire operations including suppression actions in pine rocklands under Alternative B would be short-term, minor, and adverse.

Hardwood Hammocks and Tree Islands. Hardwood hammocks and tree islands would not be managed with prescribed fire, but prescribed fire would be used to reduce fuels around hammocks to protect them from catastrophic fire. Under Alternative B, there would be an increased use of prescribed fire to protect hardwood hammocks and tree islands. Prescribed fire would not be used if the soil moisture within the hammocks was too low to prevent fire from moving into the hammock. The effects of prescribed fire on hardwood hammocks and tree islands under Alternative B would be long-term beneficial impacts from burning fuels around hammocks. Wildfire does not occur in hardwood hammocks or tree islands under normal conditions, but may occur in vegetation surrounding hardwood hammocks. Management of unplanned ignitions would be the same as described for Alternative A, but hardwood hammocks in all FMUs would be protected with prescribed fire around the perimeter and wildfire would be prevented from moving into hammocks.

Wildfire management actions in and around hardwood hammocks under Alternative B would be similar to those described for Alternative A, although the adverse impacts would likely be incrementally less because of reduced need for suppression. Wildfire management actions within hardwood hammocks would have short- to long-term, minor adverse effects on vegetation.

Cypress forests. Under Alternative B, the use of prescribed fire in cypress forests of FMUs 2, 3, and 4 would involve more acreage and potentially be more frequent than that described for Alternative A. Prescribed fire under Alternative B would have long-term beneficial impacts on cypress forests.

The management and operational strategies employed for unplanned ignitions under Alternative B would be the same as described for Alternative A and the effects would be similar, namely short-term, minor, and adverse as well as long-term and beneficial.

Mangrove/Buttonwood Forests. The park would manage mangrove/buttonwood forests under Alternative B similar to Alternative A. Prescribed fire would not be used. The short-term effects would be the same as those for Alternative A, negligible adverse effects to mangrove forests from prescribed fire in coastal prairies.

Sloughs. Wildfire is rare in sloughs; the effects of wildfire during drought conditions in sloughs would be short- and long-term, and negligible to moderate adverse. Under Alternative B, wildfire

management actions during extreme drought would have short- and long-term beneficial effects to sloughs.

Cumulative Impacts

Impacts associated with other past, present and reasonably foreseeable actions are similar to those described under Alternative A.

When short-term negligible to minor beneficial impacts to vegetation due to exotic plant removal and other long-term beneficial impacts to restored vegetation through better hydrological and fire conditions are combined with the long-term beneficial fire management effects to vegetation under Alternative B, the resulting cumulative effect would be considered short- and long-term beneficial. The long-term beneficial effects of Alternative B would contribute appreciably to the overall long-term beneficial cumulative impact.

Conclusions

Under Alternative B, the amount of prescribed fire used in the park would be substantially greater than in Alternative A and result in a long-term beneficial impact on vegetation. The adverse impacts of wildfire management actions on vegetation under Alternative B would be short-term and minor, with some long-term beneficial effects.

When the impacts to vegetation of other plans and projects are combined with the effects to vegetation under Alternative B, the resulting cumulative effect would be short- and long-term, and beneficial. The adverse and beneficial effects of Alternative B would contribute appreciably to the overall long-term beneficial cumulative impacts.

WILDLIFE AND THEIR HABITATS

AFFECTED ENVIRONMENT

The faunal communities in Everglades National Park evolved with naturally occurring fire. Fires play a role in shaping of populations and communities through alteration of landscapes patterns and processes. Wildlife response to fire depends on the characteristics of fire such as size, severity, patchiness, and season of burning.

The warm, wet climate and unique habitats found within Everglades National Park support over 40 species of mammals, 352 species of birds, 50 species of reptiles (including 27 snakes and 16 turtles), 15 species of amphibians, a multitude of freshwater and marine aquatic species. In addition, the park has a large number of insect species, including almost 100 species of butterfly. Distribution of species within the park varies by season, dominant vegetation community, and successional status of vegetation communities. Species not federally or state-listed as threatened, endangered, or species of special concern, are described in this section; descriptions are provided for representative species of the various taxonomies listed above. Because fire management activities are not expected to affect marine environments, only terrestrial wildlife species and wetlands fish are included in this description. In addition to the native wildlife species, exotic animal species have become abundant in some areas. Exotic animals pose a threat to natural wildlife communities because exotic wildlife may prey upon native wildlife or compete for food or habitat with native species.

Mammals

Small- to medium-sized mammals inhabiting marshes include the round-tailed muskrat (*Neofiber alleni*), breeding populations of rice rats (*Oryzomys palustris*), and hispid cotton rats (*Sigmodon hispidus*) (Kushlan 1990; Gunderson and Loftus 1993). River otters (*Lutra canadensis*) also occur in sloughs and other water bodies. Raccoons (*Procyon lotor*), opossum (*Didelphis virginiana*), bobcats (*Lynx rufus*), nine-banded armadillos (*Dasypus novemcinctus*) and several rodent species occupy habitats throughout the park, including hardwood hammocks, pine rocklands, and mangrove forests. The largest mammal species in Everglades National Park is white-tailed deer (*Odocoileus virginianus*), the primary prey of the endangered Florida panther (*Puma concolor coryi*) (see the "Special Status Species and Their Habitats" section in chapter3). There is a small established population of feral pigs (*Sus scrofa*) within the park that can be observed on tree islands and within hardwood hammocks. Feral pigs may disturb burrows and remove native vegetation used by native wildlife.

Birds

Birds in the park include year-round residents, seasonal migrants and breeders, and occasional visitors. Water fowl such as mottled ducks (*Anas fulvigula*) may occur in the marshes of the park, other marsh birds include marsh wren (*Cistothorus palustris*), common yellowthroat (*Geothlypis trichas*), red-winged blackbird (*Agelaius phoeniceus*), and boat-tailed grackle (*Quiscalus major*). Wading birds are common throughout the marshes and include great egret (*Casmerodius albus*), glossy ibis (*Plegadis falcinellus*), American bittern (*Botaurus lentiginosus*), and king rail (*Rallus elegans*).

Bird species that occupy habitats in the pine rocklands include resident red-bellied woodpeckers (*Melanerpes carolinus*), northern cardinals (*Cardinalis cardinalis*), eastern towhees (*Pipilo erythrophthalamus*), pine warblers (*Dendroica pinus*), great-crested flycatchers (*Myiarchus crinutus*), and white-eyed vireos (*Vireo griseus*) (Lloyd and Slater 2011). Common migrants and winter residents of the pine rocklands include gray catbirds (*Dumetella carolinensis*), blue-gray gnatcatchers

(*Polioptila caerulea*), hermit thrushes (*Catharus guttatus*), painted buntings (*Passerina ciris*), and many species of warbler, including American redstarts (*Setophaga ruticilla*), black-and-white warblers (*Mniotilta varia*), palm warblers (*Dendroica palmarum*), and ovenbirds (*Seirus aurocapillus*).

Bird species that occur in the coastal prairies include Nelson's and saltmarsh sharp-tailed sparrows (*Ammodramus nelsoni* and *A. caudacutus*) and shore birds that feed along the waters of Florida Bay.

Raptors build nests in cypress and mangrove trees. Raptors that may occur throughout the park include red-shouldered hawks (*Buteo lineatus*), barred owls (*Strix varia*), and white-tailed kites (*Elanus leucurus*). Bird species that occur in mangrove forests include mangrove cuckoos (*Coccyzus minor*), prairie warblers (*Dendroica discolor*), white-eyed vireos (*Vireo griseus*), black-whiskered vireos (*Vireo altiloquus*), and clapper rails (*Rallus longirostris*).

Commonly kept pet species, such as parrots, can occasionally be observed flying freely in the park, but are typically not breeding. Like many other natural areas within the United States, European starlings (*Sturnus vulgaris)* are found in the park and compete with native cavity nesters such as red-bellied woodpeckers.

Amphibians and Reptiles

Amphibians occupy habitats throughout the park. Amphibians include the leopard frog (*Rana sphenocephala*), pig frog (*R. grylio*), bullfrog (*R. catesbeiana*), green tree frogs (*Hyla cinerea*), the squirrel tree frog (*Hyla squirella*), and the exotic Cuban tree frog (*Osteopilus septentrioinalis*) (Rice et al. 2004; Meshaka et al. 2000).

The largest, most well-known reptile in the park, the American alligator (*Alligator mississippiensis*), are considered keystone species because of the depressions they create and maintain, and these gator holes provide fire and dry season refugia for both the alligators and other species. In addition to the alligator, there are a number of other reptiles in habitats throughout the park. Snake species that occupy marsh habitats may include the Everglades racer (*Coluber constrictor paludicola*), Florida water snake (*Nerodia fasciata pictriventris*), Florida cottonmouth (*Agkistrodon piscivorus conanti*), and brown water snake (*Nerodia taxispilota*). Snake species that occupy upland habitats in pine rocklands and hardwood hammocks include the red rat snake (*Elaphe guttata guttata*), yellow rat snake (*Elaphe obsolete quadrivittata*), Everglades rat snake (*Elaphe obsolete rossalleni*), black racers (*Coluber constrictor*), rough green snake (*Opheodrys aestivus*), Florida brown snake (*Storeria dekayi victa*), eastern garter snake (*Thamnophilus sirtalis*), eastern coral snake (*Micrurus fulvius fulvius*), eastern diamondback rattlesnake (*Crotalus adamanteus*), and dusky pygmy rattlesnake (*Sistrurus miliarius barbouri*). Within mangrove forests, the mangrove saltmarsh snake (*Nerodia clarkia compressicauda*) is present (Meshaka et al. 2000).

The large and potentially dangerous Burmese python (*Python molorus bivittatus*) dramatically increased in numbers since 1999 and is preying on native species as large as the white-tailed deer. Until recently pythons were only found in the saline glades near Flamingo, but are now found in a variety of habitats in the park, including remote mangrove swamps.

Several turtle species are known to occur within the park, including the Florida softshell turtle (*Apalone ferox*), Florida mud turtle (*Kinosternon subrubrum steindachneri*), and Florida redbellies (*Pseudemys nelsoni*).

Lizards that may occur in the park include the green anole (*Anolis carolinensis*), Florida reef gecko (*Sphaerodactylus notatus notatus*), southeastern five-lined skink (*Eumeces inexpectatus*), and the exotic Cuban brown anole (*Anolis sagrei*).

Freshwater Fish

Fish are the food source for a number of wildlife, including most wading birds. Minnow-sized species dominate the fish fauna of the marshes and solutions holes, and include such species as the live-bearing mosquitofish (*Gambusia affinis*) and least killifish (*Heterandria formosa*), along with cyprinodont, including flagfish (*Jordanella floridae*), golden topminnow (*Fundulus chrysotus*), and bluefin killifish (*Lucania goodei*). Small sunfish are very abundant, including pygmy sunfish (*Elassoma* spp.) and bluespotted sunfish (*Enneacanthus gloriosus*). Smaller individuals of larger species such as warmouth (*Lepomis gulosus*) and redear sunfish (*Lepomis microlophus*) (Gunderson and Loftus 1993; Kushlan 1990) are found in marshes with fluctuating water levels. The dominance of small fish in these areas arises from mortality of large species during dry periods; however, the distribution and abundance of species can change seasonally or with variability in climate (Kushlan 1990), and fish may move at the start of the wet season from permanently wet sloughs to recolonize newly flooded areas in sawgrass and marl prairies. Deep marshes and alligator ponds support the largest fishes in the park, including largemouth bass (*Micropterus salmoides*), Florida gar (*Lepisosteus platyrhincus*), yellow bullhead (*Ameiurus natalis*), bowfin (*Amia calva*), and pirate perch (*Aphredoderus sayanus*) (Kushlan 1990). Karsitic areas of the Rocky Glades and marl prairies have thousands of solution holes, or deep pits where limestone has worn away. Deep marshes, alligator ponds, and solution holes may remain flooded during the dry season and provide a subsurface refuge for fish during the period when surface marshes are dry.

Invertebrates

The fauna of Everglades National Park includes a vast array of invertebrate life. Some groups are well documented, but inventories have not been conducted for most major invertebrate groups. Life histories of species reported from the park are not well known. Some species are intolerant of fire (e.g., tree snails in hammocks), while others require fire (e.g., pineland specialists). Special status invertebrates including butterflies and snails are addressed in the Special Status Species section.

Within the marshes, apple snails (*Pomacea paludosa*), prawns, crayfish, and aquatic insects are abundant invertebrates in wet prairies and sloughs.

The varied habitats of Everglades National Park provide habitat for a large number of butterfly species from at least ten families. Some butterflies are found in several habitats within the park, while other species are restricted to specific habitats (Lenczewski 1980). Many of these species are seasonal in abundance, often traveling to the park over great distances; although some are year-round residents that specialize in these habitats. Distribution and abundance of butterflies are correlated to the availability of host plants and migratory patterns of each species.

As many as 47 species of ants are reported from all habitat types within the park, and 26 of these species are exotic (Ferster and Prusak 1994). Exotic ants may be preying upon native ants, or displacing native ants from their habitats.

Climate Change Effects on Wildlife and their Habitats

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 evaporation rates. These effects would therefore affect wildlife communities as their habitats would potentially undergo change.

Mammals. Mammals would respond to changes in habitat and prey availability, and many species would experience range contractions or expansions.

Birds. Birds are shown to be responding to climate change with shifts in migration and migration timing. Migratory birds that winter in south Florida may leave wintering grounds earlier to migrate north, causing competitive interactions with local birds. Wading birds and shorebirds are expected to be affected by an increase in the rate of sea level rise with an associated loss of coastal marshes, and if freshwater fish populations are altered by changes in hydrology, inland wading birds would be adversely affected.

Amphibians and Reptiles. Amphibians appear to be among the most sensitive species to changes in temperature and precipitation patterns (NPS 2009b). The immune system of many amphibians is highly temperature dependent; as temperatures rise, amphibians may not be able to cope with new pathogens. Reptiles such as the American Alligator may be affected by changes in prey availability if changes in fish and wading bird populations occur. Further, the sex of some reptile species, including the alligator, the American crocodile, and sea turtles is determined by nest temperature during incubation.

Fish. Fish would likely be affected by altered hydrologic regimes, and increased surface water temperatures. These changes may potentially decrease concentrations of dissolved oxygen in the water column. Potential changes in hydrological patterns and extended drought conditions would substantially reduce fish populations and the availability of refugia for aquatic species.

Invertebrates. Insects may see some of the same effects as migratory birds, including altered migratory patterns, loss of plant species that are food or shelter, and northern range expansion. Butterflies are very sensitive to temperature and humidity, and increased surface temperatures and reduced precipitation could cause physiological disruptions for many butterfly species.

ENVIRONMENTAL CONSEQUENCES

Impact Analysis Methods

This section describes the probable and possible impacts of the alternative actions on the fish and wildlife within Everglades National Park. Potential impacts are described in terms of type (are the effects beneficial or adverse), duration (are the effects short-term or long-term), and intensity (negligible, minor, moderate, or major).

Analyses of the potential intensity of impacts to wildlife were derived from the professional judgment of NPS staff and a review of available literature. Descriptions of these thresholds of impacts as they relate to wildlife are as follows.

The geographic areas considered for this impact topic are the habitats in which the fish and wildlife species occur in Everglades National Park and the vegetation communities within FMUs as described in chapter 2 of this environmental assessment.

It is assumed the mitigation measures described in chapter 2 of this environmental assessment would be implemented under the action alternative in accordance with the park's fire management plan. These mitigation measures are intended to minimize impacts of the action alternative on wildlife and their habitats.

Thresholds

Threshold	Definition
Negligible	Impacts are barely detectable and/or would affect a minimal area of fish and wildlife habitat. Impacts on fish and wildlife communities would not be detectable.
Minor	Impacts are slight but detectable, and/or would affect a small area of habitat or few members of the fish and wildlife communities. The severity and timing of changes are not expected to be outside natural variability, either spatially or temporally. Key ecosystem processes and community structure are retained at the local level.
Moderate	Impacts are readily apparent and/or would affect a large area of habitat and/or a large portion of the fish and wildlife communities. The severity and timing of changes are expected to be outside natural variability, either spatially and/or temporally; however, key ecosystem processes and community structure are retained at the landscape (regional) level.
Major	Impacts are severely adverse and/or would affect a substantial area of habitat and/or the majority of the inhabiting fish and wildlife community. The severity and timing of changes are expected to be outside natural variability, both spatially and temporally. Key ecosystem processes and community structure may be disrupted. Habitat for wildlife species may be rendered nonfunctional at the landscape level.
Short-term	Impacts to wildlife would occur only during the management action and effects would last less than five years
Long-term	Impacts would persist for five or more years.
Imperceptible	The incremental effect contributed by the alternative to the overall cumulative impact is such a small increment that it is impossible or extremely difficult to discern.
Noticeable	The incremental effect contributed by the alternative, while evident and observable, is still relatively small in proportion to the overall cumulative impact.
Appreciable	The incremental effect contributed by the alternative constitutes a large portion of the overall cumulative impact.

ALTERNATIVE A: NO ACTION / CONTINUE CURRENT MANAGEMENT

Impact Analysis

Wildlife species would generally respond to prescribed and wildfire in the same manner, although the degree of effect depends on fire intensity, which varies in response to season, wind, air temperature, relative humidity, composition of fuels, and other variables. The effects of prescribed fire on wildlife are intended to be mitigated through careful planning and implementation.

Following fire, some species respond favorably and increase in numbers, while others respond negatively and decrease. Wildlife species that do not escape fire may be injured or killed. Less mobile life stages of wildlife species (such as nestlings and juveniles) and less mobile species (such as amphibians and reptiles) would be most impacted by fire. Wildlife able to escape fire may be forced into marginal habitat or occupied territories resulting in an increase likelihood of predation, difficulty foraging, and difficulty in finding shelter and mates. Wildlife species may experience habitat loss from a fire. Changes in vegetation structure and composition, burned material, and snags that occur after the fire can all affect wildlife, and loss of vegetation structure may lower wildlife species diversity in an area (McMahon and deCalesta 1990). Depending on the season, a fire can also have adverse effects on a species' nesting or reproductive success. However, wildlife of Everglades National Park evolved in the presence of fire, and a number of Everglades wildlife species are accustomed to fire and have behavioral and other adaptations to fire. Foraging opportunities may increase following fire for some species.

Unplanned fire may be used to manage resources depending on environmental conditions, fire behavior, and whether any resources are at risk. Prescribed fires by their very nature are used as a tool to manage resources. In both cases, these fires would benefit native wildlife by maintaining natural vegetation and fire mosaics. Fires that are patchy and result in a mosaic of burned and unburned or mixed burn severity areas would maintain more heterogeneous environments with broader wildlife species diversity than larger-scale, high-intensity fires that burn over large areas. Prescribed fire in prairies throughout the park are often started with aerial ignition, and some wildlife species may be affected by helicopter noise, but most wildlife species would return to the area within a short time. Some wildlife species may be at risk if they are surrounded by fires from multiple ignitions, but prescribed fires would use multiple, sequential and methodical ignition locations and techniques to avoid this situation.

Wildfire management actions may be used for wildfire or prescribed fire and the effects on wildlife would generally be due to the use of vehicles and mechanized equipment during the wildfire management actions; wildlife would move away from the area during the action, but would return to the area after the action is completed. Effects of fire are described in more detail in the following paragraphs. Wildfire management actions may remove areas of vegetation, but the area of vegetation removed would be small relative to the area affected by prescribed fire or wildfire, and would not affect entire populations of wildlife species. Wildfire management actions under Alternative A would have short-term, negligible to minor adverse effects on fish and wildlife with additional long-term beneficial effects from prescribed fire used until the categorical exclusion expiration no longer allows such use.

Mammals. Most medium-sized mammals like raccoons, opossums, bobcats, and marsh rabbits can escape the direct heat and smoke of fires in all habitats by running or using burrows or any other available cover, and few adults would be trapped by fire. There may be loss of individual litters of young, but this would be a short-term adverse impact because most adults would survive to breed again. Medium- to large-sized mammals, including deer and feral pigs, would use unburned pine rocklands, hardwood hammocks, or tree islands as dry-land refugia from fire. Smaller mammals such as rodents may be more likely to be trapped and killed in fire, but many would escape and rebreed the following season. Mammals would primarily be affected by fire's effect to vegetation, water, and cover. The response to fire would be species-specific, but in general, herbivores would tend to congregate on recently burned sites to forage on new vegetation and predators would follow the herbivores into new growth areas.

The effects of prescribed fire and wildfire on mammals would be similar; the effects would be short-term, negligible to minor, and adverse if individuals are lost; however, entire populations of wildlife species would not be lost in fire. Wildland fires that burn under optimal conditions and prescribed fire would create a mosaic with vegetation in different stages of recovery, thus providing mammals with long-term benefits.

Wildfire management actions may be used to protect important park resources such as hardwood hammocks, or to prevent organic soil fires, most mammals would move away from equipment and personnel, and would return to the area shortly after the action was completed. Wildlife species may be affected if burrows are collapsed, less-mobile animals or susceptible life-stages are impacted, or if adults are trapped, but these actions are expected to be uncommon and not affect more than a few individuals of wildlife populations. Wildfire management actions would have short-term, minor adverse effects on mammals if wildlife habitats are disrupted and temporary displacement of individuals were to occur, but long-term benefits could accrue if habitats such as hardwood hammocks are protected.

Birds. Adult birds in all habitats can easily escape fire through flying. Wildfire or prescribed fire may affect foraging and nesting birds (such as wading birds, common yellowthroats, and wrens) and their nests. Nests and their contents within a burn unit could be destroyed by fire and this would be a local, short-term, minor to moderate adverse impact because the birds could re-nest or breed again the following year. Species adapted to early seral stages would benefit following a burn.

Wildfire in the marl prairies and sawgrass marshes of Everglades National Park may reduce the quality of foraging habitat locally available through changes in vegetation structure and loss of suitable perches used during foraging and roosting. Additionally, the use of a helicopter in the vicinity of nests may damage nests and result in nest failure, as a result of air turbulence from a low-flying or hovering helicopter. Collision with a helicopter, while unlikely, is also possible.

Short-term disturbance to foraging may result from fire, or from equipment, personnel, and vehicles involved in conducting the prescribed fire or wildfire management actions. Prescribed fire in pine rocklands could consume and/or create snags, which are used by cavity-nesting wildlife. If snags burn, nests could be lost to fire, but birds could renest following a burn or nest the following year. Fire may injure trees and encourage decay, attracting a variety of wood-boring insects that in turn attract insectivorous birds, such as woodpeckers.

Management of planned and unplanned ignitions under Alternative A could result in individual nest loss and although impacts to individuals could be substantial, there would be short-term, minor adverse effects on bird species. To the extent fires create a mosaic with vegetation in different stages of recovery, the effects to bird species would be long-term and beneficial.

Amphibians and Reptiles. Amphibians and reptiles have species-specific fire adaptations. Tree frogs and other small amphibians can sometimes escape fire through use of small water bodies such as rainwater collected in bromeliads, or in tree cavities. Amphibians may also move to wetter areas until the fire has passed. Some reptiles, including turtles and snakes escape through entering bodies of water (such as sloughs) while other reptiles, including terrestrial snakes and lizards escape to burrows or other available cover. Snakes were observed on the flanks of an active fire hunting for rodents flushed out by the fire (Wade et al. 1980).

Wildfire management actions are not likely to affect amphibians and reptiles, because fire management actions would not be required in wetter areas where amphibians occur, and reptiles would likely be able to move away from fire equipment and personnel.

Because fires create a mosaic with vegetation in different stages of recovery from fire, the effects to amphibian and reptile species would be long-term and beneficial.

Freshwater Fish. Fish can be harmed by loss of vegetative cover and loss of organic sediments owing to soil subsidence following a fire. Freshwater fish typically occur in the waters of sloughs, sawgrass and marl prairies, where they can withstand lower-temperature fires without mortality. A few species of fish have drought-resistant eggs that could be affected by dry-season fires. Small fish undergo seasonal movements, and when fish are concentrated during times of seasonal movements they are susceptible to predation, and increased predation pressure may affect their reproductive success. Loss of vegetation cover from wildfire may also increase water temperatures, which would alter dissolved oxygen levels in the water, adversely affecting fish. During severe drought conditions that affect sloughs, the altered water levels are likely to have a greater impact to fish species than fire. Both planned and unplanned ignitions in sloughs, sawgrass, and marl prairies under Alternative A would have short-term, negligible to minor adverse effects on fish species through temporary removal or alternation of habitat, and would have long-term beneficial effects on invertebrate and fish species through improvement of overall wetland habitats.

Invertebrates. Aquatic invertebrates, like fish, occur in the waters of sloughs, sawgrass and marl prairies, where they can withstand lower-temperature fires without mortality. However, some groups (for example crayfish) can move overland (Acosta and Perry 2002) and others have aerial stages (many aquatic insects), placing them in a terrestrial environment where they would be affected by fires. Terrestrial and semi-aquatic invertebrate species are at more risk during fires than aquatic species. Prescribed fire and wildfire may remove vegetation cover, increasing water temperatures and altering dissolved oxygen concentrations. Aquatic invertebrates can generally tolerate very low dissolved oxygen concentrations, and are less affected than fish.

A number of invertebrate species are dependent on vegetation for reproduction and development. The adverse impacts of fire on these species would be greater than those described for aquatic and semi-aquatic species and would likely be negligible to minor and short-term.

Prescribed fire and wildfire in vegetation communities, under Alternative A would have short-term, negligible to minor adverse effects on invertebrate species through temporary removal or alternation of habitat, and would have long-term beneficial effects on invertebrate species through improvement of overall wetland habitats.

Cumulative Impacts

Other past, present, and reasonably foreseeable actions or plans that adversely affected wildlife in Everglades National Park include past land uses that reduced suitable habitat for wildlife, changes in hydrologic regime that altered wildlife habitats, and historical overhunting and collecting that reduced the size of wildlife populations. Within the park, exotic plant management would restore wildlife habitats and have long-term beneficial impacts on wildlife. Exotic animal control within the park would reduce competition for habitats and reduce predation on native wildlife, which would have long-term beneficial effects for native fish and wildlife species.

Population growth outside the park removed most similar vegetation communities, for example pine rocklands and hardwood hammocks, and thus native wildlife species in these habitats have limited dispersal options to new sites, if sites within the park become unavailable. Restoration of hydrologic flows, in conjunction with exotic plant removal within the park would benefit wildlife species by restoring suitable habitat.

When long-term adverse impacts of past actions that adversely affected wildlife and their habitats are combined with the long-term beneficial impacts of restored wildlife habitats as a result of exotic plant removal and better hydrological and fire conditions, and with the short-term, negligible to minor adverse and long-term beneficial fire management effects to wildlife under Alternative A, the resulting cumulative effect would be considered short- and long-term and beneficial. The long-term beneficial effects of Alternative A would contribute noticeably to the overall long-term beneficial cumulative impact.

Conclusion

The fire management plan under Alternative A would continue to maintain habitats suitable for a variety of wildlife species throughout the park. The effects of wildfire and prescribed fire (where implemented) would be short-term, negligible to minor, and adverse, but would result in a degree of long-term beneficial effects through maintenance of wildlife habitats, but this maintenance may not be optimal. Wildfire management actions would have short-term, minor adverse impacts if wildlife habitats are disrupted or temporary displacement occurs, but long-term benefits would accrue if habitats such as hardwood hammocks are protected.

When the long-term adverse impacts of past actions that adversely affected wildlife and their habitats are combined with the long-term beneficial impacts of restored wildlife habitats as a result of exotic

plant removal and better hydrological and fire conditions, and with the short-term, negligible to minor adverse and long-term beneficial fire management effects to wildlife under Alternative A, the resulting cumulative effect would be considered short- and long-term and beneficial. The contribution of Alternative A to these impacts would be noticeable.

ALTERNATIVE B: NATIONAL PARK SERVICE PREFERRED ALTERNATIVE

Impact Analysis

Under Alternative B, fire management would be an adaptive process that would be conducted to minimize adverse effects and maximize benefits to resources, including native fish and wildlife. To this end, there would be less fire suppression under Alternative B than Alternative A due to the reduction in fuel loads resulting from the use of prescribed fire. Therefore, wildland fires requiring suppression actions would be less likely to occur. Fish and wildlife would respond to fire in the same manner as was described for Alternative A, although the kind of fires experienced under Alternative B could be less intense and the responses would differ accordingly. Fire management actions under Alternative B would have short-term, negligible to minor adverse effects on fish and wildlife due to wildland fire and/or wildfire management actions and would have long-term beneficial effects, as described in the following paragraphs.

The multi-year fuels treatment plan associated with Alternative B includes the potential for mechanical and/or chemical fuel reduction treatments, although as currently configured there are no non-fire treatments proposed in the multi-year fuels treatments plan. However, if these management strategies were to be implemented, they would have similar effects on all groups of wildlife species. Because the timing of fuel reduction efforts could be planned to avoid sensitive breeding seasons and adjusted for different habitats (e.g., chemical use would be restricted in aquatic environments), the adverse impacts on wildlife species would be short-term, local, and minor at most. These impacts would occur primarily as a result of the presence of field personnel and equipment use, including noise and emissions, vehicles, and temporary disturbance. These short-term adverse effects would be offset by the long-term benefits associated with reduced fuel loads and the subsequent lowering of potential fire intensities.

Mammals. The effects of prescribed fire and wildfire on mammals would be short-term, negligible to minor, and adverse if individuals are lost; however, entire populations of wildlife species would not be affected. Wildland fire would be managed to create a mosaic with vegetation in different stages of recovery; therefore the effects to mammal species would be long-term and beneficial.

The impacts of wildfire management actions would be short-term, minor, and adverse if wildlife habitats are disrupted or if mammals were temporarily displaced, but long-term benefits would accrue if habitats such as hardwood hammocks were protected. Therefore, wildfire management actions conducted under Alternative B to protect park resources would be short-term, minor, and adverse as well as provide long-term benefits for mammals that would be incrementally greater than those experienced under Alternative A.

Birds. Wildland fire, both planned and unplanned, under Alternative B could result in individual nest loss and would have short-term, minor adverse effects on individual birds. However, fire management under Alternative B would be conducted and managed to create an optimal mosaic of vegetation and avian habitat in different seral stages, therefore the effects to bird species would be long-term and beneficial, and incrementally greater than those described for Alternative A.

Amphibians and Reptiles. As with Alternative A, wildfire management actions are not likely to affect amphibians and reptiles, because most of the park is wilderness, and the use of equipment that could harm reptiles and amphibians is accordingly limited, with negligible adverse impacts. Fire management under Alternative B would be conducted to create an optimal mosaic with vegetation in different stages of recovery from fire, therefore the effects to amphibian and reptile species would be long-term and beneficial, and incrementally greater than those described for Alternative A.

Freshwater Fish. Fire management under Alternative B would have short-term, negligible to minor adverse effects on fish species through temporary alteration of habitat, but would have long-term beneficial effects on fish as a result of improvement of overall wetland habitats. These benefits would be incrementally greater than those described for Alternative A.

Invertebrates. Similar to the effects described for alternative A, wildland fire activities under Alternative B would have short-term adverse effects on invertebrate species through temporary removal or alteration of habitat, but would have long-term beneficial effects on invertebrate species through improvement of overall wetland habitats. These benefits would be incrementally greater than those described for Alternative A.

Cumulative Impacts

Impacts associated with other past, present and reasonably foreseeable actions are similar to those described under Alternative A. When short- and long-term beneficial impacts to restored wildlife habitats through exotic plant and animal removal and better hydrological and fire conditions are combined with the long-term beneficial fire management effects to wildlife under Alternative B, the resulting cumulative effect would be considered short- and long-term beneficial. The long-term beneficial effects of Alternative B would contribute a noticeable amount to the overall long-term beneficial cumulative impacts.

Conclusions

The fire management program under Alternative B would be conducted so as to optimally maintain habitats suitable for a variety of wildlife species throughout the park while minimizing adverse effects. The effects of wildland fire management would be short-term, negligible to minor, and adverse but would result in long-term beneficial impacts to wildlife through maintenance of their habitats. Wildfire management actions would have short-term, negligible to minor adverse impacts if wildlife habitats are disrupted or species temporarily displaced, but long-term beneficial if habitats such as hardwood hammocks were protected. Fuel reduction activities would have short-term, minor impacts on wildlife species, with future reduced fire intensities representing a long-term benefit.

When short- and long-term beneficial cumulative impacts to restored wildlife habitats through exotic plant and animal removal and better hydrological and fire conditions are considered with the short-term negligible to minor adverse and long-term beneficial fire management effects to wildlife under Alternative B the resulting cumulative effect would be considered long-term and beneficial. The long-term beneficial effects of Alternative B would contribute a noticeable amount to the overall long-term beneficial cumulative impact and with an incrementally greater proportion than Alternative A.

SPECIAL STATUS SPECIES AND THEIR HABITAT

The Endangered Species Act of 1973 requires an evaluation of the effects of proposed actions on all federally listed species and designated critical habitat with potential to be affected by the action. NPS policy also requires, to the greatest extent possible, examination of impacts on state-listed threatened, endangered, candidate, rare, declining, and sensitive species in a manner similar to that of federally listed species (NPS 2006). A wide variety of federally listed special status species, including threatened, endangered, and candidate plants and animals, and species proposed for listing, occur in Everglades National Park. The park is also home to numerous animal species listed as endangered, threatened, or species of special concern by the State of Florida. Other animal species of management concern, including recently reintroduced avian species, are not listed by the state or federal government but are the focus of many management actions and may warrant special considerations. The flora of Everglades National Park includes 163 plant species listed as threatened, endangered, or commercially exploited by the State of Florida. Several plant species not listed by the state or federal government are very rare within the park and may warrant special consideration when implementing management activities under either alternative, and are considered herein.

For the reasons discussed below, this section does not attempt to conduct a detailed analysis of potential impacts from implementation of either alternative on all special status species that occur in Everglades National Park. An initial list of special status species was compiled that included: 1) all federally listed species that were identified as potentially present within the park in the official species list provided by the U.S. Fish and Wildlife Service (Consultation tracking number 04EF2000-2013-SLI-0040, dated 11/26/2012); 2) all plant and animal species that occur or are documented to have occurred in the park and that are listed by the State of Florida as endangered, threatened, species of special concern or commercially exploited; and 3) all additional non-listed species that are considered to be species of management concern by the park. The compiled list was then reviewed to determine which species required a detailed analysis (see Appendix A).

The list of species to be considered further was reduced by reviewing each species' status in the park and its susceptibility and relationships to the proposed action in the following manner: 1) Species that have been extirpated from Everglades National Park or that are not currently believed to occur in the park were not analyzed; 2) Species that occur in the park but do not occur in areas expected to be affected by fires, such as those in marine areas, mangroves, and hardwood hammocks, were not analyzed in detail; 3) Species that are protected by mitigations designed to minimize impacts to federally listed species were not analyzed in detail; and finally, 4) state listed species with insufficient information to conduct a detailed analysis were not included. The group of special status plant species that are closely associated with fire-adapted communities and are known to be adapted to or depend on regular fire for long-term persistence are also identified in Appendix A but are analyzed as a group in this section. In general, the effects of either alternative on these species are consistent with the effects described in the "Vegetation" section of this chapter.

For all federally listed threatened, endangered, and candidate species, and those proposed for listing, Appendix A identifies a preliminary determination of effect. Those species that do not occur in the park or will not be affected by the alternatives are identified, and a determination of "no effect" is provided. These species are not considered further in this document. Determinations for species listed as "threatened due to similarity of appearance" are not provided because section 7 consultation is not required and these species would only be retained for further consideration if it were biologically warranted.

Federally listed species that may be present within the park and have the potential to be affected by the alternatives were given an initial section 7 determination of "may affect." All of these species will be included in detailed analysis, and the further determinations of whether adverse effects are likely to occur are made below through more detailed analysis. In addition, information and analysis on

state listed or other special status species are included for those species that may be impacted by either alternative. Detailed accounts and an analysis of impacts under each alternative follow for the species that were retained for further analysis.

AFFECTED ENVIRONMENT

The following species accounts summarize existing information for each of the species retained for analysis (Appendix A).

Plants

The National Park Service periodically conducts surveys for rare plants, including Blodgett's silverbush, pineland sandmat, Garber's spurge, and Florida pineland crabgrass in appropriate habitats within the park. Data from those surveys, including geographic coordinates, estimated population size, reproductive status, and associated plant species are recorded and maintained on an internal database.

Blodgett's silverbush (*Argythamnia blodgettii*) is a candidate for listing under the Endangered Species Act and is state-listed as endangered. This species is a small, semi-woody, perennial plant that grows as tall as 2 feet. Historically, Blodgett's silverbush occurred in pine rocklands of central and southern Miami-Dade County and as well as pine rocklands, rockland hammocks, coastal berms and disturbed areas of Monroe County (Keys). Recent surveys indicate that the overall range of this species has been significantly reduced, primarily from development (Hodges and Bradley 2006 cited in USFWS 2011a). Blodgett's silverbush requires sunny sites and periodic low-intensity fires to reduce competition from larger woody species. Critical habitat has not been designated for this species.

Blodgett's silverbush occurs in Everglades National Park in two populations in higher elevation pine rocklands in FMU 3. Plants in both populations have been observed by NPS staff as recently as 2011. Two occurrences of Blodgett's silverbush are known from Long Pine Key. One consists of approximately 1000 plants and extends across two pine blocks. That occurrence is bisected by a fire road. The other consists of approximately 50 plants and is entirely within one pine block.

Specimens and field observations indicate that Blodgett's silverbush produces flowers and fruit throughout the year. However, it is not known if there is an annual peak in flowering or fruiting. The breeding system of this species is also not understood. Plants of the closely related *A. candicans* produce floral nectaries (Percival 1974), which indicates that insects may represent one means of pollination. Self-pollination may also occur in this species. Further study is needed to better understand life history traits of this species.

Primary threats to Blodgett's silverbush in Everglades National Park include fire exclusion and exotic plant invasions. Impacts from fire exclusion have been minimized through the regular application of prescribed fire in pine rocklands where this species occurs. Impacts from exotic plant infestations have also been minimized through a combination of prescribed fire and physical control of exotic species that may displace Blodgett's silverbush.

Pineland sandmat (*Chamaesyce deltoidea* ssp. *pinetorum*) is a candidate for listing under the Endangered Species Act and is state-listed as endangered. Pineland sandmat is a perennial herbaceous plant with irregularly shaped leaves with stems 4 to 6 inches long radiating from a woody taproot. It is known to occur only in pine rocklands along the Miami Rock Ridge in southern Miami-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 exclusion, and invasion by exotic species has led to a significant reduction in distribution and population size outside of Everglades National Park. Critical habitat has not been designated for this species.

Within the park, pineland sandmat occurs in higher elevation pine rocklands throughout Long Pine Key within FMU3. Herbarium specimens, observations and field notes include records of plants in 9 pine blocks throughout Long Pine Key. It is estimated that at least 10,000 plants occur in the park. Comprehensive surveys of Long Pine Key for this plant would likely result in locating plants in additional pine blocks and an increase in the estimated population size. It is unclear if this species occurs in the Pine Island area or not. Species specific surveys have not been conducted and plants have not been observed in that area. However, potentially suitable habitat occurs there.

Based on herbarium specimens and observations, plants in Everglades national park appear to flower and fruit between March and August. This is consistent with the flowering season reported in Wunderlin and Hansen (2011). The breeding system of pineland sandmat is not known. A related species (*C. hyssopifolia*) is reported to be self-pollinating while other members of the genus require insects or bees to produce seeds. Further study is needed to better understand life history traits of this species.

Within Everglades National Park, threats to this species are primarily fire exclusion and exotic plant infestations. Impacts from fire exclusion have been minimized through the regular application of prescribed fire. Impacts from exotic plant infestations are minimized through a combination of prescribed fire and physical control of exotic species that may impact pineland sandmat.

Garber's spurge (*Chamaesyce garberi*) is federally listed as threatened and state-listed as endangered. Garber's spurge is an annual or short lived perennial, herbaceous plant up to one foot tall with hairy stems and oval leaves belonging to the Euphorbiaceae family. Garber's spurge is endemic to south Florida and formerly occurred in Miami-Dade and Monroe counties from the Miami area to the Lower Florida Keys. Habitats for this species include pine rockland, coastal rock barren, beach dune and associated coastal grasslands and coastal berm. It needs open, sunny to moderately shaded areas that have frequent fires or other disturbance to maintain suitable habitat, and it prefers thin, sandy soil or exposed limestone (USFWS 1999a). Critical habitat has not been designated for this species.

Garber's spurge has been observed and/or collected in four areas of Everglades National Park. Within FMU 1, plants are known from beach dunes and coastal grasslands of Northwest Cape Sable, Middle Cape Sable, and East Cape Sable. Within FMU 3, plants occur in pine rockland habitats of Long Pine Key within two pine blocks. The population of Garber's spurge on East Cape Sable was last collected in 1995, and plants have not been seen since that time despite recent surveys of the site (Green et al. 2007a). The remaining populations in the other areas of FMU 3 have all been observed recently. Populations in both Pine Block B and Northwest Cape Sable include large numbers of plants. Counts along transects in Pine Block B recorded 4,800 plants. While no final estimate of the total population size was calculated, Green et al. (2007a) indicate that as many as 100,000 plants may be present. Data collected along transects on Northwest Cape Sable resulted in an estimated population size of over 630,000 plants at that site. Populations on Middle Cape Sable and Pine Block A were both reported to be quite small with 400-500 plants estimated at Middle Cape Sable and 600-700 estimated for Pine Block A (Green et al. 2007a, Green et al. 2007b).

Based on herbarium specimens and observations, plants in Everglades National Park appear to flower and fruit throughout the year. The breeding system of Garber's spurge is not known. A related species (*C. hyssopifolia*) is reported to be self-pollinating while other members of the genus require insects or bees to produce seeds. Based on the abundance of fruiting plants observed in both Cape Sable and Long Pine Key populations, it is likely that this species is self-pollinating. Further study is needed to better understand life history traits of this species.

Within Everglades National Park, two of the known sites are in coastal locations, where there is a risk of impacts from tropical storms. However, surveys of coastal populations after significant storm surge events in 2005 show that the populations recovered following the storms (Green et al. 2007b).

The impacts of hurricanes on Garber's spurge populations are not entirely clear. Populations on Middle and Northwest Cape Sable are also threatened by infestations of exotic invasive species, including crow foot grass (*Dactyloctenium aegyptium*), sisal hemp (*Agave sisalana*), leadtree (*Leucaena leucocephala*), Brazilian pepper, cogongrass (*Imperata cylindrica*), and coconut palm (*Cocos nucifera*). Efforts are periodically undertaken to control most of these species, diminishing the threat to some extent. Fire exclusion also represents another threat to Garber's spurge populations in pine rocklands of Everglades National Park. Historical fire patterns in flammable communities around Cape Sable are not known; it is unclear if these communities are dependent on periodic storm surge, fire or a combination of both for maintenance. Human activities, including off target damage from exotic plant control efforts and unintentional trampling from visitor and administrative access to coastal areas where this species occurs, also represent minor threats to this species.

Florida pineland crabgrass (*Digitaria pauciflora*) is a candidate for listing under the Endangered Species Act and is state-listed as endangered. Florida pineland crabgrass, also known as Everglades crabgrass, is a perennial grass that grows as tall as 3 feet and is easily recognized by its dense covering of hairs, giving it a fuzzy appearance. Historically, pineland crabgrass was distributed from south Miami to Long Pine Key. It prefers the ecotone between pine rocklands and marl prairie, but will occasionally occur in both of these habitats. Plants can withstand inundation for one to several months each year. Florida pineland crabgrass habitat has been destroyed by development, and regional water control efforts. Fire exclusion and exotic species infestations have also contributed to the species decline. Critical habitat has not been designated for this species.

The current distribution of this species in Everglades National Park is restricted to Long Pine Key within FMU 3, with approximately 1,000 to 10,000 individuals surviving there (USFWS 2011b). A recent comprehensive survey for this species was carried out between 2004 and 2008 by The Institute for Regional Conservation (Gann et al. 2008). Individuals are found in marl prairies and adjacent lower elevation pine rocklands in most of the finger glades bisecting the region. Observations of plants have also been made in prairies and associated wet pine rocklands east of the Main Park Road near Mahogany Hammock in Pine Block West of A.

Specimens and field notes on Florida pineland crabgrass from Everglades National Park indicate that this species begins flowering in June and finishes seeding as late as December. The breeding system of this species has not been documented, but it is likely that it is wind-pollinated like most other grasses. This species may also be self-compatible. Further study is needed to better understand life history traits of this species.

Threats to Florida pineland crabgrass in Everglades National Park include fire exclusion, exotic plant invasion, and changes to the regional hydrology. Impacts from fire exclusion have been minimized through the regular application of prescribed fire. Impacts from exotic plant infestations are minimized through a combination of prescribed fire and physical control of exotic species that may impact Florida pineland crabgrass. The effects of changes in regional hydrology through restoration may have significant impacts on this species and the habitats that it occupies. Increased hydroperiods in wetland habitats where this species occurs may lead to a reduction in the amount of suitable habitat, a potential reduction in the area occupied and a reduction in the number of individuals found in Long Pine Key. It is unclear to what extent this may occur, if at all. In an effort to establish a baseline assessment of future hydrologic modifications, long-term monitoring transects and plots for Florida pineland crabgrass were established between marl prairie and pine rockland habitats (Gann et al. 2008). These plots will be re-monitored periodically as resources permit. Occasionally, plants occur on or adjacent to hiking trails, and hiking or administrative access may result in impacts to individuals.

Everglades bully (*Sideroxylon reclinatum* ssp. *austrofloridense*) is a candidate for listing under the Endangered Species Act. This species is an upright shrub that reaches 3 to 6 feet in height.

Historically, this species had a narrow distribution which was generally restricted to pine rocklands and marl prairies in southern Miami-Dade County and the Lostmans Pines area of Big Cypress National Preserve in Monroe County. Plants occur in lower elevation pine rocklands, marl prairies and the ecotone between the two habitats. Loss of habitat, drainage and exotic species infestations have reduce the range of this species and plants are now generally restricted to protected habitats in Everglades National Park and Big Cypress National Preserve. Outside of the park, habitat destruction and degradation resulting from hydrological modifications and exotic species infestations remain the primary threats to populations of this species. Critical habitat has not been designated for this species.

In Everglades National Park, this species is locally common in appropriate habitats throughout the Long Pine Key area within FMU 3. Plants have been recorded in marl prairie and wet pine rocklands in 11 locations throughout LPK. Surveys did not include habitats in the western pine blocks or the Pine Island area. It is likely that additional plants would be found in these areas if surveys were conducted. The population size of this species in Everglades National Park is estimated to be between 10,000 and 100,000 plants (Gann et al. 2008). Due to the widespread distribution and abundance of this species, park staff do not typically record site specific information for this species when conducting rare plant surveys.

Wunderlin and Hansen (2011) report the flowering season of Everglades bully as spring and Elisens and Jones (2009) report the season as April and May. The flowers of Everglades bully are fragrant and white indicating that pollination by insects is likely. Further studies are needed to better understand life history traits of this species.

Everglades bully within the park is threatened to some extent by invasive exotic plant species and fire exclusion. In addition, the effects of changes in regional hydrology through restoration may have impacts on this species and the habitats that it occupies. Increased hydroperiods in wetland habitats where this species occurs may lead to a reduction in the amount of suitable habitat, a potential reduction in the area occupied and a reduction in the number of individuals found in Long Pine Key. It is unclear to what extent this may occur, if at all. In an effort to establish a baseline assessment of future hydrologic modifications, long-term monitoring transects and plots for Everglades bully were established between 2005 and 2008 (Gann et al. 2008). These plots will be re-monitored periodically as resources permit and as restoration projects are implemented.

Other Plant Species of Management Concern that Occur in Fire Dependent Habitats

Seventy plant species are considered here collectively because they are either listed by the State of Florida as endangered, threatened or commercially exploited or are considered species of management concern by Everglades National Park and they occur in habitats that require periodic burning for long-term maintenance (Appendix A). These species include trees and shrubs of Caribbean origin, near endemic understory herbs, temperate grasses as well as terrestrial and epiphytic orchids. The abundance and distribution of these species varies widely, with some restricted to a single known site and others found in a variety of habitats in multiple FMU's. The amount of information available for each of these species ranges from qualitative descriptions to site-specific quantitative data that are periodically updated by the park botanist. In general, information on long-term status and trends is limited for the majority of these species. Recorded data collection is limited to geographic coordinates, population estimates or counts, reproductive status, habitat occupied and associated taxa. This information has been collected for a subset of species in this group that are known to be very limited in distribution or otherwise warrant special consideration when planning and implementing projects that may impact them. Existing data, site visits and best professional judgment are used to generate protective measures or other mitigations on a case by case basis during the planning process for park activities.

Factors that may impact populations of plant species of management concern that occur in fire dependent habitats in the park include fire exclusion, implementation of prescribed fire and other fire management activities, exotic plant and insect infestations, hydrological modifications to wetland habitats, vegetation management activities and poaching. The extent to which these factors have influenced populations over time is not well understood. The long-term persistence of rare plant species in fire dependent habitats where historical and current information is available indicates that most of the rarest species are typically as abundant or are more abundant than they were historically. Plant species of management concern found in fire dependent habitats with exotic plant infestations have likely declined in those areas. The influence of hydrological modification on these species, if any, is unknown.

Invertebrates

Florida leafwing (*Anaea troglogyta floridalis*) is a medium-sized butterfly endemic to pine rocklands and associated hardwood hammocks and marl prairies of southeastern Florida. This species is listed as endangered under the Endangered Species Act (USFWS 2014). It is not currently listed by the State of Florida. Critical habitat has been identified for this species in a substantial area of Long Pine Key within FMU3 (USFWS 2014).

Historically, the Florida leafwing occurred in suitable habitat from the lower Florida Keys north to Miami with limited observations or collections from the surrounding counties in South Florida (Salvato and Hennessey 2003). Range-wide declines have greatly diminished the former distribution of this species. Potential causes for declines include habitat destruction, invasive plant and animal (ant) infestations, and mosquito spraying, though no definitive reason has been established. The Florida leafwing is now believed to be extant only within the Long Pine Key area of Everglades National Park (Schweitzer et al. 2011). Populations may also persist in pine rockland fragments at Navy Wells in southern Miami-Dade County and Big Pine Key in the lower Florida Keys, though individuals have not been observed there since 2006 (USFWS 2012a).

Florida leafwings have been observed regularly in a widespread area of Long Pine Key over the past several years. In surveys conducted between 2005 and 2011, adults or larvae were recorded by park staff in 13 individual fire blocks within FMU 3. Larvae of the Florida leafwing depend on pineland croton (*Croton linearis*) as the sole food source needed for development and are restricted to areas where that species occurs. As a result, the close tie between the Florida leafwing and pineland croton requires the consideration of both species when developing management strategies and addressing potential impacts. In Everglades National Park, pineland croton occurs in pine rocklands that do not seasonally flood as well as lower elevation pine rocklands adjacent to marl prairies that are seasonally inundated. Pineland croton is frequently encountered along the edges of marl prairies but also occurs well away from these wetlands.

Adult leafwings are frequently seen in pine rockland habitat in association with their host plants. Individuals have also been observed at the edges of hardwood hammock and in disturbed uplands adjacent to pine rockland areas. Adults (Salvato and Salvato 2010) and larvae (Salvato and Salvato 2010; unpublished NPS data) have been observed during every month of the year. Salvato and Salvato (2010) report a peak in abundance of adults during the fall and spring with the lowest observed abundance during the summer months. Monitoring data from the park's fire management staff indicate a late summer to fall peak in observations of larvae (ENP Fire Management Program, No date). Lenczewski (1980) reported the Florida leafwing as especially common during August – October of 1979.

Adult leafwings feed on fruit, dung and sap (USFWS 2012a, Salvato and Hennessey 2003). Pine rocklands that support larval host plants as well as adult food sources are needed to support Florida

leafwing populations. Pine rocklands with pineland croton adjacent to hardwood hammocks may represent ideal habitat for this species.

Despite the wide distribution of observations, the number of individuals observed is typically very low. Salvato (cited in USFWS 2012a) estimated a total population size of several hundred or fewer adult individuals in Long Pine Key. Salvato (2001) reported population densities ranging from 1.4 – 6.0 adults/ha at a single survey location within a small portion of pinelands in the park between 1988 and 1998. More recent surveys resulted in an estimate of one adult/ha (Salvato and Salvato 2010). Based on these estimates and an estimate of 1068ha of suitable habitat in Long Pine Key (Henessey and Habeck 1991), the Florida leafwing population in the park could approach several thousand individuals if all suitable habitat was occupied. However, surveys of habitat with host plant populations frequently fail to result in detection of Florida leafwing adults or larvae. All suitable habitat in the park is not utilized at any given time by Florida leafwings and a population of several hundred or fewer individuals is reasonable. Salvato and Salvato (2010) also suggest that a decline in the Florida leafwing population at one of their study sites is occurring.

Surveys of pineland croton along fire roads and to some extent into undisturbed pine rockland habitat in Long Pine Key have been carried out by park staff and volunteers from 2007 to the present. This work has provided some insight into the overall distribution of this species in Long Pine Key. In addition, this information can be used to identify occurrences of pineland croton that occur in adjacent pine blocks and are divided by existing fire roads. A study is currently underway that includes transect based surveys for pineland croton throughout Long Pine Key. Once completed, a quantitative estimate of the population size of pineland croton in Long Pine Key may allow a more robust estimate of host plant population size to be made.

Monitoring of tagged pineland croton plants is being conducted by the NPS in several locations in Long Pine Key. Fire management staff also studies effects of fire on pineland croton and larval abundance in limited areas of the park (ENP Fire Management, unpublished report). In addition, monitoring of the croton population at Hayes Barn Road in the Hole-in-the-Donut restoration area is carried out by park biology staff. At both sites, plants are measured and reproductive status is recorded. Presence of larvae or adults is also noted when found on plants or observed in the area. This information allows the park to continue to refine the understanding of general characteristics of croton populations as well as the impacts of events such as fire and frost. This information will also be used to better understand characteristics of host plants that are supporting one or more larvae of this species. Non-NPS studies are also currently underway to determine the impacts of parasitism on Florida leafwing larval survival and to estimate the population size and other characteristics of this species in Long Pine Key.

Historically, natural fire led to the development of the plant and animal associations that occur in pine rocklands, including pineland croton and the Florida leafwing. Regularly recurring fire is considered to be a necessary component for maintenance of pine rockland; without fire, pine rocklands can succeed to rockland hammock in as little as 15-25 years (Robertson 1953). Long-term studies indicate that regular prescribed fire in Long Pine Key has resulted in relatively stable Florida leafwing populations over time (Salvato and Salvato 2010).

Within Everglades National Park, populations of the Florida leafwing are threatened by competition or elimination of host plants by exotic invasive species. Brazilian pepper is the only species that has been consistently observed within or adjacent to known pineland croton populations. Regular application of prescribed fire in pinelands typically keeps Brazilian pepper at very low population levels (Stevens and Beckage 2010). As a result, no areas have been identified to date where this species is believed to be causing significant displacement of pineland croton in Long Pine Key. Infestations of Australian pine and shoebutton Ardisia (*Ardisia elliptica*) also represent localized threats to pineland croton in some areas of Long Pine Key. Focused treatments using hand pulling,

herbicide application or a combination of the two are used for control of infestations in areas impacted by these species.

Substantial impacts to pineland croton populations and mortality of Florida leafwing larvae have been observed following frost in Long Pine Key. Mortality of leaves and above ground stems has been observed in pineland croton populations following freezing temperatures. Observations of leafwing larvae following frost indicate that as many as half of larvae may die as a direct result of freezing temperatures or defoliation of host plants resulting from frost (Hallac et al. 2010). Damage levels to croton probably depend primarily on the duration and severity of subfreezing temperatures. Pine canopy cover also appears to influence severity of impacts. The influence of fire on canopy structure may represent a long-term driver of croton population dynamics, but this relationship is not understood and requires further study. Recovery time of host plants from frost damage appears to be similar to that following fire; however, the long-term impacts of these events on the Florida leafwing are not understood.

Pineland croton plants growing along several fire breaks between pine blocks are at risk from unintentional damage from vehicles or trampling when these roads are accessed. Park staff, researchers and the public all use existing pineland fire roads throughout Long Pine Key. Plants growing along the edges and in the middle of these fire roads may be unintentionally damaged by these activities. If plants are occupied by larvae of the Florida leafwing, these impacts will also directly affect that species.

Efforts to control mosquitoes around park housing and infrastructure with insecticides have been carried out by park staff. These efforts may have impacted Florida leafwings in the park in the past. Mosquito spraying in Everglades National Park is currently restricted to 12 acres in the Flamingo housing area and does not occur near pine rockland habitats. If the park resumes mosquito control activities using adulticides in pine rockland habitat, potential impacts to Florida leafwing individuals and populations would be possible.

Parasitism and predation by other insects has been observed in Florida leafwing larvae. Salvato and Salvato (unpublished data cited in USFWS 2012a) estimated larval mortality of 50-75 percent resulting from a fairly wide range of insect predators and parasites. This may have a substantial influence on Florida leafwing population size in Long Pine Key. However, the population level implications of this are not currently understood.

Within Everglades National Park, critical habitat has been proposed in approximately 8,000 acres throughout the known range of the species within Long Pine Key. For the purpose of this analysis, it is assumed that proposed critical habitat will ultimately be designated as described in the proposed rule, and therefore it is included. The Primary Constituent Elements (PCE's) of the proposed critical habitat include sufficient sized areas of pine rockland habitat and associated rockland hammocks, the absence of competitive nonnative plant species or their existence in quantities low enough to have minimal effect on survival of the Florida leafwing, the presence of sufficient host plant and low levels of pesticides, and a disturbance regime that ensures the long term maintenance of these habitats. A component of the disturbance regime identified as a PCE includes application of prescribed fire carried out in such a way to mimic natural fire cycles.

Bartram's scrub hairstreak (*Strymon acis bartrami*) is a small butterfly endemic to pine rocklands and associated hardwood hammocks and marl prairies of southeastern Florida. This species is listed as endangered under the Endangered Species Act (USFWS 2014). It is not currently listed by the State of Florida. Critical habitat has been identified for this species in a substantial area of Long Pine Key within FMU3 (USFWS 2014).

Historically, the Bartram's hairstreak occurred in suitable habitat in Miami-Dade and Monroe Counties. Range-wide declines have greatly diminished the former distribution of this species. Potential causes for declines include habitat destruction, invasive plants, fire exclusion, and

mosquito spraying, though no definitive reason has been established. Bartram's hairstreak is now believed to be extant only within the Long Pine Key area of Everglades National Park, a few isolated pine rockland fragments in urban Miami-Dade County and a small area of pine rockland on Big Pine Key (USFWS 2012b).

Bartram's hairstreaks have been observed regularly in a widespread area of Long Pine Key over the past several years. In surveys conducted between 2005 and 2011, adults or larvae were recorded by park staff in 8 individual burn blocks within FMU 3. Observations of adults or larvae have been recorded during every month of the year within the park. USFWS (2012b) indicate that population size varies due to season and other resource conditions. The number of individuals observed is typically very low. The total range-wide population size was estimated by Salvato (cited in USFWS 2012b) to consist of several hundred or fewer individuals. A total population estimate for Long Pine Key has not been made.

Larvae of the Bartram's hairstreak depend on pineland croton (*Croton linearis*) as the sole food source needed for development. As a result, the close tie between Bartram's hairstreak and pineland croton requires the consideration of both species when developing management strategies and addressing potential impacts. In Everglades National Park, pineland croton occurs in pine rocklands that do not seasonally flood as well as lower elevation pine rocklands adjacent to marl prairies that are seasonally inundated. Pineland croton is frequently encountered in pine rockland along the edges of transverse glades but also occurs well away from these wetlands. Adult Bartram's hairstreaks feed on the nectar of flowers of pineland croton as well as a variety of other native pineland herbs (USFWS 2012b; Salvato and Salvato 2008).

Monitoring of tagged pineland croton plants is being conducted by the NPS in several locations in Long Pine Key. Fire management staff studies effects of fire on pineland croton and larval abundance in limited areas of the park. At all sites, plants are measured and reproductive status is recorded. Presence of larvae or adults is also noted when found on plants or observed in the area. This information allows the park to continue to refine the understanding of general characteristics of croton populations as well as the impacts of events such as fire and frost. This information will also be used to better understand characteristics of host plants that are supporting one or more larvae of this species.

Historically, natural fire led to the development of the plant and animal associations that occur in pine rocklands, including pineland croton and the Bartram's hairstreak. Regularly recurring fire is considered to be a necessary component for maintenance of pine rockland; without fire, pine rocklands can succeed to rockland hammock in as little as 15-25 years (Robertson 1953).

Within Everglades National Park, populations of the Bartram's hairstreak are threatened by competition or elimination of host plants by exotic invasive species. Brazilian pepper is the only species that has been consistently observed within or adjacent to known pineland croton populations. Regular application of prescribed fire in pinelands typically keeps Brazilian pepper at very low population levels (Stevens and Beckage 2010). As a result, no areas have been identified to date where this species is believed to be causing significant displacement of pineland croton in Long Pine Key. Localized infestations of Australian pine and shoebutton ardisia (*Ardisia elliptica*) also represent minor threats to pineland croton in some areas of Long Pine Key. Focused treatments using hand pulling, herbicide application or a combination of the two are used for control of infestations in areas impacted by these species.

Substantial impacts to pineland croton populations have been observed following frost in Long Pine Key. Mortality of leaves and above ground stems has been observed in pineland croton populations following freezing temperatures (Hallac et al. 2010). Damage levels to croton probably depend primarily on the duration and severity of subfreezing temperatures. Pine canopy cover also appears to influence severity of impacts. Areas with greater aerial cover of pine sustained less leaf damage

than more exposed populations following frost in 2010 (J. Sadle personal observation). Recovery time of host plants from frost damage appears to be similar to that following fire; however, the long-term impacts of these events on the Bartram's hairstreak are not understood.

Pineland croton plants growing along several fire breaks between individual pine blocks are at risk from unintentional damage from vehicles or trampling when these roads are accessed. Park staff, researchers and the public all use existing pineland fire roads throughout Long Pine Key. Plants growing along the edges and in the middle of these fire roads may be unintentionally damaged by these activities. If plants are occupied by larvae of the Bartram's hairstreak, these impacts will also directly affect that species.

In the past, efforts to control mosquitoes around park housing and infrastructure with insecticides have been carried out by park staff. These efforts may have impacted the Bartram's hairstreak in the park in the past. Mosquito spraying in Everglades National Park is currently restricted to 12 acres in the Flamingo housing area and does not occur near pine rockland habitats. If the park resumes mosquito control activities using adulticides in pine rockland habitat, potential impacts to Bartram's hairstreak individuals and populations would be possible.

Poaching also represents a potential but poorly understood threat to Bartram's hairstreak adults in Long Pine Key. USFWS (2012b) established that demand for specimens exists. NPS park rangers have made at least one recent contact for illegal collecting of butterflies near the Shark River Visitors Center. In this case, common butterfly species collected in the park as well as basic collecting gear were found. While no instances of illegal butterfly collecting are known for Long Pine Key, it is likely that it may be occurring undetected.

Within Everglades National Park, critical habitat has been proposed in approximately 8,000 acres throughout the known range of the species within Long Pine Key. For the purpose of this analysis, it is assumed that proposed critical habitat will ultimately be designated as described in the proposed rule, and therefore it is included. The Primary Constituent Elements (PCE's) of the proposed critical habitat include sufficient sized areas of pine rockland habitat and associated rockland hammocks, the absence of competitive nonnative plant species or their existence in quantities low enough to have minimal effect on survival of the Bartram's scrub hairstreak, the presence of sufficient host plant and low levels of pesticides, and a disturbance regime that ensures the long term maintenance of these habitats. A component of the disturbance regime identified as a PCE includes application of prescribed fire carried out in such a way to mimic natural fire cycles.

Stock Island Tree Snail *(Orthalicus reses)*. The Stock Island tree snail is a large, conical snail attaining approximately 45 to 55 mm in length. It is arboreal, and inhabits the hardwood hammocks of the Florida Keys and other locations where it was released. It was listed by the State of Florida and the U.S. Fish and Wildlife Service as threatened because of population declines, habitat destruction and modification, pesticide use, and overcollecting.

Stock Island tree snails were first introduced to the park by collectors to a small area near Flamingo in the late 1980s. Between 1987 and 1994, the presence of snails in the area was reported, but by 1995, snails were no longer found. The apparent disappearance of the snails from the park may be due to a number of causes, including over-collecting, hurricanes, exotics, competition, or inability to adapt to the surroundings. Because of the difficulty of locating all individuals, there remains a possibility that this tree snail continues to occur in some limited areas near Flamingo. A population of snails was also reported in Big Cypress, but surveys are necessary to confirm this. The status of the populations in Everglades National Park and Big Cypress is considered to be declining or extirpated (USFWS 1999b). The Stock island tree snail is likely not a fire-adapted species and is associated with tropical hardwood hammocks which rarely if ever burn.

Florida tree snail *(Liguus fasciatus)*. The Florida tree snail is a state listed species of special concern that is found in upland habitats in extreme southern Florida. Tree snails of the genus *Liguus* are

known for their diversity in coloration and appearance, and more than 50 named varieties of *Liguus fasciatus* occur (Hillis 1995). Many of the reported varieties are restricted to single tropical hardwood hammocks or tree islands in the Everglades and the Florida Keys. These snails are mostly arboreal as adults, but lay eggs in moist soil and detritus at the base of trees. Their distribution is largely limited to high-humidity interiors of hardwood hammocks, but they do occur in marginal hammock/pineland habitats. They prefer smooth-barked deciduous trees. Over-collecting has been recognized as a threat, and many collectors have translocated individuals and varieties in efforts to both protect them and to generate new color forms through hybridization.

Reptiles

American crocodile (*Crocodylus acutus*). The American crocodile is a large, greenish-gray reptile. It is one of two native crocodilians (the other being the American alligator (*Alligator mississippiensis*)) that occur in the continental United States, and is limited in distribution in the United States to south Florida. It is federally listed as endangered throughout most of its range in the Caribbean, and central and South America. In 2007, the Florida distinct population segment of the American crocodile was downlisted from endangered to threatened (72 FR 13027). Critical habitat was designated for the American crocodile in southern Florida in 1977, covering much of Florida Bay and adjacent coasts within the park. This critical habitat was among the first ever designated, and did not include identification of primary constituent elements.

Within the United States, the historic core geographic range of crocodiles included Miami-Dade, Broward, and Monroe Counties, but reports indicated that they occupied areas as far north as Indian River County on the east coast of Florida (Kushlan and Mazzotti 1989 a). Since listing, the nesting range of the American crocodile has expanded on both the east and west coasts of Florida, and crocodiles are frequently seen throughout most of their historical range. Nesting has extended back into Biscayne Bay on Florida's east coast, and regularly occurs along the mainland coast, with most breeding occurring on the mainland shore of Florida Bay between Cape Sable and Key Largo (Mazzotti et al. 2002). The distribution of crocodiles in Florida appears to be limited by winter temperatures, and crocodiles only rarely occur north of Naples on the west coast, and Broward County on the east coast. Within these areas, the majority of mangrove-lined coastal estuaries are protected, and this protection has benefitted the crocodile population.

Crocodile nests historically occurred on beaches and well-drained banks of estuarine tidal creeks. However, the availability of these habitats has decreased, potentially as a result of sea level rise, but crocodiles have adapted by nesting on canal banks, spoil, road beds, and other artificial substrates, in a variety of soil types. Females construct earthen nests (mounds or holes) on these elevated substrates. Females do not become reproductively active until they reach a total length of approximately 2.3 m (7.4 ft) (Mazzotti 1983), which generally corresponds to an age of 10 to 13 years (LeBuff 1957). Female crocodiles nest only one time per year and may not nest every year after they reach sexual maturity.

After laying eggs, females do not defend the nest, but generally remain in the area of the nest. Females remain near their nest sites and must excavate young from the nest after hatching (Kushlan and Mazzotti 1989b). Kushlan (1988) reported that females may be very sensitive to disturbance at the nest site; most females that were disturbed near their nests did not return to excavate their young after hatching. Female crocodiles show little parental care, and young are generally independent shortly after hatching. Hatchlings disperse from nest sites to nursery habitats that are generally more sheltered, have lower salinity (1 to 20 ppt), shallower water (generally), and more vegetation cover, shortly after hatching, where they remain until they grow larger. Growth during the first year can be rapid, and crocodiles may double or triple in size (Moler 1991). Growth rates in hatchling crocodiles depend primarily on the availability of fresh water and food in the nursery habitat.

The American crocodile population in the park has grown, and nesting activity has increased, particularly on Cape Sable. Crocodiles may routinely nest along the estuarine banks from US 1 to Cape Sable. A crocodile refuge was established within the park in the 1970s in the estuarine areas downstream of the C-111 canal east of Flamingo, and that designation remains today, despite the fact that the majority of crocodile nesting now occurs on Cape Sable and near Flamingo. In 2010, an unusually long-lasting cold spell affected American crocodiles in south Florida, and approximately 600 crocodiles are estimated to have died in this event. However, crocodile numbers appear to have rapidly rebounded following the cold event, and the cold temperatures may have disproportionately affected small and young individuals.

Fire does not normally affect crocodiles because they are primarily marine. However, fire can affect some nesting areas such as beach dune and back-dune habitats. Additionally, while the majority of crocodile critical habitat is not susceptible to fire, the designated critical habitat does include the lower reaches of Everglades freshwater marshes which do occasionally burn. These marshes are generally not significant for American crocodiles. For the purposes of our evaluation, primary constituent elements include suitable nest sites, quiet, mangrove-lined estuaries that are protected from wave action, and estuarine waters with salinity less than that of sea water that supports abundant fish and other prey.

Within Everglades National Park, American crocodile critical habitat is limited to the lower portions of the freshwater marshes in the vicinity of Taylor slough, and the mangrove and estuarine areas of Flamingo and Cape Sable. No primary constituent elements (PCE) were identified in the designation. For the purposes of this environmental assessment, PCEs are considered to consist of suitable crocodile nesting habitat, of suitable elevation and substrate, to allow crocodiles to excavate the substrate, and to keep nests from being inundated during normal tides, sheltered, mangrove-lined low-salinity estuarine waters where juveniles can take shelter, and the availability of prey, consisting of estuarine fish and other animals. PCEs are present in the estuarine reaches of the park, but not in the freshwater marshes included within the designation.

Eastern indigo snake (*Drymarchon corais couperi*). The eastern indigo snake is a large, shiny, blue-black colored, non-venomous snake that may reach up to 8 feet in length. It was listed as a federally threatened species in 1978 as a result of population decline. The decline in eastern indigo snake populations is attributed to loss of habitat to agriculture, and also to collecting for the pet trade. The docile nature of this snake has made it desirable as a pet (USFWS 1982). The species has also suffered from mortality during gassing of gopher tortoise burrows for rattlesnake collection. The species occurs throughout Florida and along the coastal plain of Georgia. Eastern indigo snakes prefer well-drained, sandy soil, and often use tortoise burrows for nesting, though it also occurs in areas without tortoises. Eastern indigo snakes require a mosaic of habitats, and generally prefer upland habitats, but they may also inhabit areas that are seasonally flooded if dry refugia are present. The home range of these snakes varies by season and prey availability, and may cover from 12 to 266 acres (USFWS 1982). In habitats lacking gopher tortoises, eastern indigos may take shelter in logs, hollow root channels, or burrows of rodents, armadillo, or crabs.

The range of the eastern indigo snake is believed to be declining, based on the reduction in available habitat (both quantity and quality) across its range, and trends in population are presumed to be declining as well, though population assessments at regional and local scales are lacking. Habitat loss is currently believed to be the main factor affecting populations, but collecting, road mortality, and other factors also affect populations (USFWS 2009).

Little is known about the specific habits and niche of the eastern indigo snake in Everglades National Park, as most information is from incidental observations. In the park, the species is generally found in pine and tropical hardwood forests and, to a lesser extent, in coastal habitats, and has shown no strong preference for disturbed sites. In general, it appears to prefer open, undeveloped areas (USFWS 1999c). Sightings and collections of road killed individuals have occurred in the past three

years within Everglades National Park, but they are only rarely encountered, and there is little information about their status and distribution in the park besides occasional anecdotal observations and roadkills. In general, the population in the park appears to have declined in recent years. There has been no research into the apparent decline within the park, but park biologists suspect competition for the limited supply of dry burrows with the non-native introduced Burmese python.

The eastern indigo snake has evolved in habitat frequently affected by fire, and most of the vegetation communities that it occupies throughout most of its current range in the U.S. are fire-adapted or fire-maintained. It is frequently observed in recently burned areas, presumably due to an increased ability for snakes to be located in areas with reduced cover for concealment. No preference for burned areas has been documented for indigo snakes. The eastern indigo snake tends to occupy burrows and holes, and may use burrows as refugia from fire. During the decades that Everglades National Park has been conducting a fire management program, a dead burned eastern indigo snake has never been observed by fire management staff.

Gopher tortoise (*Gopherus polyphemus*). The gopher tortoise is a large, terrestrial, herbivorous tortoise that reaches a total length up to 15 in (38 cm), and typically inhabits the sandhills, pine/scrub oak uplands, and pine flatwoods associated with the longleaf pine (*Pinus palustris*) ecosystem. A fossorial animal, the gopher tortoise is usually found in areas with well-drained, deep, sandy soils; an open tree canopy; and a diverse, abundant, herbaceous groundcover. Burrows of the tortoise also provide refuge for more than 350 other commensal species, including some species that are currently state and federally listed in Florida.

The gopher tortoise ranges from extreme southern South Carolina south through peninsular Florida, and west through southern Georgia, Florida, southern Alabama, and Mississippi, into extreme southeastern Louisiana. Florida represents the largest portion of the total global range of the species. Gopher tortoises remain widely distributed in Florida, occurring in parts of all 67 counties. The eastern population of the gopher tortoise in South Carolina, Florida, Georgia, and Alabama (east of the Mobile and Tombigbee Rivers) is a federal candidate species; the gopher tortoise is federally listed as threatened in the western portion of its range, which includes Alabama (west of the Mobile and Tombigbee Rivers), Mississippi, and Louisiana. In July 2011, the U.S. Fish and Wildlife Service completed a 12-month status review for the gopher tortoise and found that the federal listing as threatened under the Endangered Species Act was warranted, but precluded due to higher priority listing activities. The Florida Fish and Wildlife Conservation Commission published its first tortoise management plan in 2007, and the species was reclassified from a Species of Special Concern to Threatened. A revised State plan was prepared in September 2012.

The primary threat to the gopher tortoise is habitat fragmentation, destruction, and modification (either deliberately or from inattention), including conversion of longleaf pine forests to other silvicultural or agricultural habitats, urbanization, shrub/hardwood encroachment (mainly from fire exclusion or insufficient fire management), and establishment and spread of invasive species. For example, the spread of exotic plant species such as Brazilian pepper, Australian pine, cogongrass, and hairy indigo (*Indigofera hirsuta*) are known to degrade tortoise habitat.

Other threats include disease, predation (mainly on nests and young tortoises), and inadequate regulatory mechanisms, specifically those needed to protect and enhance relocated tortoise populations in perpetuity. Gopher tortoise populations can typically sustain themselves despite natural predation, with only one to three of every 100 eggs likely to produce a breeding adult. However, predator populations, such as raccoons and crows (*Corvus* spp.), can be artificially high in some habitats because of anthropogenic factors. Also, new tortoise predators have invaded Florida via human transport or habitat alteration: nine-banded armadillo (*Dasypus novemcinctus*), coyote, monitor lizards (*Varanus* spp.), and red imported fire ant (*Solenopsis invicta*). Recently, Argentine tegu lizards (*Tupinambis merianae*) have been found using gopher tortoise burrows near Tampa; and Burmese pythons have been found using burrows near Naples; their impact on tortoises, including

tortoise commensals, is currently unknown. Studies need to be undertaken to evaluate the effects of these lizards and other exotic reptiles and mammals on Florida's tortoise populations.

The U.S. Fish and Wildlife Service considers the magnitude of threats to the eastern range of the gopher tortoise as moderate to low, and populations extend over a broad geographic area. Conservation measures are also in place in some areas. However, because the species is currently being affected by a number of threats, including destruction and modification of its habitat, disease, predation, exotics, and inadequate regulatory mechanisms, according to the U.S. Fish and Wildlife Service, the threat is imminent.

Within Everglades National Park, the Gopher tortoise can be found in beach dune and coastal grassland communities at Cape Sable. Tortoises on Cape Sable are notable because they are disjunct from current and historically occurring populations further north. There has been some suggestion that the gopher tortoise population may have been introduced onto the Cape within historic time, though the evidence is not conclusive. The burrows are generally scattered throughout the dune area, from the foredune to slightly beyond the tree line. With the exception of a few small hammocks, the tortoise habitat at Cape Sable is essentially treeless, and is likely maintained in that state as a result of storms. This storm associated instability in coastal areas, and periodic drought, may also be the cause of fluctuations in tortoise populations.

At Cape Sable, burrow counts using line- or strip-transects were conducted in 1979, 1990, and 2001. The density of active burrows decreased 76 percent between 1979 and 2001. Between 1979 and 1990 the population was probably stable or slightly increasing, but declined substantially between 1990 and 2001, despite evidence of recruitment. Reduced habitat quality and tropical storms may have been responsible for the observed declines between 1990 and 2001. Continued monitoring of this population would provide more information on the long-term dynamics of survival and reproduction at this site. More frequent burrow surveys and surveys after major storm events would provide insight about the vulnerability of tortoises at Cape Sable to tropical storms. No surveys have been conducted for this species since 2001, and although the species continues to occupy the Cape, the current population size and trend of the species there is unknown.

Gopher tortoises occasionally are found in the pinelands of the park on the road adjacent to the Hole-in-the-donut restoration area. The origin of individuals in this area is uncertain as well. There has been some suggestion that these individuals may have been introduced as unwanted pets. Sporadic observations continue to occur in this area dating from as far back as the mid-1950s. The current population size and trend of the species in this area is also currently unknown.

Gopher tortoises occupy most upland plant communities that contain relatively well-drained soils for burrowing, and sufficient herbs and grasses for forage. Historically, the recurrence of lightning-ignited fire was pivotal in influencing vegetative succession and shaping species composition and structure of Florida's upland plant communities. The frequency and periodic occurrence of these fires provided a competitive advantage to fire-tolerant vegetation, resulting in open pine stands and lush ground cover, conditions well-suited to the needs of the gopher tortoise.

The following considerations regarding fire and the gopher tortoise are largely taken from the Florida Fish and Wildlife Conservation Commission (2012) Gopher Tortoise Management Plan, and associated documents. In general, the regular application of prescribed burning is critical for the maintenance of habitat conditions preferred by the gopher tortoise. Prescribed burning reduces shrub and hardwood encroachment, and stimulates growth of tortoise forage plants such as grasses, forbs, and legumes. This allows greater sunlight penetration to reach ground level, which promotes establishment of understory species used by the tortoise as forage. Fire also promotes conditions necessary for gopher tortoise egg incubation. Early growing season fires (April – June) cause a more pronounced vegetative response when compared to burning during the period of plant dormancy. These early growing season burns stimulate flowering in many warm season grasses, increase species

composition among understory plants, and result in higher understory biomass production. When practical, prescribed fire should be avoided in September and October. This is a period when hatchlings are more numerous and vulnerable.

Equipment operators should be made aware of tortoises and instructed to avoid them. Marking the location of burrows (often done with flagging) in advance of the treatment helps equipment operators avoid collapsing burrows and is encouraged whenever feasible. When practical, minimize use of heavy equipment during September and October since hatchlings are more numerous and vulnerable at this time, and it is difficult for individuals operating equipment to see hatchlings. As tortoises tend to be most active during coolest times in the warm months, and the warmest time during the cool months, adjusting the times when heavy equipment is used may reduce the risk to gopher tortoises.

Managers can use prescribed fire to maintain gopher tortoise habitat already in maintenance condition, or use it in conjunction with other tools to restore degraded natural communities to a more natural form and function. Although growing season fire is favored in most instances, for managers to meet the recommended fire return intervals, managers on most properties will need to apply fire throughout the year, making use of as many good burn days as possible. Further, if a patch is due for a burn and conditions are not suitable during the growing season, it may be better to maintain the frequency of the fire return interval by applying a dormant season burn rather than waiting for the following growing season. Diversity in the application of fire benefits the habitat and the gopher tortoise. Additionally, the frequent application of fire is a major contributing factor to high species richness, which in turn is favorable to the tortoise.

Mammals

Florida panther (*Puma concolor coryi*). Florida panthers are wide ranging habitat generalists that require large contiguous areas of habitat to meet their life history needs, and preferentially select forested upland habitats interspersed with other habitats utilized proportionate to availability. Primary prey species are white tail deer and feral swine, a diet supplemented with small to medium mammals, reptiles, including alligators and avifauna. Panthers are cryptic predators that occur at very low densities and select habitat based on prey availability and sufficient patches of dense understory vegetation, which serve as critical forage, rest, and denning cover. Near impenetrable areas of dense saw palmetto, thick hammocks, and invasive Brazilian pepper stands consistently emerge as the vegetation types most frequently used by Florida panthers for denning and rearing of young.

Panthers were once distributed across the southeastern United States and now occur in less than five percent of their historical range. The combined effects of human persecution and habitat loss led to listing of the Florida panther. It was among the first group of species to be listed as federally endangered under the Endangered Species Act of 1973. No critical habitat has been designated for the Florida panther. By the late 1970s the only known Florida panthers occurred in southern Florida with an estimated population of fewer than 30 individuals. In 1981 the Florida Fish and Wildlife Conservation Commission undertook long-term research to determine the status of this population in the Big Cypress region. The National Park Service began a concurrent study in Everglades National Park in 1986. Results of both studies indicated that the remaining population suffered from geographic isolation, habitat loss, low population numbers, and extensive inbreeding resulting in loss of genetic variability. Externally, inbreeding was displayed as crooked tails and cowlicks in most cats. Of greater concern was the prevalence of rare genetically determined traits such as cryptorchidism, low sperm count/quality, atrial septal defects, and susceptibility to opportunistic infections.

The 1994 Florida Panther Genetic Restoration and Management Plan (USFWS 1994) recommended genetic augmentation as the only means likely to preserve the south Florida population as genetic

variability was deemed so depressed as to be the greatest immediate threat to survival. Eight female Texas puma (*Puma concolor stanleyana*) were released into the existing south Florida population in 1995, including two in the park east of Shark River Slough. Since the introduction of the eight females, the estimated total panther population has increased to between 80-100 adults by 2002-2005 (Land and Lacy, 2000; McBride personal communication) within approximately 2.5 million acres in south Florida (Kautz et al. 2006). Recent estimates of the total panther population range from 120-160 individuals.

Florida panthers located in the park on the east side of Shark Slough are considered a sub-population of the broader panther population in Florida, and are isolated from the main population by Shark Slough and rapid urban development in the greater Miami area. While panthers can cross Shark Slough, they are unlikely to do so, and the frequency of panther movements between the park subpopulation and the rest of the panther population is low. Geographic isolation makes this small population particularly susceptible to extirpation due to either complete mortality of one sex (likely male) or the recurrence of genetic depression due to inbreeding. Non-invasive camera trap monitoring techniques used by NPS staff indicate that the current minimum population east of Shark River Slough consists of only five to seven individual adult panthers, and likely only one male.

Within Everglades National Park, panthers occupy very large home ranges on the order of 450 km^2 (111,200 acres) for males and 250 km^2 (61,800 acres) for females. Dispersing juveniles have been known to travel hundreds and in some cases thousands of miles prior to establishing a permanent home range. Known individuals within the park have overlapping primary home ranges centered in and around Long Pine Key, yet habitat use varies seasonally. Panthers in the park can be found in nearly all terrestrial habitats, yet many years of telemetry and track data indicate that pine dominated landscapes followed by seasonally dry prairie interspersed with hammocks and cypress comprise the core habitats that support Everglades National Park subpopulation. Panther use extends south and west into the mangrove transition zone or boundary of Shark River slough high water and; to the east and north of LPK, panthers extensively utilize areas extending to northern and eastern park borders and adjacent lands. Panthers are also known to occur at least seasonally in regions of the park bordering Big Cypress National Preserve. Sporadic reports occur in the Cape Sable region of the park and these are most likely transitional dispersing males if and when the reports are credible, and are unlikely to be resident cats. The remote west central coast of the park has deer and hog populations potentially sufficient to support panthers, yet sightings and panther occurrence in and use of this area have not been documented. Immigration and emigration are known to be rare but are poorly understood within the eastern part of the park and require further study. The Chekika area in particular appears to have an increasing deer and feral swine prey base sufficient to support greater use by panthers than is currently known to occur and this area may become a more significant component of home ranges in future years.

Panthers are known to give birth year round in Florida, but the majority of panther births occur in mid-winter to early spring. For the first two to three months of their lives, panther kittens remain in well-concealed dens and only rarely leave dens. As they mature, kittens begin to make exploratory movements, but generally remain near den sites. Park data on denning is sparse, but with the absence of dense saw palmetto, most known dens in the park are known to be located primarily within dense hardwood hammocks or invasive Brazilian pepper forests located within or near the pinelands.

Within Everglades National Park, threats to the subpopulation include loss of genetic diversity due to inbreeding, complete mortality of one sex, disease, reduced habitat or prey availability due to changes in hydrology, and prey impacts from competing species, including coyotes and large constrictors, which have arrived in the park relatively recently. Current panther monitoring is conducted through use of camera traps, and the park does not regularly capture panthers to assess condition or monitor detailed movements.

The Everglades ecosystem has evolved with frequent fire as a natural component of the landscape and panthers have adapted to these fires. While several studies have focused on the response of Everglades wildlife, including panthers and other large carnivores/omnivores to fire, results and interpretation of these studies vary widely. Most researchers ultimately agree that implementing landscape-level fire regimes which best replicate natural conditions are favored over those designed to enhance habitat for particular species.

Adult and sub-adult panthers are highly mobile and telemetry data indicate that they easily move in and around fires with no apparent ill effects, perhaps even being attracted to active fire. Several studies show that white tailed deer and other important prey species may benefit from fire effects, thus concluding that fire is an important component of panther ecology. Dees et al. (1999) found panthers exhibit a strong preference for pine dominated habitats for the first year post prescribed fire. This affinity declines over time until by >4 years, there is no apparent preferential selection for the area over those of longer burn interval (Dees et al. 2001). Maehr et al. (1990) found that white-tailed deer, feral hogs, and other panther prey responded to prescribed fire with increased use during that same <1yr period, presumably due to increased forage quantity and quality. Both studies concluded that panthers preferential selection of these habitats post fire is in response to increased prey availability resultant from fire driven changes to vegetation composition, yet caution that overly extensive or frequent burning (intervals <4 years) may reduce cover and travel corridors for panthers and result in loss of beneficial effects.

Maehr and Larkin (2004) argued that fire return intervals as infrequent as 15-20 years would best benefit panthers and bears. This assertion was largely made based on apparent reliance on extensive patches of mature and extremely dense saw palmetto for refuge, including denning and rearing young. Fire greatly reduces the occurrence of dense, mature palmetto patches, forcing panthers to select alternative den sites. Dense saw palmetto patches are not as common in the park as in other areas of Florida and given low population density, are not thought to limit reproduction, and panthers have used hardwood hammocks and dense Brazilian pepper in the park for denning and cover. Excluding fire for excessively long periods and allowing dense palmetto patches to develop may encourage their use by panthers but also increase the intensity of fire when it does ultimately occur, which may increase likelihood of periodic kitten mortality, and cause changes in the suitability of habitat. Fire regimes within pine dominated habitats that result in a mosaic of recently burned, relatively open habitat, interspersed with denser unburned patches probably provide the best overall benefits for panthers in the park.

Florida manatee *(Trichechus manatus latirostris)***.** The Florida manatee is an aquatic mammal that occurs in marine, estuarine, and freshwater habitats throughout much of Florida. It is one of two subspecies of the West Indian manatee, which was among the first group of species to be listed on the Endangered Species Act in 1973. This endangered species mostly occurs within estuarine lakes and waterways, but may occur upstream into freshwater reaches of these waters, and can also occur within canals. Manatees require freshwater for drinking, and are also susceptible to cold temperatures, which frequently lead manatees into mangrove-lined estuarine waterways and deep freshwater rivers or canals. Their entire life cycle occurs within water, so they are largely unaffected by fire. However, they can be susceptible to human disturbance, and boat-strikes represent the primary source of adult mortality within the Everglades region (USFWS 2007).

Critical habitat was designated for the manatee in 1977, and within the park includes all estuaries and rivers along from the Park's westward boundary through Whitewater Bay. It also includes Blackwater and Little Blackwater sounds between Key Largo and mainland Miami-Dade County.

Florida bonneted bat (*Eumops floridanus*).The Florida bonneted bat is a relatively large member of the Molossidae (free-tailed bats) family. It measures approximately 5.1 to 6.5 inches in length and is the largest bat in Florida. Previously known as Wagner's mastiff bat, its taxonomy was revised in 2004, and it was identified as a separate species unique to Florida. The species has a very small

estimated population size and faces numerous and immediate threats throughout its very restricted range. The U.S. Fish and Wildlife Service proposed the species for listing as endangered on October 4, 2012 (77 FR 60750). The final rule listing the species as endangered was published in the *Federal Register* on October 2, 2013 (78 FR 61003). The State of Florida recognizes the species as imperiled, and the Florida Fish and Wildlife Conservation Commission currently lists the Florida bonneted bat as threatened (Florida Administrative Code, Chapter 68).

The Florida bonneted bat occurs in the southern portion of Florida, excluding the Florida Keys, in urban, suburban, and forested areas. Bonneted bats are closely associated with forested areas because of their tree-roosting habits. Although very little is known about the Florida bonneted bat's habitat use and life history, what is known suggests the species roosts singly or in small groups of up to a few dozen individuals in buildings (e.g., under Spanish roof tiles) or sometimes in tree hollows, woodpecker cavities, or in the foliage of palm trees. Our contemporary knowledge of naturally occurring roosts in Florida is limited to a woodpecker cavity in a longleaf pine in a pine flatwoods community near Punta Gorda, occupied by the Florida bonneted bat in 1979. Historically the species was also reportedly found under rocks and in fissures in limestone outcrops.

The ecomorphology of the Florida bonneted bat, and *Eumops* species in general, suggests bats fly high, relatively fast, and quite possibly far from the roost. Bats feed on night-flying insects; however, information about specific diet composition and preferred foraging habitat(s) is extremely limited. The Florida bonneted bat is vulnerable to habitat loss (in urban and forested areas), habitat alteration, and pesticide spraying for mosquitoes.

Bonneted bats have been acoustically detected in Everglades National Park, although infrequently. Results from 81 surveys conducted on 75 nights (from October 2011 to November 2012) in the park and surrounding areas produced relatively few call sequences indicating the presence of the Florida bonneted bat. The species was detected on three occasions along the Main Park Road from the eastern boundary to the Long Pine Key Campground. Habitat types where detected included pine rocklands, wet prairie, and tropical hardwoods, and are included in FMU 3. Additional locations in the park where the bat has been detected include Darwin's Place and Watson Place along the forested northwest coast of the park and along the northeast boundary of the park over the L-31N canal, from SW 136th Street to US 41 (FMU 1 and FMU 4, respectively). Roosting sites and confirmed foraging habitat, while anticipated, have yet to be identified in the park. The sparse number of acoustic detections may be an indicator of the rarity of the Florida bonneted bat, but it may also underscore the difficulty of detecting a bat that may travel and forage some of the time (if not frequently) at altitudes beyond the range of detection by acoustic survey equipment. Surveys in the park are ongoing and this possibility will be investigated.

Given that Florida bonneted bats are closely associated with forested areas because of their tree-roosting habits in hollows and cavities, it is necessary to consider how fire management impacts, among other things, snags and snag production, as well as solution holes and rock outcrops. However, because naturally occurring bat roosts in forested areas are notoriously difficult to find, only a generalized consideration of potential fire effects can be provided at this time. In general, bonneted bats are likely fire-adapted, because their range appears to include large areas that have historically been frequently burned, and they are known to occur within pine forests which burn frequently over time.

Prescribed burning benefits to bats in the park are likely attributed to forest modifications that alter or increase amounts and quality of roosting habitat, modify or improve foraging habitat and increase arthropod prey abundance. Newly created snags, however, may not be immediately usable by bats. Cavity roosts or exfoliating bark roosts can take considerable time to appear and may not be available for one or more seasons. Snags serving as bat roosts could be consumed by burning and during intense fires, and roosting bats could be killed. However, relatively little is known about the Florida bonneted bats' life history, so seasonal susceptibility remains unknown. Because the Florida

bonneted bat is a species that likely roosts internally within cavities, they may be likely to escape from fires, but their behavioral responses to fire remain undocumented. Because of the warm south Florida climate, Everglades National Park bats are likely able to arouse quickly as the difference between the ambient temperature and active body temperature of bats is less. The Florida bonneted bat is a fast flier, so it is likely that escape and relocation to unburned areas easily can occur. Snag roosts, depending on age and condition and fire behavior can be highly combustible. However, there is some suggestion that the Florida bonneted bat may rely on multiple roosts throughout a given forest, providing alternate roosts should the current roost be destroyed by fire.

Everglades mink (*Mustela vison evergladensis*) is state-listed as threatened. The Everglades mink is a dark brown member of the weasel family, and is a disjunct population of the southeast (continental) mink. In the Big Cypress swamp, Everglades mink are widely dispersed in all types of shallow wetlands. Habitat requirements in the park are probably similar to those in Big Cypress National Preserve. Minks mostly feed on crayfish, small mammals, and fish. In the late 1970s, mink were most abundant at the northern edge of the park in Northeast Shark Slough, although these data consisted primarily of individual observations of minks crossing roads or levees (Smith 1980). There are no estimates on Everglades mink populations or densities (Humphrey 1992), and it is unknown whether or not any minks remain within the park. The most recent mammal inventory in the park failed to document Everglades mink, despite several thousand trap-nights of effort.

Mangrove fox squirrel or Big Cypress fox squirrel (*Sciurus niger avicennia*) is state-listed as threatened. It was formerly a candidate for listing under the Endangered Species Act, but was found to not warrant federal protection. The mangrove fox squirrel is a subspecies of the fox squirrel found only in southwest Florida. They nest in trees, but spend a great deal of time on the ground searching for nuts, buds, and seeds. This fox squirrel has been found to use most types of forests within its range, including open pinelands (wet or dry), mixed open pine-cypress, mixed open pine hardwoods, open hardwood, prairie with interspersed pines, live oak savannas, and mangrove, cypress, and hardwood swamps. The Big Cypress fox squirrel appears to be opportunistic in its use of available habitat (USFWS 2002). There is little information available about their relationship with fire, though they occur in areas with frequent fire, as well as in areas where fire is rare.

Birds

Cape Sable seaside sparrow (*Ammodramus maritimus mirabilis*). The Cape Sable seaside sparrow is one of eight extant subspecies of seaside sparrow in North America. Its distribution is limited to the short-hydroperiod wetlands at the bottom of the greater Everglades system, on the southern tip of mainland Florida. The majority of these sparrows occur within Everglades National Park, and only a small number are found on the adjacent state-owned Southern Glades Wildlife and Environmental Area. It was among the first group of species to be listed under the Endangered Species Act of 1973. Critical habitat was first designated for this species in 1977, and revised critical habitat designation was published in November 2007. Unlike most other subspecies of seaside sparrow, which occupy primarily brackish tidal systems (Post and Greenlaw 1994), the Cape Sable seaside sparrow currently occurs primarily in the short-hydroperiod wet prairies, also referred to as marl prairies, though it may still occupy brackish marshes in some areas.

The Cape Sable seaside sparrow is generally sedentary, secretive, and non-migratory, occupying the marl prairies of southern Florida year-round. Since they were discovered in 1918, sparrows have been extirpated from Cape Sable and coastal brackish marshes along the southwest coast near Ochopee. They currently occur within six geographically distinct areas that are generally referred to as subpopulations A-F.

During the breeding season (March to August), male sparrows establish and defend territories that are variable in size, ranging from 0.7 to 16.8 acres (Werner 1975), with reported average sizes ranging

from 2.2 to 8.9 acres within different sites and years (Werner and Woolfenden 1983; Pimm et al. 2002). Cape Sable seaside sparrows are generally monogamous with a pair generally remaining within one territory, but they may be polygamous under some circumstances, such as within small populations, and it is unknown whether the birds are simultaneously or sequentially polygamous (Lockwood et al. 2006).

Sparrows generally begin nesting in early March (Lockwood et al. 2001), but may begin territorial behavior and courtship in late February (Lockwood et al. 1997). This timing coincides with the dry season, and most areas within the marl prairies are either dry or only shallowly inundated at the beginning of the breeding season. During the dry portion of the breeding season (March to May), sparrows weave nests into concealing vegetation approximately 6.7 to 7.1 inches above the ground (Werner 1975; Lockwood et al. 2001).

During the wet portion of the sparrow breeding season (June to August), sparrows build their nests higher in the vegetation than during dry periods, an average of 8.3 inches above the ground surface (Lockwood et al. 2001). Wet-season nests probably occur in taller vegetation than during the dry season because even at the nest height, there must be sufficient height and density of vegetation to cover and conceal nests.

The sparrow nesting cycle, from nest construction to independence of young, lasts about 30 to 50 days (Werner 1975; Lockwood et al. 2001), and sparrows may renest following both successful and failed nesting attempts (Werner 1975; Post and Greenlaw 1994; Lockwood et al. 2001). Because of the long breeding season in southern Florida, sparrows regularly nest several times within a year, and may be capable of successfully fledging 2 to 4 clutches, though few sparrows probably reach this level of success (Lockwood et al. 2001). Second and third nesting attempts may occur during the early portion of the wet season, and nests later in the season usually occur over water.

Nest success rates vary among years, and range from 12 to 53 percent (Lockwood et al. 2001). Nest predation is the primary cause of nest failure that is documented (Pimm et al. 2002), accounting for more than 75 percent of all nest failures (Lockwood et al. 1997). As water levels begin to rise above ground surface with the onset of the summer rains in May to June, nest predation rates also rise. Nests that are active after June 1, when water levels are above ground, are more than twice as likely to fail as nests during drier periods (Lockwood et al. 2001). This effect appears to be a result of both increased likelihood of nests being flooded and an increased likelihood of predation (Lockwood et al. 1997, 2001; Pimm et al. 2002).

Outside of the breeding season, sparrows generally remain sedentary in the general vicinity of their breeding territories, but expand the area that they use compared to the breeding season territory (Dean and Morrison 1998). Some individuals make exploratory movements away from the area of their territories, and may occasionally relocate their territories and home ranges before resuming a sedentary movement pattern (Dean and Morrison 1998).

Sparrows are generally short-lived, with an average individual annual survival rate of 66 percent (Lockwood et al. 2001). The average lifespan is probably two to three years. Consequently, a sparrow population requires favorable breeding conditions in most years to be self-sustaining, and cannot persist under poor conditions for extended periods (Lockwood et al. 1997, 2001; Pimm et al. 2002).

The freshwater habitats occupied by the Cape Sable seaside sparrow are composed of a group of associated species that is characterized by the presence of muhly grass (*Muhlenbergia filipes*) (Werner 1975; Kushlan and Bass 1983; Werner and Woolfenden 1983; Post and Greenlaw 1994). However, a variety of vegetation species occurs within the freshwater marl prairies occupied by sparrows, including vegetation from which Muhlenbergia is absent (Ross et al. 2006). Other dominant species that occur in these prairies include sawgrass (*Cladium jamaicense*), Florida little bluestem (*Schizachyrium rhizomatum*), black-topped sedge (*Schoenus nigricans*), and beak rushes (*Rhynchospora* spp.) (Werner and Woolfenden 1983; Ross et al. 2006).

Sparrows occupy these communities year-round, and the vegetation must support all sparrow life stages. During periods when the communities are dry, usually coinciding with the late winter and early spring (December to May), sparrows travel across the ground surface beneath the grasses, and only occasionally perch within the vegetation. During the wet season (June to November), these areas are continually inundated, with peak water depths occasionally exceeding 2 ft (Nott et al. 1998). During these periods, sparrows travel within the grass, perching low in the clumps, hopping among the bases of dense grass clumps, and walking over matted grass litter. They fly more frequently, and regularly perch low in the vegetation, but generally remain inconspicuous (Dean and Morrison 1998).

Sparrow subpopulations require patches of contiguous open habitat 4,000 acres or larger. The minimum area required to support a population has not been specifically determined, but the smallest area that has remained occupied by Cape Sable seaside sparrows for an extended period is this size. Individual sparrows are area-sensitive, and generally avoid the edges where other habitat types meet the marl prairies. They will only occupy patches of marl prairie vegetation that are less than 100 acres when they occur within large, expansive areas and are not close to forested boundaries (Dean and Morrison 1998).

Small tree islands and individual trees and shrubs occur throughout the areas occupied by the sparrows, but at a very low density. Sparrows do not appear to require woody vegetation during any aspect of their normal behavior, and generally avoid areas where shrubs and trees are either dense or evenly distributed. However, the small tree islands and scattered shrubs and trees may serve as refugia during extreme environmental conditions, and may be used as escape cover when fleeing from potential predators (Dean and Morrison 1998). Because of their general aversion to dense trees and woody vegetation, encroaching trees and shrubs can quickly degrade potential habitat.

The local variability across the landscape within areas where sparrows occur produces a heterogeneous arrangement of different vegetation conditions that all provide habitat for sparrows during some environmental conditions. A complex relationship between hydrologic conditions, fire history, and soil depth determine the specific vegetation conditions at a site, and variation in these characteristics may result in a complex mosaic of vegetation characteristics (Taylor 1983; Ross et al. 2006). This variability is characteristic of the habitats that support sparrows.

Sparrows do not regularly occupy burned areas for two to three years following fires (Pimm et al. 2002; Lockwood et al. 2005), though they can re-occupy areas after only one year under some conditions (Taylor 1983; Werner and Woolfenden 1983). This is probably because of the sparrow's dependence on some level of structural complexity that must develop to provide cover, support nests, and allow them to move through the habitat during wet periods. Fire is not uncommon within the areas occupied by sparrows, and nearly all areas where sparrows currently occur have been burned within the past 10 to 20 years (Lockwood et al. 2003). A combination of naturally ignited and human-ignited (both prescribed and arson/accidental ignitions) fires have resulted in very different fire frequencies in different portions of the sparrow's range. Most of the plant species that occur within sparrow habitat are fire-adapted and respond quickly following fire (Snyder 2003). Under normal conditions, fires do not kill the individual plants that make up the dominant species in sparrow habitat, and fires only remove the above-ground growth and leaf litter (Snyder and Schaeffer 2004). The plant species rapidly respond, sprout quickly following fire, and grow rapidly. Many of the dominant grasses may grow more than 15 inches after only a few weeks (Steward and Ornes 1975; Snyder 2003). For this reason, the species composition and even the general structural characteristics of the vegetation may be nearly indistinguishable from unburned areas only two to three years after burning (Lockwood et al. 2005).

The interaction of fire and flooding strongly influence the suitability of habitat for sparrows. In the most extreme case, the vegetation in any areas that burn and are subsequently flooded within 1 to 3 weeks, either because of a natural rainfall event or human-caused hydrologic changes, may not

recover for up to 10 or more years (Ross, personal communication 2006). Alternatively, if water levels overtop the sprouting grasses, the grasses may die, resulting in an absence of vegetation. Recovery of vegetation from these circumstances has to result from seed germination, which requires a longer time for recovery, and may result in a different plant species composition and structure from the vegetation that was present prior to the fire. Under less extreme conditions, vegetation may recover following fire more quickly when water levels are near the soil surface, providing ample water for the plants.

Additional detailed information about the Cape Sable seaside sparrow, its life history, and information on its habitat can be found in Pimm et al. (2002), and the South Florida Multi-species Recovery Plan (USFWS 1999d).

> **Cape Sable seaside sparrow critical habitat**: The current critical habitat designation includes five units that correspond with sparrow subpopulations B-F, and portions of all of them include park lands (the majority of unit 3 lies within adjacent state land). The critical habitat designation identifies three primary constituent elements of the habitat, and these are the characteristics that are essential to the conservation of Cape Sable seaside sparrows. They are:
>
> (i) Calcitic marl soils characteristic of the short-hydroperiod freshwater marl prairies of the southern Everglades;
>
> (ii) Herbaceous vegetation that includes greater than 15 percent combined cover of live and standing dead vegetation of one or more of the following species (when measured across an area of greater than 100 ft^2 (9.3 m^2)): Muhly grass (*Muhlenbergia filipes*), Florida little bluestem (*Schizachyrium rhizomatum*), blacktopped sedge (*Schoenus nigricans*), and cordgrass (*Spartina bakeri*);
>
> (iii) Contiguous open habitat (sparrow subpopulations require large, expansive, contiguous habitat patches with few or sparse woody shrubs or trees.); and
>
> (iv) Hydrologic regime such that the water depth, as measured from the water surface down to the soil surface, does not exceed 7.9 inches (20 cm) for more than 30 days during the period from March 15 to June 30 at a frequency of more than 2 out of every 10 years.

The second and third elements can be affected by fires. In general, all vegetation species identified in the elements are either fire-adapted or fire-dependent, and fire management can aid in maintaining the favorable condition. Fire can also help to restore and maintain the contiguous open spaces that sparrows require by helping to limit woody vegetation encroachment in some areas.

From the discovery of Cape Sable seaside sparrows in the brackish *Spartina* marshes on Cape Sable in 1918 until the discovery of sparrows near Taylor Slough in 1972, there was limited knowledge of the distribution of this sparrow. The 1981 sparrow survey provided the first complete baseline on the distribution and abundance of sparrows at that time, and similar follow-up surveys in 1992 were remarkably similar, though there is no information available about how the population may have changed over the intervening 12 years.

Since 1992, the decline in the overall sparrow population has been dramatic, and there has been no evidence of significant improvements. Subpopulations B and E have remained relatively stable, although notable annual variances have been observed. In addition, Subpopulation A continues to have a small number of sparrows, but the Service estimates the habitat is available to support up to 1,000 birds, making it a critical location in the sparrow's range. In addition to the decline in overall numbers, the distribution has declined. Sparrow subpopulations that have declined have mostly contracted toward the center of the remaining habitat patches. Declines have been linked to hydrologic effects on sparrow breeding (Pimm et al. 2002), and accompanying changes in habitat and its suitability for sparrows. Fires have also been implicated in some population declines.

Hydrologic alteration has been a key focus of sparrow management concerns, and hydrologic requirements for sparrows and their habitat have been a key driver of hydrologic management plans following the 1999 "jeopardy" opinion on the Corps' proposed hydrologic management program. Concerns about adverse effects to sparrows from hydrologic management continue through the present.

In general terms, the overall number of sparrows today is approximately half the number that was present in 1992, and only two of the six subpopulations are at levels that are likely to be resilient and self-sustaining.

Everglade snail kite (*Rostrhamus sociabilis plumbeus*). The Everglade snail kite is a medium-sized raptor with an approximate body length of 14 to 15.5 inches (Sykes et al. 1995). In both sexes, the tail is square-tipped with a distinctive white base that appears as a white patch on the rump when in flight. The plumage is markedly different among adult male, adult female, and juvenile birds. Adult males have a uniformly slate gray plumage, adult females are brown dorsally and pale cream colored with dark streaking on the breast. Immature kites are similar in appearance to adult females but are more cinnamon-colored, with tawny or buff-colored streaking rather than brown streaking. It is one of three subspecies of snail kites worldwide, and this subspecies occurs in Florida, Cuba, and a portion of Honduras. The Everglade snail kite was among the first group of species to be listed under the Endangered Species Act of 1973. Only snail kites in Florida are federally listed as endangered. Critical habitat was designated for this species in 1977. The critical habitat designation identified nine units of critical habitat throughout southern Florida, from Indian River County south through Everglades National Park.

Everglade snail kites are dietary specialists, and the Florida apple snail (*Pomacea paludosa*) is the kite's principal natural prey in Florida, and makes up the great majority of the kites' diet (Sykes 1987a; Kitchens et al. 2002). Under normal conditions, Everglade snail kites are nearly completely dependent on apple snails as prey, but other prey items have been documented. In recent years, snail kites have become increasingly dependent on the invasive apple snail (*Pomacea insularum*) that has become abundant in many parts of the snail kite's range in Florida. The close tie between the Everglade snail kite and apple snails requires consideration of both species when developing management strategies and addressing potential impacts.

Everglade snail kites and their primary prey are both wetland-dependent species and rely on wetland habitats for all aspects of their life history. The primary wetland habitat types upon which kites rely consist of freshwater marshes and the shallow vegetated littoral zones along the edges of lakes (natural and man-made) where apple snails occur in relatively high abundance and can be found and captured by kites. While kites are capable of foraging successfully under a variety of habitat conditions, the preferred foraging habitat is typically consists of relatively short-stature, sparse graminoid marsh vegetation less than 6.5 ft (2 m) in height. The apple snail requires emergent aquatic plants to provide substrate that allows them to reach the water surface to breathe. However, for kites to feed, the emergents must be sparse enough that they are capable of locating and capturing snails (Kitchens et al. 2002).

The Everglade snail kite breeding season in Florida varies from year to year and is probably affected by rainfall and water levels (Sykes et al. 1995). Ninety-eight percent of the nesting attempts are initiated from December through July, while 89 percent are initiated from January through June (Sykes 1987b; Beissinger 1988; Snyder et al. 1989), with the peak in nest initiation occurring from February to April (Sykes 1987b). Snail kites often renest following failed attempts early in the season, as well as after successful attempts (Beissinger 1986; Snyder et al. 1989), but the actual number of clutches per breeding season is not well documented (Sykes et al. 1995).

Pair bonds are established prior to egg-laying and are relatively short, typically lasting from nest initiation through most of the nestling stage (Beissinger 1986, Sykes et al. 1995). Male kites select nest

sites and conduct most nest-building, which is probably part of courtship (Sykes 1987c; Sykes et al. 1995). Unlike most raptors, snail kites do not defend large territories and frequently nest in loose colonies or in association with wading bird nesting colonies (Sykes 1987c; Sykes et al. 1995). Snail kites are highly gregarious. In addition to nesting in loose colonies and roosting communally in large numbers, kites may also forage in common areas in proximity to other foraging kites. Nesting almost always occurs over water, which deters predation (Sykes 1987c). An important feature for snail kite nesting habitat is the proximity of suitable nesting sites to favorable foraging areas. Thus, extensive stands of contiguous woody vegetation are generally unsuitable for nesting and suitable nest sites consist of single trees or shrubs or small clumps of trees and shrubs within or adjacent to an extensive area of suitable foraging habitat. Trees usually less than 32 ft tall are used for nesting.

Snail kites are considered nomadic, and this behavior pattern is probably a response to changing hydrologic conditions (Sykes 1979). During breeding season, kites remain close to their nest sites until they fledge young or fail. Following fledging, adults may remain around the nest for several weeks, but once young are fully independent adults may depart the area. Outside of breeding season, snail kites regularly travel long distances within and among wetland systems in southern Florida (Bennetts and Kitchens 1997). While most movements may be in response to droughts or other unfavorable conditions, kites may also move away from wetlands when conditions appear favorable. Movements within large wetlands and movements among adjacent wetland units occur frequently.

Prior to 1969, the snail kite population was monitored only through sporadic and inconsistent surveys (Sykes 1979, 1984). From 1969 to 1994, an annual quasi-systematic mid-winter snail kite count was conducted by a succession of principal investigators. Counts since 1969 have ranged from 65 in 1972 to 996 in 1994. It is unknown whether decreases in snail kite numbers in the annual count were due to mortality, dispersal into areas not counted, decreased productivity, or a combination of these factors. Despite the difficulty in interpreting the annual counts, the data from 1969 to 1994 indicated a generally increasing trend (Sykes 1979; Rodgers et al. 1988; Bennetts et al. 1994). Since 1997, population estimates and estimates of demographic parameters have been generated exclusively employing mark-recapture methods that incorporate detection probabilities. From 1997 through 1999, the snail kite population was estimated to be about 3,000 birds (Dreitz et al. 2002). From 1999 through 2002, the population estimates declined each year until they reached a low level of about 1,400 birds in 2002 and 2003, then increased slightly to about 1,700 birds in 2004 and 2005 (Martin et al. 2006). The kite population declined by nearly half again from 2006 to 2008, and leveled off at approximately 600-800 kites from 2008-2010. The population estimate for 2011 was 925, which is significantly higher than 2008-2010, but still low (Reichert et al. 2012). The population trend is depicted in Figure 23.

Within Everglades National Park, kite nesting has been relatively uncommon in the past two decades. In 2011, two nests were located in northeastern Shark Slough, but both failed. This has been a typical pattern, likely due to low water levels and rapid drying in Shark Slough that leaves nests vulnerable to predators. However, there has also been relatively low survey effort and it is difficult to survey all suitable areas within the park, and some additional nests may occur. Regardless, the park supports a small fraction of the snail kite nesting effort in Florida in recent years. Outside of nesting season, kites may occur and forage throughout the park, but rarely in large numbers. In summer and fall 2012, kites were routinely observed foraging in the vicinity of Taylor Slough, as well as in other places within the park.

Fire occurs in many places where snail kites occur. In the Everglades marshes, fires regularly burn large areas of marsh where kites forage and nest. Under most conditions, fires have little effect on snail kites. In dense emergent marshes, fires may make snails more available and increase habitat suitability for kites. However, because apple snails rely on exposed stems for oviposition, fires could reduce snail reproduction, but a sufficient number of stems generally remain after fires to allow snails to oviposit. Fire may also reduce available nesting substrate by top-killing small trees and

shrubs in the marsh and removing dense sawgrass and cattail stands. However, there is little evidence that kites are limited by suitable nesting substrate. The adaptability of kites and their use of nearly the entire Everglades landscape makes them resilient to even the largest of fires, and in response to a large, severe fire, they would most likely just relocate to another area until favorable conditions return.

Everglade snail kite critical habitat: The critical habitat that is designated within the park has been used by kites little in recent decades, and no nesting has been recorded within critical habitat in over 10 years. However, when hydrologic conditions are favorable, it is likely that kites forage in this area, but probably not more than other areas outside of critical habitat in the park. The snail kite critical habitat was one of the first published critical habitats, and primary constituent elements were not identified. Based on the snail kite's biological requirements, we consider PCEs to be: natural marsh vegetation for the Everglades region, presence and availability of the snail kite's primary prey, the apple snail, and suitable hydrologic conditions. Fire may affect vegetation and potentially apple snails over short time periods, but would tend to maintain these constituent elements in the long term.

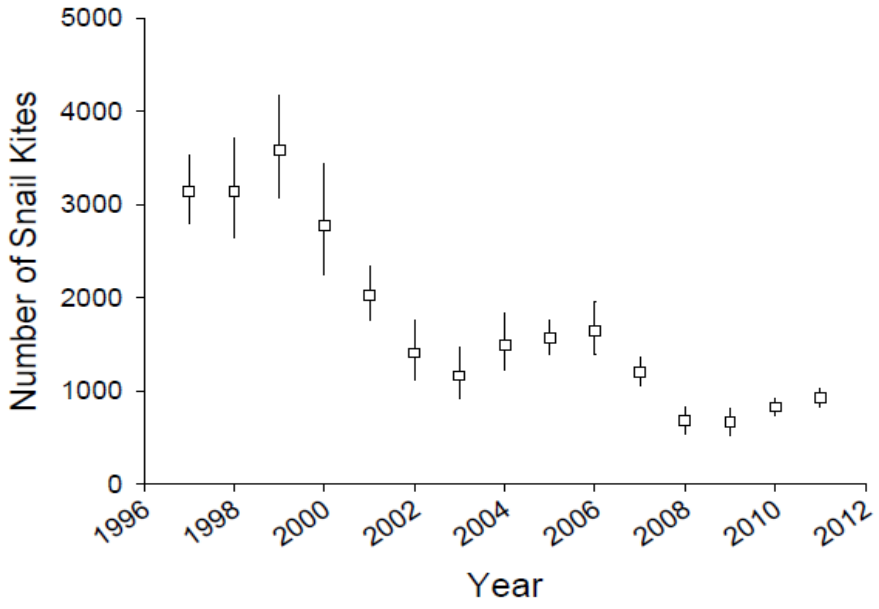

Figure 23. Population of Abundance of Snail Kites from 1996 through 2011.
(From *Reichert, B, et al. 2011***)**

Wood stork (*Mycteria americana*). The wood stork occurs from northern Argentina, eastern Peru and western Ecuador, north to Central America, Mexico, Cuba, Hispaniola, and the southeastern United States (American Ornithologists Union 1983). Only the population segment that breeds in the southeastern United States is listed as threatened. On June 30, 2014, a final rule was published in the Federal Register (79 FR 37078), which downlisted the wood stork from endangered to threatened. The rule took effect on July 30, 2014.

The wood stork is a large, long-legged wading bird, with a head to tail length of 33 to 45 inches and a wingspan of 59 to 65 inches (Coulter et al. 1999). The plumage is white, except for iridescent black primary and secondary wing feathers and a short black tail. Wood storks fly with their neck and legs extended. On adults, the rough scaly skin of the head and neck is unfeathered and blackish in color,

the legs are dark, and the feet are dull pink. The bill color is also blackish, except in young storks, when the bill color can appear yellowish.

Wood storks nest colonially, often in conjunction with other wading bird species, and generally occupy the large-diameter trees at a colony site (Rodgers et al. 1996). The same colony site will be used for many years as long as the colony is undisturbed and sufficient feeding habitat remains in surrounding wetlands. However, not all storks nesting in a colony will return to the same site in subsequent years (Kushlan and Frohring 1986). Natural wetland nesting sites may be abandoned if surface water is removed from beneath the trees during the nesting season (Rodgers et al. 1996). In response to this type of changes to nest site hydrology, wood storks may abandon that site and establish a breeding colony in managed or impounded wetlands (Ogden 1991). Wood storks that abandon a colony early in the nesting season due to unsuitable hydrological conditions may re-nest in other nearby areas (Crozier and Cook 2004). Between breeding seasons or while foraging wood storks may roost in trees over dry ground, on levees, or large patches of open ground. Wood storks may also roost within wetlands while foraging far from nest sites and outside of the breeding season (Gawlik 2002).

While the majority of stork nesting occurs within traditional stork rookeries, a handful of new stork nesting colonies are discovered each year (Meyer and Frederick 2004; USFWS unpublished data 2006). These new colony locations may represent temporary shifts of historic colonies due to changes in local conditions, or they may represent formation of new colonies in areas where conditions have improved.

Wood storks forage in a wide variety of wetland types, where prey are available and the water is shallow and open enough to hunt successfully (Ogden et al. 1978; Browder 1984; Coulter 1987). Calm water, about 2 to 16 inches deep and free of dense aquatic vegetation is ideal (Coulter and Bryan 1993). Typical foraging sites include freshwater marshes, ponds, hardwood and cypress swamps, narrow tidal creeks or shallow tidal pools, and artificial wetlands such as stock ponds, shallow, seasonally flooded roadside or agricultural ditches, and managed impoundments (Coulter et al. 1999; Coulter and Bryan 1993).

Several factors affect the suitability of potential foraging habitat for wood storks. Suitable foraging habitats must provide both a sufficient density and biomass of forage fish and other prey, and have vegetation characteristics that allow storks to locate and capture prey. During nesting, these areas must also be near the colony for efficient delivery of prey to nestlings. Hydrologic and environmental characteristics have strong effects on fish density, and these factors may be some of the most significant in determining foraging habitat suitability, particularly in southern Florida.

Storks nest during the dry season, and rely on the drying wetlands to concentrate prey items in the ever-narrowing wetlands (Kahl 1964). Because of the continual change in water levels during the stork nesting period, any one site may only be suitable for stork foraging for a narrow window of time when wetlands have sufficiently dried to begin concentrating prey and making water depths suitable for storks to access the wetlands. Once the wetland has dried to where water levels are near the ground surface, the area is no longer suitable for stork foraging, and will not be suitable until water levels rise and the area is again repopulated with fish. Consequently, there is a general progression in the suitability of wetlands for foraging based on their hydroperiods, with the short hydroperiod wetlands being used early in the season, the mid-range hydroperiod sites being used during the middle of the nesting season, and the longest hydroperiod areas being used later in the season (Kahl 1964; Gawlik 2002).

Dense submergent and emergent vegetation may reduce foraging suitability by preventing storks from moving through the habitat and interfering with prey detection (Coulter and Bryan 1993). Some submergent and emergent vegetation does not detrimentally affect stork foraging, and may be important to maintaining fish populations. Average submergent and emergent vegetation cover at

foraging sites was 26 and 29 percent, respectively, at foraging sites at a Georgia colony, and ranged from 0 to 100 percent (Coulter and Bryan 1993). These cover values did not differ significantly from random wetland sites. Similarly, densely forested wetlands may preclude storks from accessing prey within the areas (Coulter and Bryan 1993). Storks tend to select foraging areas that have an open canopy, but occasionally use sites with 50 to 100 percent canopy closure (Coulter and Bryan 1993; O'Hare and Dalrymple 1997; Coulter et al. 1999).

Wood storks generally forage in wetlands within 31 miles of the colony site (Bryan and Coulter 1987), but forage most frequently within 12.5 miles of the colony (Coulter and Bryan 1993). Gawlik (2002) characterized wood storks as "searchers" that employ a foraging strategy of seeking out areas of high density prey and optimal (shallow) water depths, and abandoning foraging sites when prey density begins to decrease below a particular efficiency threshold, but while prey was still sufficiently available that other wading bird species were still foraging in large numbers (Gawlik 2002). Wood stork choice of foraging sites was significantly related to both prey density and water depth (Gawlik 2002). Because of this strategy, wood stork foraging opportunities are more constrained than many of the other wading bird species (Gawlik 2002).

The total nesting period, from courtship and nest-building through independence of young, lasts about 100 to 120 days (Coulter et al. 1999). Within a colony, nest initiation may be asynchronous, and consequently, a colony may contain active breeding wood storks for a period significantly longer than the 120 days required for a pair to raise young to independence. Adults and independent young may continue to forage around the colony site for a relatively short period following the completion of breeding. Wood storks produce an average of 1.29 fledglings per nest.

Following the completion of the nesting season, both adult and fledgling wood storks generally begin to disperse away from the nesting colony. Fledglings have relatively high mortality rates within the first 6 months following fledging, most likely of their lack of experience, including the selection of poor foraging locations (Hylton et al. 2006). Post-fledging survival also appears to be variable among years, probably reflecting the environmental variability that affects storks and their ability to forage (Hylton et al. 2006).

The United States breeding population of wood storks declined from an estimated 20,000 pairs in the 1930s to about 10,000 pairs by 1960 (USFWS 1984). Since the 1960s, the wood stork population has declined in southern Florida and increased in northern Florida, Georgia, and South Carolina (Ogden et al. 1987). The number of nesting pairs in the Everglades and Big Cypress ecosystems (southern Florida) declined from 8,500 pairs in 1961 to 969 pairs in 1995. During the same period, nesting pairs in Georgia increased from 4 to 1,501 and nesting pairs in South Carolina increased from 11 to 829 (USFWS 1997).

Productivity is generally higher in central-north Florida than south Florida. Whereas the number of colonies in south Florida has remained relatively stable, the number of colonies in central-north Florida region continues to increase (Ogden et al. 1987). The increase in central-north Florida is associated with an increase in colony numbers and not colony size; colonies in the north are smaller than colonies in the south. Historically, colonies in the south are associated with extensive wetland systems and predictable patterns of prey availability. Ogden et al. (1987) suggests the population shift is the result of deteriorating feeding conditions in south Florida and better nesting success rates in central-north Florida that compound population growth in that area.

Wood stork nesting within the park is highly variable among years, and this pattern is consistent with their life history strategy of selecting nesting areas based on the hydrological conditions in the region. Nest success is equally variable, and is again largely dictated by hydrologic conditions that determine the availability of prey for wood storks. Between 2007 and 2011, the peak number of wood stork nests in a year has ranged from 145 in 2008, to 2,602 in 2009. The majority of wood stork

nesting occurs within a handful of traditional large wood stork colonies that include: Tamiami West, Paurotis Pond, Cuthbert, Rodgers River, and others.

Human disturbance is a factor known to have a detrimental effect on wood stork nesting (USFWS 1997). Wood storks have been known to desert nests when disturbed by humans, thus exposing eggs and young birds to the elements and to predation by gulls and fish crows.

Wading birds within the Everglades system have co-evolved with fires, and fires are not likely to have significant effects on wading birds in most circumstances. Because wading birds tend to select nest sites with standing water around the, presumably to provide protection from predators, this selection also confers some protection from fires to the colonies (Epanchin et al. 2002). Outside of nesting, wading birds are likely to fly away from approaching fires and avoid most potential adverse effects of fire simply by moving to other areas. Under some limited circumstances, fires may injure or kill adult wading birds, as described by Epanchin et al. (2002). While the circumstances that result in death are unlikely, they may occur, but it remains unclear if the cause is smoke asphyxiation, birds becoming overcome by rapidly advancing flames, or other factors.

Periodic fires may improve foraging opportunities for wading birds by removing dense emergent vegetation. Wading birds generally do not enter densely vegetated areas to forage, but following fire, these areas may be more accessible, allowing birds to locate and capture prey in areas where they wouldn't have been able to otherwise. Because emergent vegetation generally recovers from fire rapidly, the duration of beneficial effects may be limited, but some incremental benefit may last for several years after dense stands of marsh vegetation are burned.

Wading Birds are one of the iconic groups of species associated with the Everglades. There are several species in this group that make up this group, and they vary in terms of size and coloration, habitat preference and foraging patterns, and other behavioral characteristics. However, as a group, they also share many common characteristics, including their dependence on fish, crayfish, and other primarily aquatic animals for food; their nearly complete dependence on wetlands; and communal nesting in large groups with other species of wading birds. These species are primarily affected by hydrologic conditions and water management. They are quite adaptable, and can forage in a wide variety of wetland types, including forested wetlands, herbaceous marshes, tidal and estuarine wetlands, and even canals and manmade lakes and ponds. Like the wood stork, they nest in trees and shrubs, generally located over water, and nesting colonies are consequently generally protected from the effects of fire. However, like the wood stork, fires may change the suitability and condition of foraging habitat. The mechanisms of selection of foraging areas varies among the species (Gawlik 2002), but within the Everglades, they all make use of the expansive and contiguous wetlands, and generally respond to disturbance or poor habitat conditions by moving to other areas and selecting habitats that contain favorable conditions. Several species of wading birds, including the great blue heron (*Ardea herodias*), great egret (*Ardea alba*), and several others, are not identified as species of special concern, though several are reported as declining. Most of these species have wide distributions, and occur in a variety of habitat conditions and settings across their ranges. In addition to the federally listed wood stork, several members of this group are listed as species of special concern by the Florida Fish and Wildlife Conservation Commission. Each listed species is briefly described below:

Little blue heron (*Egretta caerula*). The little blue heron is a state-listed species of special concern. Little blue heron is a wading bird found along the Atlantic coast from Massachusetts to Florida, and is most abundant along the Gulf of Mexico. This species ranges up to 30 inches in height and can have a wingspread of 3 feet. Little blue herons feed during the day on fish, reptiles, crustaceans, and insects. The long bill is used to jab and eat the prey, with a success rate of about 60 percent. They lay 3 to 5 eggs, and both sexes tend the nest and feed the young. Little blue herons can be observed foraging in the park, and they nest in the park as well, but accurate estimates of nesting are not

available due to the difficulty of detecting and accurately counting them during nesting due to their small size and dark coloration (Oberhofer and Bass 2004).

Snowy egret (*Egretta thula*). The snowy egret is state-listed species of special concern. Snowy egrets are small white herons, about 2 feet tall, with a 3-foot wingspan, and weighing just less than one pound. This species is distinguished by a black bill and legs, with yellow feet. Both males and females have the same coloration. Snowy egrets breed in multi-species wading bird colonies in estuarine areas, freshwater marshes, and anthropogenic wetlands, and generally nest in woody shrubs, particularly mangroves and willows. Prey includes aquatic organisms and insects, such as shrimp, fish, frogs, and insects. They forage by walking slowly or standing motionless and striking at the prey, and prefer calm waters for foraging. Populations were reduced by 20th century plume-hunting. Their numbers have rebounded, and snowy egrets are common throughout the park.

Tricolored heron (*Egretta tricolor*). The tricolored heron is a state-listed species of special concern. The tricolored heron, sometimes called the Louisiana heron, may reach 30 inches in height and weigh up to one pound. Its slate-gray plumage is complemented by a white belly and a white chin stripe. During most of the year, the bill is yellow with a black tip and legs are yellow. During mating season the bill turns bright blue and the legs are bright pink. The tricolored heron is found from Massachusetts to the Gulf Coast. Its diet consists primarily of fish, but may include small reptiles, amphibians, insects, and crustaceans. This species usually breeds in trees and shrubs in estuarine coastal areas, in mixed colonies with other herons, but also frequently nests in freshwater wetlands in the Everglades. Nests are close to the ground, with a clutch size of 3 to 4 eggs. Tricolored herons are commonly observed in all areas of the park.

White ibis (*Eudocimus albus*). The white ibis is a state-listed species of special concern. The white ibis is a medium-sized wading bird. Its feathers are entirely white in adults, except for its black wing tips. Juveniles are uniform to mottled brown in color. The face of the ibis is bare and pink, blending into a long, curved bill. It has long pink legs and webbed toes. Within the Everglades, ibis nest in multi-species colonies in both freshwater marsh and estuarine landscapes. White ibis probe for aquatic crustaceans and insects using the curved bill, and prefer foraging in relatively shallow freshwater wetlands when feeding young. This species frequents urban and suburban areas, and frequently forages in lawns, wet pastures, and other wetlands outside of breeding season. White ibis are highly sociable, nesting, feeding, roosting, and flying in flocks. Nests are placed on a variety of trees, shrubs, and vines, and tend to be closer to the ground than other colonially nesting wading birds. White ibis can be observed throughout Everglades National Park and adjacent areas.

Roseate spoonbill (*Platalea ajaja*). The roseate spoonbill is a state species of special concern. Roseate Spoonbills are found in the coastal marshes, mudflats, and mangrove keys from Florida to coastal Texas. These large wading birds stand almost 3 feet tall and have a wingspan in excess of 4 feet. This species is often found in small groups, often with other wading birds. To feed, roseate spoonbills immerse their bill tips in water and swing their heads from side to side. Their diet consists of small fishes, crustaceans, mollusks, slugs, and aquatic insects. Roseate spoonbills often nest in rookeries with herons, ibis, and other wading birds. They construct their nests of sticks, in trees or bushes, 5 to 15 feet off the ground. Early in the 20th century, this species was depleted as a result of the feather trade. Since protective laws were enacted in Florida, their numbers rose. However, their nesting success in Florida Bay was impacted by water management practices (Lorenz et al. 2009). Roseate spoonbills form breeding colonies in the islands of Florida Bay, and are commonly observed foraging in the mudflats off Flamingo, in Mrazek Pond, and in Eco Pond. The estuarine zone of the southern mainland is an important feeding ground for the Florida Bay colonies. Roseate spoonbills forage in marine and estuarine waters more frequently than in freshwater areas, and nest primarily on coastal islands, and recently nested inland at Paurotis Pond and in various colony sites along headwaters of west coast rivers.

Limpkin (*Aramus guaruana*) is a state-listed species of special concern. The limpkin is a heron-sized brown rail-like waterbird. It feeds primarily on apple snails, and the limpkin's distribution is therefore almost identical to that of the apple snail. The dependence on apple snails also means the limpkin uses a wide variety of freshwater wetland habitats that include most freshwater Everglades wetlands, but also canals. Limpkins almost became extirpated as a result of overhunting. Although their population has recovered, limpkins are still vulnerable to habitat loss, especially wetlands drainage and decreases in wetlands water quality. They are solitary nesters and nest in a wide variety of locations, including mounds of aquatic vegetation and marsh grasses, among cypress knees, and high in trees (FNAI 2001). The population size of limpkins within Everglades National Park is unknown, although limpkins breed throughout the park.

Florida sandhill crane (*Grus canadensis pratensis*) is state-listed as threatened. The Florida sandhill crane is a subspecies of the Sandhill crane. Although other subspecies of sandhill cranes occur in Florida and cannot easily be distinguished from Florida sandhill cranes, the Florida sandhill crane is nonmigratory and is the only subspecies that breeds in Florida. Cranes feed on a variety of items, including tubers, seeds, acorns, berries, grasshoppers, dragonflies, crayfish, snakes, frogs, and rats. Florida sandhill cranes maintain the same mate for years, and diligently guard their young for up to a year. Cranes construct their nests of mounds of emergent vegetation and mud in standing water. Their favored habitats are generally pastures, prairies, and transition zones between wetlands and adjacent uplands, and they prefer to forage in uplands over wetlands. The biggest threat to Florida sandhill cranes is habitat loss, including alteration of shallow freshwater marshes through drainage, filling, and degradation of water quality. Florida sandhill cranes rarely nest in the Everglades, likely as a result of their preference for open uplands with adjacent wetlands. Cranes respond to burns that occur in appropriate habitat, often feeding just after the fire has passed (FFWCC 2011a).

White-crowned pigeon (*Columba leucocephala*) is a state-listed threatened species. Within the park, white-crowned pigeons are common in summertime, and uncommon in winter. They feed on fruits of common native tropical hardwoods such as fig (*Ficus* spp.), pigeon plum (*Coccoloba diversifolia*), poisonwood (*Metopium toxiferum*), and others. Birds nesting on small keys in Florida Bay fly to the mainland or upper Keys (e.g., Key Largo) daily to feed. They migrate to the Bahamas during the winter, so their population numbers are highly seasonal. More than half of the Florida population nests in Florida Bay in Everglades National Park. Nesting on the mainland of Florida is rare. Nesting occurs on mangrove covered islands free of raccoons and human disturbance. White-crowned pigeons require an abundant supply of fruit (FFWCC 2011b). Plants that produce this fruit are found in a number of habitats in southern Florida. The birds are frequently found in disturbed areas where poisonwood is abundant.

Reintroduced pineland bird species. In 1997, an experimental avian reintroduction program in the Long Pine Key region of Everglades National Park was initiated. This program was considered a test of the restoration progress made through protection of pine forests and the development and implementation of appropriate fire management practices. The goal of the program was to reestablish viable populations of two extirpated cavity-nesters, the Brown-headed nuthatch and the eastern bluebird. Over a four-year period 47 adults of each species were translocated from a donor population in Big Cypress National Preserve (Slater 2001). In 2001, 15 nuthatch and 18 bluebird territories were established and further translocations were deemed unnecessary (Slater 2001). Monitoring continued for two years after translocations to monitor population size and evaluate the success of the program. Based on demographic criteria, the reintroduction of both species was considered a success (Slater 2004). However, population levels remained low and information on relationships between management and population dynamics was considered a significant information need (Slater 2004).

Brown-headed nuthatches (*Sitta pusilla*) are tiny birds restricted to southeastern pinelands. They feed chiefly on small insects and spiders from trunks and branches of pines, and also on pine seeds

and mast, and can be observed creeping along trunks, even upside down. They are known to use pieces of bark as tools to find insects. They nest in cavities they excavate in pine snags, often within 4 to 5 feet off the ground. They breed from February to May and raise four to six eggs, and sometimes raise two broods a year. Brown-headed nuthatches have declined in population due to logging and forest fragmentation. Fire exclusion may negatively impact these birds by slowing the creation of snags, encouraging dense understory, and negatively impacting the quality and quantity of available food.

Eastern bluebirds (*Sialia sialis*) are small thrushes (approximately 7 inches long) with short black bills and a chestnut underside with a white belly. Males are deep blue on the head, nape, back, wings, and tail. Females have gray-blue upper parts with a gray-brown wash on the back. Eastern bluebird populations declined in recent years to as low as 17 percent of their previous numbers in the late 1950s and early 1960s. Reasons postulated for this decline include severe winters, harmful effects from the use of pesticides to control fire ants, and competition with other cavity nesters (including the introduced non-native European starling) for increasingly scarce nest sites. Bluebirds are frequently seen foraging in recently burned pinelands in Everglades National Park.

The **Florida wild turkey** (*Meleagris gallopavo osceola*) is found only on the peninsula of Florida. They are slightly smaller than the eastern wild turkey and darker in color with less white in the feathers. Its colorations and behavior are ideal for the flat pine woods, oak and palmetto hammocks, and swamp habitats of Florida. Egg laying occurs between March and June Florida Fish and Wildlife Conservation Commission (no date). As a part of the pineland bird restoration program in Everglades National Park, a cooperative program was conducted between The National Wild Turkey Federation, the Florida Fish and Wildlife Conservation Commission, and the park to reintroduce Florida wild turkeys. Twenty-nine turkeys were released in January of 2000. Although monitoring indicates that breeding occurred between 2001 and 2003, no systematic estimate of population size was conducted. Turkeys have been observed intermittently, and still occur in some numbers within the pinelands on long Pine Key. Camera traps recorded several female and young turkeys in the summer 2012.

ENVIRONMENTAL CONSEQUENCES

Impact Analysis Methods

Each alternative is compared to a baseline to determine the context, duration, and intensity of the resource impacts. Impacts are often considered relative to the "no action" alternative or a pre-impact condition. Each alternative is compared to a baseline to determine the context, duration, and intensity of resource impacts. For purposes of the impact analysis in this document, this baseline is the current condition of resources, species, and habitats, as observed and documented within Everglades National Park. This baseline represents a combination of naturally occurring events and past fire management decisions in the park. The described impacts of Alternative A therefore represent the expected trajectory of resource condition relative to the current condition if current management is continued. Similarly, the impacts of Alternative B represent the expected trajectory of resource condition if this alternative were selected, relative to current resource conditions. In the absence of quantitative data, best professional judgment was used to determine impacts. In general, impacts were determined using existing literature, federal and state standards, and consultation with subject matter experts, park staff and other agencies.

For this analysis, impacts of the application of fire under each alternative are considered. Impacts also include the effects of fire management associated with burning such as surveys, fire line

preparation, and wildfire management actions, as well as post-burn assessment. Potential impacts of all alternatives are described in terms of type (Are the effects beneficial or adverse?); context (Are the effects site-specific, local, or regional?); duration (Are the effects short-term or long-term?); and intensity (Are the effects negligible, minor, moderate, or major?). Because definitions of intensity can vary by topic, intensity thresholds are provided separately for each impact topic.

Guiding Regulations and Policies

The primary regulation governing this topic is the Endangered Species Act of 1973, 16 USC § 1531-1543. The purpose of the Endangered Species Act is to conserve "the ecosystem upon which endangered and threatened species depend" and to conserve and recover listed species. The Endangered Species Act is a comprehensive wildlife conservation law administered by the Department of Interior's U.S. Fish and Wildlife Service and National Oceanographic and Atmospheric Administration's National Marine Fisheries Service. The Endangered Species Act mandates that all federal agencies protect listed species and preserve their habitats.

The State of Florida also has regulations for the protection of threatened and endangered species. The Florida Endangered and Threatened Species Act (Title 28, Florida Statutes, Natural Resources Conservation, Reclamation, and Use, Chapter 372, Wildlife, Section 372.072) is the primary regulation in the state, and sets the policy to conserve and wisely manage these wildlife resources, as well as provide for research and management to conserve and protect these species as a natural resource. This act also emphasizes coordination with state agencies, and outlines annual reporting requirements as well the development of specific biological goals for manatees.

The Endangered Species Protection Act (Florida Statutes Section 372.0725) prohibits the intentional wounding or killing of any fish or wildlife species designated by the Florida Game and Freshwater Fish Commission (now known as the Florida Fish and Wildlife Conservation Commission) as "endangered," "threatened," or of "special concern." This prohibition also extends to the intentional destruction of the nests or eggs of any such species.

The protection of endangered, threatened, or "commercially exploited" plants is addressed in the Preservation of Native Flora of Florida Act (Florida Statutes Section 581.185). Commercially exploited plants are defined as species native to the state which are subject to being removed in substantial numbers from native habitats in the state and sold or transported for sale. This act sets the policy for the State of Florida relating to these species, and includes several prohibitions covering the "willful destroying or harvesting" of such plants. It also contains an exemption for agricultural and silviculture uses.

Section 4.4.2.3 of the NPS *Management Policies* 2006 provides specific guidance for management of threatened or endangered plants and animals. These policies dictate that the NPS would survey for, protect, and strive to recover all species native to national park system units that are listed under the ESA. The NPS would fully meet its obligations under the NPS Organic Act and the ESA to both proactively conserve listed species and prevent detrimental effects on these species. This section also states that the NPS would inventory, monitor, and manage state and locally listed species in a manner similar to its treatment of federally listed species to the greatest extent possible. In addition, the Service would inventory other native species that are of special management concern to parks (such as rare, declining, sensitive, or unique species and their habitats) and would manage them to maintain their natural distribution and abundance.

Assumptions, Methodology, and Impact Thresholds

Applicable guidance for implementing Section 7 consultation under the Endangered Species Act uses the following terminology to assess impacts on federally listed species:

"No Effect" – This conclusion is reached if the proposed action and its interrelated and interdependent actions will not directly or indirectly affect listed species or destroy/adversely modify designated critical habitat. Formal section 7 consultation is not required when the no effect conclusion is reached. However, a request for the optional written concurrence is encouraged to facilitate a complete administrative record.

"May affect, but is not likely to adversely affect" – This conclusion is appropriate when effects to the species or critical habitat are expected to be beneficial, discountable, or insignificant. Beneficial effects are contemporaneous positive effects without any adverse effects to the species or habitat. Insignificant effects relate to the size of the impact (and should never reach the scale where take occurs), while discountable effects are those that are extremely unlikely to occur. Based on best judgment, a person would not: (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur. If the project scientist making the determination and the project manager agree that the project "is not likely to adversely affect" listed species or critical habitat, the intra-Service section 7 consultation process is completed. If formal section 7 consultation is required for other species affected by this proposed action, then it may be easier and less confusing to fold the "is not likely to adversely affect" concurrence into the formal section 7 consultation rather than doing a separate concurrence.

"May affect, and is likely to adversely affect" – This conclusion is reached if any adverse effect to listed species or critical habitat may occur as a direct or indirect result of the proposed action or its interrelated or interdependent actions, and the effect is not discountable or insignificant (see definition of "is not likely to adversely affect." In the event the overall effect of the proposed action is beneficial to the listed species or critical habitat, but may also cause some adverse effect on individuals of the listed species or segments of the critical habitat, then the determination should be "is likely to adversely affect." Such a determination requires formal section 7 consultation.

Impact Intensity Threshold Definitions

Based on these impact levels, the following thresholds were used to determine the magnitude of impacts on special status species. Impact thresholds are developed for adverse effects; beneficial impacts are assessed qualitatively:

Thresholds

Threshold	Definition
Negligible	There would be no observable or measurable impacts to special status species, their habitats, or the natural processes sustaining them in the proposed project area. This impact intensity would equate to a determination of "no effect" under Section 7 of the ESA.
Minor	Individuals may temporarily avoid areas. Impacts would not affect critical periods (e.g., breeding, nesting, denning, feeding, resting) or habitat. This impact intensity would equate to a determination of "not likely to adversely affect" under Section 7 of the ESA. Critical habitat may be affected, but not in a manner that substantially affects the primary constituent elements.
Moderate	Individuals may be impacted by disturbances that interfere with critical periods (e.g., breeding, nesting, denning, feeding, resting) or habitat; and the level of impact may result in physical injury or mortality of individuals, but would not be expected to affect the population's likelihood of persistence, or lead to extirpation or declines. This impact intensity would equate to a determination of "likely to adversely affect" under Section 7 of the ESA. Critical habitat may be

	affected, and PCEs may be minimally altered, such as minor changes in the arrangement, amount, or condition of PCEs, but would not remove PCEs or cause adverse modification.
Major	Individuals may suffer physical injury or mortality such that populations may decline substantially or be extirpated from the park. Critical habitat would be affected, and one or more PCEs would be eliminated or substantially altered. This impact intensity would equate to a determination of "likely to adversely affect" under Section 7 of the ESA.
Short-term	Impacts to special status species would occur only during the management action and effects would last less than five years
Long-term	Impacts would persist for five or more years.
Imperceptible	The incremental effect contributed by the alternative to the overall cumulative impact is such a small increment that it is impossible or extremely difficult to discern.
Noticeable	The incremental effect contributed by the alternative, while evident and observable, is still relatively small in proportion to the overall cumulative impact.
Appreciable	The incremental effect contributed by the alternative constitutes a large portion of the overall cumulative impact.

Area of Analysis (geographic area evaluated for impacts)

The area of analysis for this topic comprises all of the mainland in the park and the immediately adjacent waterways that may be affected by actions within the defined FMUs.

ALTERNATIVE A: NO ACTION / CONTINUE CURRENT MANAGEMENT

Impact Analysis

Plants. Fire is likely to result in injury or mortality of individuals of some plant special status species. However, the effect of fire on each of these species depends on a variety of factors. The likelihood of mortality depends not only on adaptations specific to each species but also on the behavior and characteristics of the fire. For example, low intensity fires that occur in habitats with lower fuel loading are thought to be less likely to result in injury and mortality than high intensity fires that would occur in habitats with greater fuel loading. Indirect impacts to plant species of management concern can also occur through successional processes that occur in the absence of regularly occurring fire. For example, unburned pine rockland may convert to rockland hammock resulting in habitat loss for pine rockland-preferring plant species in a relatively short period of time. In general, it is assumed that if fire dependent habitats experience fire at intervals similar to those that occurred historically, they will persist in the landscape over time.

Blodgett's Silverbush – The direct impacts of fire on Blodgett's silverbush are not well understood. Periodic fire is critical in maintaining the open understory and species diversity in pine rocklands where this species occurs. Regular prescribed fire also reduces infestations of exotic species that may compete with Blodgett's silverbush, particularly Brazilian pepper. Plants are perennial, so resprouting from existing rootstock in moist marl soils or limestone bedrock is likely to occur following low intensity fires. However, mortality of some individuals probably results from fire events. Surveys following a prescribed fire in Pine Block B in 2008 led to the observation of significantly more plants than were previously known from the area. It is unclear if plants were present and became more easily observed following reduction in shrub cover from the fire or if the fire led to the expansion of the existing, known population. Currently, no information is available on differences in mortality or long-term population impacts resulting from wet or dry season burns.

Indirect evidence suggests that burning in either season is suitable to maintain populations of this species in pine rocklands. Prescribed fire in the park was originally conducted during the dry season. Fire management was gradually shifted to wet season burning in an effort to better mimic natural lightning ignited fire patterns. Currently, prescribed fire is conducted year round in the park. As a result, pinelands in the park where this species occurs have been burned in both the wet season and dry season. Long-term maintenance of populations in those areas indicates that either practice will sustain populations of Blodgett's silverbush.

Under Alternative A, prescribed fire would not be implemented in designated wilderness. Given that all known populations of Blodgett's silverbush occur in designated wilderness, they are not expected to be directly affected by management ignited prescribed fire. In the absence of prescribed fire, ignition sources for all fires would be limited to lightning strikes and unintentional or intentional human ignited fire (arson, cigarettes, campfires, etc.). Prescribed fire may be used to control exotic invasive species populations in wilderness, but those actions would be associated with the exotic vegetation species management plan, and not considered part of Alternative A. It is anticipated that fire would continue to occur in some areas of pine rockland habitat and potentially within habitat occupied by Blodgett's silverbush. Fire return intervals under Alternative A may, on average, remain within those described in the literature for pine rockland habitats. However, human influences over time have reduced the potential for historic fire patterns to occur in habitats throughout the park. Pine rockland habitat within Long Pine Key is now discontinuous due to the construction of roads that separate the area into individual blocks and divide the area from north to south. Wildfire may result in fires that are not within prescription parameters designed to minimize impacts to sensitive species and habitats. Areas in the Hole-in-the-Donut area that have not been restored may prevent fire from moving across the landscape. Drainage of natural plant communities may have resulted in a greater frequency of fire and an increased likelihood that landscape scale fires would occur. Finally, management of natural or human-caused fire will occur and may include suppression activities in certain situations under Alternative A. Such management also influences the likelihood of fire in areas occupied by Blodgett's silverbush.

All aspects of fire in wilderness will be dictated by unpredictable events under Alternative A. Park fire management staff will not be able to ensure that areas that require burning for maintenance will be burned. While these areas may still burn, the timing, frequency, intensity and spatial area will not be predictable. In the event that fire does not occur in these occupied areas, shrub and tree encroachment will eventually convert pine rockland habitat occupied by Blodgett's silverbush to hardwood dominated rockland hammock. In some areas this may occur in as little as 15-25 years. Given the relatively localized distribution and relatively low number of plants, populations of Blodgett's silverbush are likely to decline and may eventually be extirpated if unplanned fire does not occur.

In the absence of management ignited fire in occupied habitat, fire management under Alternative A would have negligible, short-term adverse effects on Blodgett's silverbush. Due to the potential for long-term changes in plant communities, impacts of fire management on Blodgett's silverbush under Alternative A would be moderate, long-term, and adverse. Given the extremely limited distribution, impacts would be regional with respect to this species. Management under Alternative A may affect and is likely to adversely affect Blodgett's silverbush.

Pineland Sandmat – The impacts of fire on pineland sandmat are not well understood. Fire is necessary to maintain an open understory that is required by this species to persist in that habitat and is important in reducing exotic species infestations. Periodic fires may result in mortality of individuals if occupied habitat burns. However, Herndon (1998) pointed out that the life history of this species includes a cryptic stage, making interpretation of mortality of aboveground parts difficult. This species is perennial and possesses a well-developed rootstock that is protected from

fire. Resprouting of individuals following fire is likely to occur. Currently, no information is available on differences in mortality or long-term population impacts resulting from wet or dry season burns. Indirect evidence suggests that burning in either season is suitable to maintain populations of pineland sandmat in pine rocklands. Prescribed fire in the park was originally conducted during the dry season. Fire management was gradually shifted to wet season burning in an effort to better mimic natural lightning ignited fire patterns. Currently, prescribed fire is conducted year round in the park. As a result, pinelands in the park where pineland sandmat occurs have been burned in both the wet season and dry season. Long-term maintenance of populations in those areas indicates that either practice would sustain populations of pineland sandmat.

Under Alternative A, prescribed fire would not be implemented in designated wilderness. Given that all known populations of pineland sandmat occur in designated wilderness, they are not expected to be directly affected by management ignited prescribed fire. In the absence of prescribed fire, ignition sources for all fires would be limited to lightning strikes and unintentional or intentional human ignited fire (arson, cigarettes, campfires, etc.). Prescribed fire may be used to control exotic invasive species populations in wilderness, but those actions would be associated with the exotic vegetation species management plan, and not considered part of Alternative A. It is anticipated that fire would continue to occur in some areas of pine rockland habitat and potentially within habitat occupied by pineland sandmat. Fire return intervals under Alternative A may, on average, remain within those described in the literature for pine rockland habitats. However, human influences over time have reduced the potential for historical fire patterns to occur in habitats throughout the park. Pine rockland habitat within Long Pine Key is now discontinuous due to the construction of roads that separate the area into individual blocks and divide the area from north to south. Wildfire may result in fires that are not within prescription parameters designed to minimize impacts to sensitive species and habitats. Areas in the Hole-in-the-Donut area that have not been restored may prevent fire from moving across the landscape. Drainage of natural plant communities may have resulted in a greater frequency of fire and an increased likelihood that landscape scale fires would occur. Finally, management of natural or human-caused fire will occur and may include suppression activities in certain situations under Alternative A. Such management also influences the likelihood of fire in areas occupied by pineland sandmat.

All aspects of fire in wilderness would be dictated by unpredictable events under Alternative A. Park fire management staff would not be able to ensure that areas that require burning for maintenance would be burned. While these areas may still burn, the timing, frequency, intensity and spatial area would not be predictable. In the event that fire does not occur in these occupied areas, shrub and tree encroachment would eventually convert to hardwood dominated rockland hammock. In some areas this may occur in as little as 15-25 years. Given the relatively widespread distribution of this species in Long Pine Key and relatively large number of plants, some populations of pineland sandmat would likely decline and may eventually be extirpated if natural or arson fire does not occur. Other populations are likely to persist due to random fire occurrences maintaining appropriate habitats.

In the absence of management ignited fire in occupied habitat, fire management under Alternative A would have negligible short-term effects on pineland sandmat. Due to the potential for long-term changes in plant communities, impacts of management on pineland sandmat under Alternative A would be moderate, long-term and adverse. Given the relatively broad distribution of this species within Long Pine Key, impacts would be local to regional with respect to this species. Management under Alternative A may affect and is likely to adversely affect pineland sandmat.

Garber's Spurge – The impacts of fire on Garber's spurge are not entirely understood. Fire is necessary to maintain an open understory that is required by this species to persist in pine rockland habitat. Regular prescribed fire also reduces infestations of exotic species that may compete with

Garber's spurge, particularly Brazilian pepper. Periodic fires result in mortality of individuals when occupied habitat burns (Herndon 1998). In addition, recruitment has been observed within one-year following fire (Herndon 1998) and it is likely that fire results in rapid turnover of populations that burn. Currently, no information is available on differences in mortality or long-term population impacts resulting from wet or dry season burns. Indirect evidence suggests that burning in either season is suitable to maintain populations of Garber's spurge in pine rocklands. Prescribed fire in the park was originally conducted during the dry season. Fire management was gradually shifted to wet season burning in an effort to better mimic natural lightning ignited fire patterns. Currently, prescribed fire is conducted year round in the park. As a result, pinelands in the park where Garber's spurge occurs have been burned in both the wet season and dry season. Long-term maintenance of populations in those areas indicates that either practice would sustain populations of Garber's spurge.

The effects of fire on coastal populations of Garber's spurge have not been studied. Similar open, grass dominated habitats in Everglades National Park and elsewhere in Florida typically require fire for long-term maintenance. However, no fire return interval has been established for the park's coastal grasslands. Periodic storm surges may also produce similar effects on reducing understory vegetation in these habitats. In 2004, coastal grasslands at NW Cape Sable were burned as a result of an unintentionally set wildfire. At least one major storm surge event impacted the area the following year. Garber's spurge is currently widespread and abundant in this area indicating that impacts from one or both of these events on Garber's spurge were short lived and probably beneficial. Additional studies on the impacts of fire on coastal populations of Garber's spurge may aid in developing specific prescriptions for those populations.

Under Alternative A, prescribed fire would not be implemented in designated wilderness. Given that all known populations of Garber's spurge occur in designated wilderness, they are not expected to be directly affected by management ignited prescribed fire. In the absence of prescribed fire, ignition sources for all fires would be limited to lightning strikes and unintentional or intentional human ignited fire (arson, cigarettes, campfires, etc.). Prescribed fire may be used to control exotic invasive species populations in wilderness, but those actions would be associated with the exotic vegetation species management plan, and not considered part of Alternative A. It is anticipated that fire would continue to occur in some areas of pine rockland and coastal grassland habitat and potentially within habitat occupied by Garber's spurge. Fire return intervals under Alternative A may, on average, remain within those described in the literature for pine rockland habitats. However, human influences over time have reduced the potential for historic fire patterns to occur in habitats throughout the park. Pine rockland habitat within Long Pine Key is now discontinuous due to the construction of roads that separate the area into individual blocks and divide the area from north to south. Wildfire may result in fires that are not within prescription parameters designed to minimize impacts to sensitive species and habitats. Areas in the Hole-in-the-Donut area that have not been restored may prevent fire from moving across the landscape. Drainage of natural plant communities may have resulted in a greater frequency of fire and an increased likelihood that landscape scale fires would occur. Finally, management of natural or human-caused fire will occur and may include suppression activities in certain situations under Alternative A. Such management also influences the likelihood of fire in areas occupied by Garber's spurge.

All aspects of fire in wilderness would be dictated by unpredictable events under Alternative A. Park fire management staff would not be able to ensure that areas that require burning for maintenance would be burned. While these areas may still burn, the timing, frequency, intensity and spatial area would not be predictable. In the event that fire does not occur in these occupied areas, shrub and tree encroachment would eventually convert pine rockland to hardwood dominated rockland hammock. In some areas this may occur in as little as 15-25 years. In this scenario, populations of Garber's spurge would likely decline if natural or arson fire does not occur in those habitats. Due to

the relatively widespread distribution and large number of plants in Long Pine Key, it seems unlikely that the absence of prescribed fire would lead to complete conversion of occupied pine rockland habitat to rockland hammock.

Tropical storms appear to create disturbance effects in coastal grasslands that are similar to those caused by fire. Therefore, in the absence of prescribed fire in coastal grassland of Cape Sable, habitat maintenance should still occur. As a result, Garber's spurge populations in these communities should be maintained in the absence or presence of fire.

In the absence of management ignited fire in occupied habitat, fire management under Alternative A would have negligible short-term effects on Garber's spurge. Due to the potential for long-term changes in plant communities in pine rockland, impacts of management on Garber's spurge under Alternative A would be moderate, long-term, and adverse. Given the relatively broad distribution of this species within Long Pine Key and disjunct populations in Cape Sable, impacts would be local with respect to this species. Management under Alternative A may affect and is likely to adversely affect Garber's spurge.

Florida Pineland Crabgrass – The impacts of fire on Florida pineland crabgrass are not well understood. Fire is critical in maintaining the open understory and species diversity in marl prairies and wet pine rocklands where this species occurs. Mortality of some individuals may occur from prescribed fire and it is anticipated that mortality would increase with increasing fire intensities. Plants are perennial, so resprouting from existing rootstock in moist marl soils or limestone bedrock is likely to occur following low intensity fires. Herndon (1998) reported a significant population decline resulting from fire followed by flooding from a tropical storm in one of the occurrences of this species in Long Pine Key. It is not clear if this population has recovered since that time. Currently, limited information is available on differences in mortality or long-term population impacts resulting from wet or dry season burns. Indirect evidence suggests that burning in either season is suitable to maintain populations of Florida pineland crabgrass in pine rocklands. Prescribed fire in the park was originally conducted during the dry season. Fire management was gradually shifted to wet season burning in an effort to better mimic natural lightning ignited fire patterns. Currently, prescribed fire is conducted year round in the park. As a result, pinelands and marl prairies in the park where Everglades crabgrass occurs have been burned in both the wet season and dry season. Long-term maintenance of populations in those areas indicates that either practice would sustain populations of this species. However, Herndon (1998) suggests that summer or wet season fires increase the likelihood that the combined influence of fire and flooding would occur.

Under Alternative A, prescribed fire would not be implemented in designated wilderness. Given that all known populations of Florida pinelands crabgrass occur in designated wilderness, they are not expected to be directly affected by management ignited prescribed fire. In the absence of prescribed fire, ignition sources for all fires would be limited to lightning strikes and unintentional or intentional human ignited fire (arson, cigarettes, campfires, etc.). Prescribed fire may be used to control exotic invasive species populations in wilderness, but those actions would be associated with the exotic vegetation species management plan, and not considered part of Alternative A. It is anticipated that wildfire would continue to occur in some areas of pine rockland and marl prairie habitat and potentially within habitat occupied by Florida pineland crabgrass. Fire return intervals under Alternative A may, on average, remain within those described in the literature for pine rockland and marl prairie habitats. However, human influences over time have reduced the potential for historic fire patterns to occur in habitats throughout the park. Pine rockland and marl prairie habitat within Long Pine Key is now discontinuous due to the construction of roads that separate the area into individual blocks and divide the area from north to south. Wildfire may result in fires that are not within prescription parameters designed to minimize impacts to sensitive species and habitats. Areas in the Hole-in-the-Donut area that have not been restored may prevent fire from moving across the

landscape. Drainage of natural plant communities may have resulted in a greater frequency of fire and an increased likelihood that landscape scale fires would occur. Finally, management of natural or human-caused fire will occur and may include suppression activities in certain situations under Alternative A. Such management also influences the likelihood of fire in areas occupied by Everglades crabgrass.

All aspects of fire in wilderness would be dictated by unpredictable events under Alternative A. Park fire management staff would not be able to ensure that areas that require burning for maintenance would be burned. While these areas may still burn, the timing, frequency, intensity and spatial area would not be predictable. In the event that fire does not occur in these occupied areas, shrub and tree encroachment in pine rockland would eventually convert to hardwood dominated rockland hammock. In some areas this may occur in as little as 15-25 years; however, this successional pattern may take longer or not occur in the wetter pine rocklands where this species occurs. In some marl prairies, particularly the north-south oriented transverse glades, wetland hardwood species encroachment that is already occurring is likely to continue to increase. Given the relatively widespread distribution of Everglades crabgrass in Long Pine Key, some populations would likely decline if natural or arson fire does not occur. Some populations would likely persist due to random fire occurrences maintaining appropriate habitats.

In the absence of management ignited fire in occupied habitat, fire management under Alternative A would have negligible, short-term, adverse effects on Florida pineland crabgrass. Due to the potential for long-term changes in plant communities, impacts of management on Florida pineland crabgrass under Alternative A would be moderate, long-term, and adverse. Given the relatively broad distribution of this species within Long Pine Key, impacts would be local to regional with respect to this species. Management under Alternative A may affect and is likely to adversely affect Florida pineland crabgrass.

Everglades Bully – The impacts of fire on Everglades Bully are not entirely understood. Fire is necessary to maintain an open understory that is required by this species to persist in marl prairies and pine rockland habitat and is important in reducing exotic species infestations. Periodic fires may result in mortality of individuals if occupied habitat burns. However, this species grows in wet marl soils and in soil deposits within crack in the limestone bedrock. This provides protection to the roots of this perennial species allowing plants to resprout following fire. Currently, no information is available on differences in mortality or long-term population impacts resulting from wet or dry season burns. Indirect evidence suggests that burning in either season is suitable to maintain populations of Everglades Bully in pine rocklands. Prescribed fire in the park was originally conducted during the dry season. Fire management was gradually shifted to wet season burning in an effort to better mimic natural lightning ignited fire patterns. Currently, prescribed fire is conducted year round in the park. As a result, pinelands and marl prairies in the park where Everglades bully occurs have been burned in both the wet season and dry season. Long-term maintenance of populations in those areas indicates that either practice would sustain populations of Everglades bully.

Under Alternative A, prescribed fire would not be implemented in designated wilderness. Most known populations of Everglades bully occur in designated wilderness, and as a result, they are not expected to be directly affected by management ignited prescribed fire. In the absence of prescribed fire, ignition sources for all fires would be limited to lightning strikes and unintentional or intentional human ignited fire (arson, cigarettes, campfires, etc.). Prescribed fire may be used to control exotic invasive species populations in wilderness, but those actions would be associated with the exotic vegetation species management plan, and not considered part of Alternative A. It is anticipated that fire would continue to occur in some areas of pine rockland habitat and potentially within habitat occupied by Everglades bully. Fire return intervals under Alternative A may, on average, remain

within those described in the literature for pine rockland and marl prairie habitats. However, human influences over time have reduced the potential for historic fire patterns to occur in habitats throughout the park. Pine rockland and marl prairie habitat within Long Pine Key is now discontinuous due to the construction of roads that separate the area into individual blocks and divide the area from north to south. Wildfire may result in fires that are not within prescription parameters designed to minimize impacts to sensitive species and habitats. Areas in the Hole-in-the-Donut area that have not been restored may prevent fire from moving across the landscape. Drainage of natural plant communities may have resulted in a greater frequency of fire and an increased likelihood that landscape scale fires would occur. Finally, management of natural or human-caused fire will occur and may include suppression activities in certain situations under Alternative A. Such management also influences the likelihood of fire in areas occupied by Everglades bully.

All aspects of fire in wilderness would be dictated by unpredictable events under Alternative A. Park fire management staff would not be able to ensure that areas that require burning for maintenance would be burned. While these areas may still burn, the timing, frequency, intensity and spatial area would not be predictable. In the event that fire does not occur in these occupied areas, shrub and tree encroachment in pine rockland would eventually convert to hardwood dominated rockland hammock. In some areas this may occur in as little as 15-25 years, however, this successional pattern may take longer or not occur in the wetter pine rocklands where this species occurs. In some marl prairies, particularly the north-south oriented transverse glades, wetland hardwood species encroachment is likely to continue to increase. Given the relatively widespread distribution of Everglades bully in Long Pine Key, some populations would likely decline if natural or arson fire does not occur. Some populations would likely persist due to random fire occurrences maintaining appropriate habitats.

Everglades bully also occurs in non-wilderness areas in the vicinity of Pine Island. These areas would be managed with prescribed fire within literature defined fire return intervals under Alternative A. Management of these areas is expected to lead to the long-term maintenance of pine rockland and marl prairie habitat required for the persistence of this species. It is anticipated that mortality of a small number of individuals of Everglades bully is likely to occur with each prescribed fire. It is also anticipated that regularly recurring fire would maintain conditions required for establishment of new individuals of this species.

Fire management activities carried out under Alternative A in non-wilderness would result in reduced fuel loads and subsequently lower intensity fires. As a result, the timing, frequency, intensity and spatial area would be more predictable. These conditions are most likely to represent the greatest chance of long-term survival of Everglades bully in the Pine Island area and populations of this species in those areas would likely be stable over time. Mosaic patterned burning in pine rockland habitat would reduce the chances that habitat occupied by Everglades bully would burn during each prescribed fire. However, it is expected that over time, all areas within a given burn block would burn, resulting in maintenance of all occupied habitat.

In the absence of management ignited fire in occupied habitat, fire management under Alternative A would have no short-term effect on Everglades bully. Due to the potential for long-term changes in plant communities, impacts of fire management in wilderness on Everglades bully under Alternative A would be moderate, long-term, and adverse. Management of this species in non-wilderness areas under Alternative A would have short-term, negligible to minor adverse impacts and long-term, beneficial effects on Everglades bully. Given the relatively broad distribution of this species within Long Pine Key, impacts would be local to regional. Overall, fire management under Alternative A may affect and is likely to adversely affect Everglades bully.

Other Plant Species of Management Concern that Occur in Fire Dependent Habitats. The effect of fire on each of the 68 plant species considered in this analysis depends on a variety of factors. The

likelihood of mortality depends not only on adaptations specific to each species but also on the behavior and characteristics of the fire. For example, low intensity fires that occur in habitats with lower fuel loading are thought to be less likely to result in injury and mortality than high intensity fires that would occur in habitats with greater fuel loading. Indirect impacts to plant species of management concern can also occur through successional processes that occur in the absence of regularly occurring fire. For example, unburned pine rockland may convert to rockland hammock resulting in habitat loss for plant species of management concern in a relatively short period of time. In general, it is assumed that if fire dependent habitats experience fire at intervals similar to those that occurred historically, they would persist in the landscape over time.

Under Alternative A, prescribed fire would not be implemented in designated wilderness. Most known populations of the plant species considered here occur in designated wilderness, and as a result, they are not expected to be directly affected by management ignited prescribed fire. In the absence of prescribed fire, ignition sources for all fires would be limited to lightning strikes and unintentional or intentional human ignited fire (arson, cigarettes, campfires, etc.). Prescribed fire may be used to control exotic invasive species populations in wilderness, but those actions would be associated with the exotic vegetation species management plan, and not considered part of Alternative A. It is anticipated that fire would continue to occur in some areas of pine rockland habitat and potentially within habitat occupied by these species. Fire return intervals under Alternative A may, on average, remain within those described in the literature for pine rockland and marl prairie habitats. However, human influences over time have reduced the potential for historic fire patterns to occur in habitats throughout the park. Pine rockland and marl prairie habitat within Long Pine Key is now discontinuous due to the construction of roads that separate the area into individual blocks and divide the area from north to south. Wildfire may result in fires that are not within prescription parameters designed to minimize impacts to sensitive species and habitats. Areas in the Hole-in-the-Donut area that have not been restored may prevent fire from moving across the landscape. Drainage of natural plant communities may have resulted in a greater frequency of fire and an increased likelihood that landscape scale fires would occur. Finally, management of natural or human-caused fire will occur and may include suppression activities in certain situations under Alternative A. Such management also influences the likelihood of fire in areas occupied by one or more of these species.

All aspects of fire in wilderness would be dictated by unpredictable events under Alternative A. Park fire management staff would not be able to ensure that areas that require burning for maintenance would be burned. While these areas may still burn, the timing, frequency, intensity and spatial area would not be predictable. In the event that fire does not occur in these occupied areas, shrub and tree encroachment in pine rockland would eventually convert to hardwood dominated rockland hammock. In some areas this may occur in as little as 15-25 years; however, this successional pattern may take longer or not occur in the wetter pine rocklands where several sensitive plant species occur. In some marl prairies, particularly the north-south oriented transverse glades, wetland hardwood species encroachment is likely to continue to increase. Given the relatively widespread distribution of these species throughout the park, some populations would likely decline if natural or arson fire does not occur. Some populations would likely persist due to random fire occurrences maintaining appropriate habitats.

Numerous species considered here also occur in non-wilderness areas in the vicinity of Pine Island. These areas would be managed with prescribed fire within literature defined fire return intervals under Alternative A. Management of these areas is expected to lead to the long-term maintenance of pine rockland and marl prairie habitat required for the persistence of these species. It is anticipated that mortality of a small number of individuals of any species exposed to fire is likely to occur with each prescribed fire. It is also anticipated that regularly recurring fire would maintain conditions required for reproduction and establishment of new individuals.

Fire management activities carried out under Alternative A in non-wilderness would result in reduced fuel loads and subsequently lower intensity fires. As a result, the timing, frequency, intensity and spatial area would be more predictable. These conditions are most likely to represent the greatest chance of long-term survival of the species considered here in the Pine Island area and populations in those areas would likely be stable over time. Mosaic patterned burning in pine rockland habitat would reduce the chances that habitat occupied by individuals of these species would burn during each prescribed fire. However, it is expected that over time, all areas within a given burn block would burn, resulting in maintenance of all occupied habitat.

In the absence of management ignited fire in habitat where these species occur, fire management under Alternative A would have no short-term effect on their survival. Due to the potential for long-term changes in plant communities, impacts of fire management in wilderness on these plant species under Alternative A would range from negligible to moderate, long-term, and adverse. Impact levels would depend on the species considered and how the absence of fire would affect the plant communities where it occurs. Impacts would range from site specific to regional and would depend on the distribution of the species within the park. Management of these species in non-wilderness areas under Alternative A would have short-term, negligible to minor adverse impacts and long-term beneficial effects on these species.

Invertebrates. *Florida Leafwing* – Fire has the potential to directly and indirectly impact Florida leafwings. Adults are mobile and likely to leave the area when fires occur, particularly if adjacent to unburned suitable habitat. Larvae are essentially immobile and individuals would be killed if the host plants burn or are defoliated. Fire is also necessary to maintain suitable habitat for butterflies and host plants. Pineland croton resprouts rapidly after fire and with significant regrowth within 6 months to 1 year. Burned areas may be recolonized by Florida leafwings within three to six months (Salvato and Salvato 2010). Regular fire also reduces understory growth and prevents the establishment and spread of exotic invasive plant species, both of which would otherwise impact pineland croton and the butterflies that it supports. Fire control activities, including vehicular activity and the creation of fire breaks, represent potential threats to this species in areas where host plants occur. Creation of fire breaks in undisturbed pine rockland habitat is not a frequent occurrence. However, previous control efforts to protect sensitive hammocks in Long Pine Key have required the creation of fire breaks to halt unwanted fire spread into the hammocks. Impacts of fire control activities are not anticipated to pose more than a localized threat to pineland croton or Florida leafwings but quantifying these impacts is not possible with existing information and the uncertain nature of fire behavior. Heavy rains from tropical storms immediately following fire have led to substantial mortality of pineland croton in parts of Long Pine Key and failure of these areas to be recolonized by both pineland croton and Florida leafwings followed the event (Salvato and Salvato 2010).

Under Alternative A, prescribed fire would not be implemented in designated wilderness. Given that all known populations of Florida leafwing occur in designated wilderness, they are not expected to be directly affected by management ignited prescribed fire. In the absence of prescribed fire, ignition sources for all fires would be limited to lightning strikes and unintentional or intentional human ignited fire (arson, cigarettes, campfires, etc.). Prescribed fire may be used to control exotic invasive species populations in wilderness, but those actions would be associated with the exotic vegetation species management plan, and not considered part of Alternative A. It is anticipated that fire would continue to occur in some areas of pine rockland and marl prairie habitat and potentially within habitat occupied by the Florida leafwing. Fire return intervals under Alternative A may, on average, remain within those described in the literature for pine rockland and marl prairie habitats. However, human influences over time have reduced the potential for historic fire patterns to occur in habitats throughout the park. Pine rockland and marl prairie habitat within Long Pine Key is now discontinuous due to the construction of roads that separate the area into individual blocks and

divide the area from north to south. Wildfire may result in fires that are not within prescription parameters designed to minimize impacts to sensitive species and habitats. Areas in the Hole-in-the-Donut area that have not been restored may prevent fire from moving across the landscape. Drainage of natural plant communities may have resulted in a greater frequency of fire and an increased likelihood that landscape scale fires would occur. Finally, management of natural or human-caused fire will occur and may include suppression activities in certain situations under Alternative A. Such management also influences the likelihood of fire in areas occupied by the Florida leafwing.

All aspects of fire in wilderness would be dictated by unpredictable events under Alternative A. Park fire management staff would not be able to ensure that areas that require burning for maintenance would be burned. While these areas may still burn, the timing, frequency, intensity and spatial area would not be predictable. In the event that fire does not occur in these occupied areas, shrub and tree encroachment in pine rockland would eventually convert to hardwood dominated rockland hammock. In some areas this may occur in as little as 15-25 years. In some marl prairies, particularly the north-south oriented transverse glades, wetland hardwood species encroachment that is already occurring is likely to continue to increase. Both of these habitat changes would result in loss of habitat suitable for pineland croton and indirect impacts to the Florida leafwing. Given the relatively widespread distribution of the Florida leafwing in Long Pine Key, some populations would likely decline if natural or arson fire does not occur. Some populations would likely persist due to random fire occurrences maintaining appropriate habitats.

In the absence of management ignited fire in occupied habitat, fire management under Alternative A would have no short-term effect on the Florida leafwing. Due to the potential for long-term changes in plant communities, impacts of management on the Florida leafwing under Alternative A would be moderate, long-term, and adverse. While this species has a relatively broad distribution throughout Long Pine Key, it does not occur at any sites outside of the park. Therefore, impacts would be regional with respect to this species. Management under Alternative A may affect and is likely to adversely affect the Florida leafwing.

Impacts to areas proposed for critical habitat may also occur, depending on the ability of naturally or unintentionally ignited fires to move across the pine rockland landscape. In the absence of fire or similar disturbance, decline and loss of sufficient host plant, encroachment of non-native vegetation and loss of native plants as the predominant cover may occur. Under Alternative A, degradation or loss of one or more PCE's could result in adverse modification to critical habitat.

Bartram's Scrub Hairstreak – Fire has the potential to directly and indirectly impact Bartram's hairstreak. Adults are mobile and may be able to leave the area when fires occur, particularly if fires occur adjacent to unburned suitable habitat. However, adult Bartram's hairstreaks are generally observed close to host plants (Salvato and Salvato 2008) and have been reported to primarily remain within 5m of host plants. Larvae are basically immobile and individuals would be killed if the host plants burn. Thus, both adults and larvae are believed to be very susceptible to mortality from fire. Fire is also necessary to maintain suitable habitat for butterflies and host plants. Pineland croton resprouts rapidly after fire with significant regrowth within a few months of a burn event. Burned areas are recolonized by adult Bartram's hairstreaks but the amount of time required for recolonization following fire is unclear. Regular fire also reduces understory growth and prevents the establishment and spread of exotic invasive plant species, both of which would otherwise impact pineland croton and the butterflies that it supports. Fire control activities, including vehicular activity and the creation of fire breaks, represent potential threats to this species in areas where host plants occur. Creation of fire breaks in undisturbed pine rockland habitat is not a frequent occurrence. However, previous control efforts have required the creation of fire breaks to protect sensitive hammocks in Long Pine Key. Impacts of fire control activities are not anticipated to pose more than a localized threat to pineland croton or Bartram's hairstreak but quantifying these impacts

is not possible with existing information and the uncertain nature of fire behavior. Heavy rains from tropical storms immediately following fire have led to substantial mortality of pineland croton in parts of Long Pine Key and failure of these areas to be recolonized by pineland croton following the event (Salvato and Salvato 2010).

Under Alternative A, prescribed fire would not be implemented in designated wilderness. Given that all known populations of Bartram's hairstreak in the park occur in designated wilderness, they are not expected to be directly affected by management ignited prescribed fire. In the absence of prescribed fire, ignition sources for all fires would be limited to lightning strikes and unintentional or intentional human ignited fire (arson, cigarettes, campfires, etc.). Prescribed fire may be used to control exotic invasive species populations in wilderness, but those actions would be associated with the exotic vegetation species management plan, and not considered part of Alternative A. It is anticipated that fire would continue to occur in some areas of pine rockland and marl prairie habitat and potentially within habitat occupied by Bartram's hairstreak. Fire return intervals under Alternative A may, on average, remain within those described in the literature for pine rockland and marl prairie habitats. However, human influences over time have reduced the potential for historic fire patterns to occur in habitats throughout the park. Pine rockland and marl prairie habitat within Long Pine Key is now discontinuous due to the construction of roads that separate the area into individual blocks and divide the area from north to south. Wildfire may result in fires that are not within prescription parameters designed to minimize impacts to sensitive species and habitats. Areas in the Hole-in-the-Donut area that have not been restored may prevent fire from moving across the landscape. Drainage of natural plant communities may have resulted in a greater frequency of fire and an increased likelihood that landscape scale fires would occur. Finally, management of natural or human-caused fire will occur and may include suppression activities in certain situations under Alternative A. Such management also influences the likelihood of fire in areas occupied by the Bartram's hairstreak.

All aspects of fire in wilderness would be dictated by unpredictable events under Alternative A. Park fire management staff would not be able to ensure that areas that require burning for maintenance would be burned. While these areas may still burn, the timing, frequency, intensity and spatial area would not be predictable. In the event that fire does not occur in these occupied areas, shrub and tree encroachment in pine rockland would eventually convert to hardwood dominated rockland hammock. In some areas this may occur in as little as 15-25 years. In some marl prairies, particularly the north-south oriented transverse glades, wetland hardwood species encroachment that is already occurring is likely to continue to increase. Both of these habitat changes would result in loss of habitat suitable for pineland croton and indirect impacts to Bartram's hairstreak through habitat loss. Given the relatively widespread distribution of this species in Long Pine Key, some populations would likely decline and may eventually be extirpated if natural or arson fire does not occur. Some populations would likely persist due to random fire occurrences maintaining appropriate habitats.

In the absence of management ignited fire in occupied habitat, fire management under Alternative A would have no short-term effect on Bartram's hairstreak. Due to the potential for long-term changes in plant communities, impacts of management on Bartram's hairstreak under Alternative A would be moderate, long-term, and adverse. Given the relatively broad distribution of this species within Long Pine Key and limited occurrences outside of the park, impacts would be local to regional. Management under Alternative A may affect and is likely to adversely affect Bartram's hairstreak.

Impacts to areas proposed for critical habitat may also occur, depending on the ability of naturally or unintentionally ignited fires to move across the pine rockland landscape. In the absence of fire or similar disturbance, decline and loss of sufficient host plant, encroachment of non-native vegetation and loss of native plants as the predominant cover may occur. Under Alternative A, degradation or loss of one or more PCE's could result in adverse modification to critical habitat.

Stock Island Tree Snail – Under Alternative A, fires would not be expected to normally affect Stock Island tree snails because the hardwood hammocks where these snails occur are unlikely to be affected by fire except during extreme conditions. Fire management activities would also be unlikely to affect snails because they would generally be limited to work in fuels outside of tropical hardwood hammocks. However, because fuels treatment burns would not be conducted within wilderness, fuel accumulation adjacent to the hammocks in the Flamingo area may result in fires that affect hammock vegetation on the periphery of the hammocks, potentially reducing the suitability of limited areas of habitat for use by snails. Such fires could affect snails through exposure to heat and smoke, resulting in behavioral responses or injury. The likelihood of these effects reaching a level of injury or death is so low that it cannot be reasonably predicted, and consequently, the effects are discountable. Implementation of Alternative A is not likely to adversely affect Stock Island tree snails. The effects of fire could have site specific, short-term, minor adverse effects on this species.

Florida Tree Snail – The effects of Alternative A on Florida tree snails are similar to the effects on the Stock Island tree snail. Fires would not be expected to normally affect Florida tree snails because the hardwood hammocks where these snails occur are unlikely to be affected by fire except during extreme conditions. Fire management activities would also be unlikely to affect snails because they would generally be limited to work in fuels outside of tropical hardwood hammocks. However, because fuels treatment burns would not be conducted within wilderness, fuel accumulation adjacent to the hammocks and tree islands may occur and result in fires that affect hammock vegetation on the periphery of the hammocks or burning through individual tree islands, potentially reducing the suitability of limited areas of habitat for use by snails and killing individuals. Such fires could affect snails through exposure to heat and smoke, resulting in behavioral responses or injury. Florida tree snails may be expected to be affected by fires in marginal habitats. The effects of fire would have local, short-term, minor to moderate adverse effects on this species, and long-term, minor adverse effects through habitat degradation in some extreme cases. Conversion of pine rockland to hardwood hammock may result in an increase in available habitat to this species, leading to the potential for long-term, beneficial effects.

Reptiles. *American Crocodile* – American crocodiles would be unlikely to be affected by wildfires within FMU 1 because these fires would generally be very infrequent in the mangrove communities and estuarine waters where crocodiles generally occur. Fires on the coastal dunes and in areas of coastal prairies near tidal creeks could result in disturbance to basking crocodiles, but injury or death of crocodiles is unlikely because crocodiles generally bask in areas where they can quickly return to the water, or in shallow water or mud that would limit fire intensity. Under Alternative A, fires would occur in the vicinity of crocodile nesting areas, including beaches and artificial uplands, with moderate severity, primarily as a result of wildfires or exotic vegetation treatment. Fires are unlikely to affect crocodile nests because most fires would be prescribed fires conducted under planned environmental and fire behavior parameters that are expected to prevent burning of organic soils. Fire management and suppression activities, including helicopter use, presence of fire management personnel, and fire effects monitoring activities may disturb adult and juvenile crocodiles, causing temporary changes in behavior, including changes in breeding, feeding, and sheltering. These effects would never be expected to reach a level where injury or death occurs. These effects would be insignificant and discountable, and Alternative A would not likely adversely affect American crocodiles. Adverse effects of Alternative A on American crocodiles would be site specific, short-term and negligible to minor.

Alternative A may result in temporary changes in the conditions of vegetation in potential nesting areas, but is otherwise not expected to affect the availability, suitability, or amount of suitable crocodile nesting habitat, sheltered low-salinity estuarine waters, or the availability of prey, which are considered to be the primary constituent elements of crocodile critical habitat. Alternative A

would not likely to adversely affect designated American crocodile critical habitat, and would have short-term, negligible adverse effects on crocodile critical habitat.

Eastern Indigo Snake – Under Alternative A, fuel treatment burns would not be implemented in designated wilderness, and the majority of Eastern indigo snake habitat in the park lies within designated wilderness. Prescribed fire may also be used to control exotic invasive species populations in wilderness. In the absence of prescribed fire for fuels treatment, ignition sources for fires would be limited to lightning strikes and unintentional or intentional human ignited fire (arson, cigarettes, campfires, etc.). Under this alternative, fuel accumulations would be expected to be greater in some areas over time, resulting in higher intensity and more complete burns with fewer unburned patches under these conditions, and these characteristics may increase the likelihood of injury or mortality. Alternative A would generally be expected to maintain the mosaic of habitat types that indigo snakes prefer, as well as generally suitable habitat conditions.

Although Eastern indigo snakes move across the landscape quickly and retreat to burrows or other refugia when disturbed, some snakes may become caught in fires, and these individuals may be injured or killed. If snakes are present at the fringes of habitats that don't typically burn they may move into these habitats during fires. Snakes able to escape the fire may be temporarily forced into marginal habitat or occupied territories, resulting in an increase likelihood of predation, difficulty foraging, and difficulty in finding shelter and mates.

Fire management, wildfire operations, and effects monitoring could all cause disturbance to Eastern indigo snakes. Disturbance resulting from the presence of fire management and monitoring personnel may cause temporary changes in behavior that may affect normal breeding, feeding, and sheltering. Because mechanical ground disturbance related to fires within the park is very limited, the likelihood of injury or death of snakes during fire management and suppression activities is very low. However, operation of vehicles during fires has the potential to injure or kill snakes.

Alternative A would have short-term, minor to moderate adverse impacts, and long-term beneficial effects by maintaining natural habitat characteristics used by this species. Effects would be site specific to local. Fire management under Alternative A may affect, and is likely to adversely affect Eastern indigo snakes due to the potential for injury or death of individuals.

Gopher Tortoise – The occurrences of gopher tortoise within FMU 1 and FMU 3 would be susceptible to the effects of fire. Wildfires in gopher tortoise habitat on fore and back dunes of FMU 1 or in gopher tortoise habitat within FMU 3 are likely to be rare occurrences, and fire is not significant in maintaining suitable habitat within FMU1. If fires occur, individual tortoises may be stranded if away from burrows, and injured or killed either in fire or by dehydration. However, tortoises generally find refugia from fires in burrows, and the likelihood of injury or death due to fire is low. Alternative A would not include prescribed fire in wilderness areas on Cape Sable, with the exception of those for exotic plant treatments (under the auspices of the exotic vegetation management plan), and the likelihood of fire affecting tortoises is low. Reduction of exotic plants through managed fire and fuels reduction would contribute to improving the native plant communities that sustain gopher tortoises, reduces old vegetation, and promotes new growth, which increases the quality and quantity of forage available for gopher tortoises.

Alternative A would likely have short-term, minor to moderate adverse impacts and long-term beneficial impacts to gopher tortoises through habitat maintenance and improvements at Cape Sable. Observations of this species in pine rockland habitat are extremely limited and evidence of an established population has not been found. Impacts would be site specific to local. Alternative A may result in temporary disturbance to gopher tortoises, and may injure or kill individuals in very limited

circumstances. As a result, management under Alternative A may affect and is likely to adversely affect gopher tortoise.

Mammals. *Florida Panther* – Under Alternative A, fuel treatment burns would not be implemented in designated wilderness, and a large portion of panther habitat in the park lies within designated wilderness. Prescribed fire may be used to control exotic invasive species populations in wilderness, but these would tend to be infrequent and relatively small burns. In the absence of prescribed fire for fuels treatment, ignition sources for fires would be limited to lightning strikes and unintentional or intentional human ignited fire (arson, cigarettes, campfires, etc.). Under this alternative, fuel accumulations would be expected to be greater in some areas over time, resulting in higher intensity and more complete burns with fewer unburned patches when these conditions occur. Fires may also be more likely to occur during dry periods which tend to coincide with the peak panther denning, and as a result of higher fuel loads, fires may be more likely to burn large portions of panther habitat. While adult panthers are expected to successfully avoid fires under nearly all conditions, panther kittens up to 5-6 months of age that occur in an area that burns could be injured if they occur in vegetation types that may burn. There would be potential for Florida panther kitten mortality, but this would be unlikely. Panthers use a variety of habitat types for denning, but thick, dense vegetation is the consistent characteristic. Within Everglades National Park, these conditions are often associated with hardwood hammocks and dense Brazilian pepper, but long-unburned patches of dense sawgrass, palmetto, or other highly combustible vegetation may also be used. Considering the lack of detailed telemetry monitoring of panthers within the park, it is unlikely that panther den locations would be known in an area subject to fire, and wildfire management actions would therefore likely be insufficient to protect panther dens. Because of the small number of panthers in the park and the relatively low chances that a den would be located within burnable vegetation types, it is unlikely that a panther den would be lost in any one fire, unless it burns a large portion of the pinelands in one fire. However, the likelihood that at least one panther den will be affected by fire is substantial when considering a program of fire management conducted over large areas and over many years.

Alternative A would generally be expected to maintain the mosaic of habitat types that panthers use, as well as generally suitable habitat conditions. It may increase the potential for fires to enter into the margins of hardwood hammocks due to expected greater intensity and severity, and would be less likely to result in unburned areas of thick dense vegetation that would be good den sites.

Fire management, aviation, wildfire operations, effects monitoring, and other fire-related activities could all cause disturbance to Florida panthers. Disturbance resulting from the presence of fire management and monitoring personnel may cause temporary changes in behavior that may affect normal breeding, feeding, and sheltering, and could increase risk of predation of young kittens. Operation of vehicles during fires also has the potential to injure or kill panthers.

Alternative A would to have short-term, minor to moderate adverse effects on Florida panthers, and long-term beneficial effects by maintaining natural habitat characteristics. Impacts, if they occur, would be site specific. Fire management under Alternative A may affect, and is likely to adversely affect Florida panthers due to the potential for injury of kittens at some time during the lifetime of the fire management plan.

Florida Manatee – Wildfires are not expected to affect manatees or their habitat. Potential boat use would be limited in scope and would be in accordance with normal boat operation, including compliance with manatee protection zones. However, the presence of fire management personnel, helicopter operations and fire wildfire management actions, and fire effects monitoring personnel may cause temporary changes in manatee behavior, including breeding, feeding, and sheltering. The impacts of Alternative A would be limited to short-term, site specific, negligible, and adverse. These

effects would be insignificant and discountable, and Alternative A is not likely to adversely affect manatees.

Florida Bonneted Bat – Considering the lack of knowledge of the habitat use of the bonneted bat and its response to fire, it is difficult to predict the impacts of alternative fire management strategies. Under Alternative A, fuel treatment burns would not be implemented in designated wilderness. Prescribed fire may be used to control exotic invasive species populations in wilderness, but these would tend to be infrequent and relatively small burns. In the absence of prescribed fire for fuels treatment, fires are expected to be less frequent and fuel accumulations would be expected to be greater in some areas over time, resulting in generally higher intensity and more complete burns with fewer unburned patches. This expected fire pattern in pine rockland would likely result in burning of many existing snags, but also would result in the creation of new snags. However, relatively few snags may be retained following a fire, possibly leading to less consistent availability of roosting habitat over time. If this species is utilizing snags as roosting sites in pine rockland habitat in the park, individuals would be expected to perish in fires. In general, Alternative A would maintain suitable habitat for Florida bonneted bats in the park's pine rockland habitat in the long term. If Florida bonneted bats are utilizing other roost sites such as hardwood hammock or structures, no mortality of individuals would be expected from fire and habitat would not be affected.

Alternative A is expected to have minor, short-term adverse impacts to Florida bonneted bats, and long-term beneficial effects. Impacts would be site specific. Alternative A may affect and is likely to adversely affect the Florida bonneted bat due to the possible loss of individual bats.

Everglades Mink – There is little information about the potential effects of fire on the mink. Under Alternative A, fuel treatment burns would not be implemented in designated wilderness. Prescribed fire may also be used to control exotic invasive species. In the absence of prescribed fire for fuels treatment, fires are expected to be less frequent, and fuel accumulations would be expected to be greater in general, resulting in generally higher intensity and more complete burns with fewer unburned patches. Fires may also be more likely to occur during dry periods. Mink may be susceptible to fires, but there is insufficient information to assess effects in detail, though they are presumed to be susceptible to fires in rare instances. Adults would generally be able to avoid fires by seeking refugia or water. Their apparent rarity within the park also makes effects from fire unlikely. Due to the potential for mortality of individuals, impacts of Alternative A on Everglades mink would be negligible to minor, short-term, and adverse. These impacts would be site specific.

Big Cypress Fox Squirrel – There is little information available on the effects of fire on Big Cypress fox squirrel. Because they frequently occupy forested areas subject to frequent fire, we assume that they are generally fire-adapted. In Everglades National Park, they occupy mangrove habitats extensively, and these areas are largely unaffected by fires. They generally appear to benefit from maintenance of forested habitats of many types in a natural condition. Under Alternative A, wildfire is expected to predominate. Fires are expected to be less frequent, and fuel accumulations would be expected to be greater in some areas over time, resulting in generally higher intensity and more complete burns with fewer unburned patches when these conditions occur. These conditions would tend to perpetuate forested habitats used by fox squirrels. The impacts of Alternative A would be short-term, negligible to minor, and adverse, as well as long-term and beneficial. These impacts would be local to regional due to the extensive nature of mangrove habitat used by this species.

Birds. *Cape Sable Seaside Sparrow* – Fire has been documented to affect Cape Sable seaside sparrows, both directly and indirectly. The most obvious effect is that fires have the potential to kill individuals. Sparrow eggs, nestlings, and young fledglings are susceptible to fires because they

occupy the combustible marsh grasses that burn during fires, and they have limited ability to escape fires. Because the sparrow nests primarily during the dry season when wildfires are most likely both to occur and to spread, eggs and young are likely to be lost to wildfires. Sparrow eggs and young may be lost during any fires that occur in sparrow habitat between March1 and August 31, though fires occurring in April through June, which corresponds with the peak in sparrow nesting activity, would have the greatest impact on eggs and nestlings. In these instances, all nests, eggs, and recently fledged young that occur within a burned area would be expected to be killed. Adult and independent young Cape Sable seaside sparrows may be able to fly out of harm's way, but under some circumstances, even adults may be killed. La Puma et al. (2007) reported that none of the 35 color-banded adult sparrows that had occupied the area burned by the Lopez fire in subpopulation E in 2001 were seen again following the fire.

Following a fire, sparrows do not nest within burned areas for a period of 2-3 years (La Puma 2010; La Puma et al. 2007), and this is likely a result of the relatively sparse density of vegetation that does not support a nest structure, and/or does not provide sufficient cover for nests. Any unburned patches within a large burned area may still be suitable for sparrow nesting, so in patchy burns, there is a greater potential for sparrows to retain the ability to nest following fires. After 2-3 years, suitable nesting habitat generally recovers, and sparrows resume nesting with approximately the same density and success as before fires (La Puma et al. 2007).

Under circumstances when fires are followed by heavy rainfall that causes rapidly rising water levels to overtop the growing graminoid vegetation, nearly all vegetation can be killed. Under these circumstances, recovery of vegetation sufficient to support sparrow nesting may not occur for a decade or more. The rate of vegetation recovery may be affected by a variety of factors, including soil depth and post-fire hydrologic conditions.

Fire management and wildfire management actionsities also have the potential to affect sparrows. During nesting season, sparrow eggs, nestlings, and recently fledged young may be injured or killed by water drops, both from buckets suspended by helicopters, and by air tankers. The likelihood of this occurring would be low due to the relatively low probability that a nest would occur at the location where water is dropped, but it may occur.

The presence of fire management personnel, helicopter and aircraft operation, and other equipment, during wildfire management actions, fire effects monitoring, and related activities could also disturb sparrows, causing changes in normal behavior which may increase predation risk and interfere with normal breeding, feeding, and sheltering activity. During nesting season, activities that flush females from nests may increase the chances of nest loss.

Fires have little benefit to sparrow populations (La Puma et al. 2007) or to occupied suitable habitat, but there are some beneficial effects. Fire does tend to promote the growth of C4 grasses over C3 grasses, and most of the grass species that are associated with sparrow occupancy are C4 grasses (Sah et al. 2010). In areas occupied by sparrows, this effect may have limited benefit to sparrows because the habitat is already in a suitable condition, but in areas that are suboptimal sparrow habitat such as sawgrass dominated areas, fire may help improve suitability under some conditions. This beneficial effect has not been well-documented in the Everglades system, and may warrant further study. Fires have been shown to be very effective in reducing and controlling woody vegetation, and in some areas, this effect can improve habitat. Fire also has the beneficial effect of reducing the risk of future fires. Relatively small fires within a larger unit of sparrow habitat would reduce the likelihood of an entire habitat patch burning, and would increase the likelihood of successful management of the fire by creating discontinuities in fuel loading. As wildfires encounter areas of lower fuel loading, their severity and rate of spread can be reduced, allowing for more successful control and increasing likelihood that they would be extinguished by high humidity or light rainfall.

Under Alternative A, wildfires are expected to predominate within sparrow habitat in FMUs 2 and 3. Risk to sparrows and sparrow habitat would be mitigated through the Cape Sable seaside sparrow fire management strategy and through coordination with researchers and resource managers. Fuels may accumulate without conducting fuels treatment burning, leading to a risk of larger fires and more severe fires, particularly during dry periods. These types of fires have occurred periodically in the Everglades, and have affected sparrows.

There are cumulative impacts that result from the addition of fire management to the impacts that have occurred and would continue to occur through hydrologic restoration and water management activities. Throughout subpopulation A and portions of other subpopulations, hydrologic management has in some cases degraded habitat and reduced sparrow populations. Fires in these areas may have cumulative adverse impacts. These cumulative impacts could be significant when large fires can affect large portions of sparrow habitat, and these impacts can be additive with hydrologic impacts.

Throughout their history, fires have affected Cape Sable seaside sparrows in the Everglades in this manner, and taking this into account, the impacts of Alternative A, including cumulative effects, would be moderate, short and long-term, and adverse, with long-term beneficial effects resulting from the reduced risk of catastrophic fires and the restoration of habitat. Due to the limited range of sparrows, impacts would be local to regional. Because of the potential for fires and fire management to affect sparrows both directly and indirectly, Alternative A may affect, and is likely to adversely affect the Cape Sable seaside sparrow.

Cape Sable Seaside Sparrow Critical Habitat – Fire and fire management have the potential to affect two of the three primary constituent elements of sparrow critical habitat. Fires can temporarily affect the cover of herbaceous vegetation, and reduce cover of these species below the 15 percent identified as a PCE. However, under most circumstances, herbaceous cover of these species would recover rapidly following fire, and would usually be reestablished within weeks to months following fire. Only under cases where recently burned habitat is flooded, resulting in mortality of herbaceous vegetation, would fire remove primary constituent elements. Management under Alternative A would result in application of prescribed fire in wilderness limited to areas where exotic infestations require the use of fire to control them. If carried out, prescribed fire would be conducted when the risks of long-term impacts are lower. This may reduce the likelihood that a large portion of critical habitat would be significantly degraded except in the event of a large wildfire. Fires have the potential to substantially improve the openness of critical habitat (PCE 3) through control of woody vegetation. Alternative A would allow for these benefits when they result from wildfires but would not employ prescribed fires strictly to improve or maintain sparrow habitat.

Similar to the impacts to sparrows, there are cumulative impacts that result from the combination of fire impacts and hydrologic management impacts on sparrow critical habitat. Hydrologic management also has the potential to affect all of the PCEs, and some areas of critical habitat may have been degraded by hydrologic management in the past.

The impacts of Alternative A on Cape Sable seaside sparrow critical habitat, including cumulative impacts, are short- and long- term, moderate, and adverse, with long-term beneficial effects by maintaining the openness of critical habitat and possibly promoting growth of herbaceous species identified as primary constituent elements. Alternative A may affect, but is not likely to adversely modify designated Cape Sable seaside sparrow critical habitat.

Everglade Snail Kite – Fire has the potential to directly and indirectly affect the Everglade snail kite. Kites nest within the Everglades marshes in areas that are subject to fire, and if the marshes burn when kites are nesting, eggs, nestlings, and young fledglings may be injured or killed by fires. Because

kites generally nest over water, some nests in trees or shrubs that are in areas with relatively sparse emergent vegetation may not burn because of insufficient fuels around nests. However, kites often nest in dense vegetation, including within dense stands of sawgrass or cattail that would be likely to burn in fires regardless of whether there were water underneath the nests. Because of the variability in kite nesting areas and substrate, not all kite nests within a burned area would be expected to burn during fires. Surveys for snail kite nesting within the park are not regularly conducted, and consequently, it is unlikely that all snail kite nests that occur within a particular FMU, burn unit, or area would be identified. Nests that are identified would be avoided, and management efforts implemented to minimize risk of nest loss to fires.

Under Alternative A, wildfires are expected to predominate within kite habitat in FMU 2. Risk to snail kites would be mitigated through avoidance of known nests in cases where prescribed fire is employed for exotic plant control. Fuels may tend to accumulate, leading to a risk of larger fires and more severe fires, particularly during dry periods. These types of fires have occurred periodically in the Everglades, and can affect kites.

Under Alternative A, fires are not expected to substantially affect the suitability of habitat for kites. Areas that burn may support better kite foraging due to improved visibility of snails, but they may also support fewer suitable nest sites. In general, these changes are not anticipated to significantly improve conditions for or limit snail kites.

Fire management, aviation, wildfire operations, effects monitoring, and other fire-related activities could all cause disturbance to Everglade snail kites. Disturbance resulting from aviation activities and the presence of fire management and monitoring personnel may cause temporary changes in behavior that may affect normal breeding, feeding, and sheltering, and could increase risk of predation of eggs and nestlings if adults are flushed from the nest. Rotor wash from helicopters also has the potential to dislodge kite nests from substrate, causing nest failure.

There are cumulative impacts that result from the addition of fire management to the impacts that have occurred and would continue to occur through hydrologic restoration and water management activities. Throughout the park and the rest of the snail kite range, hydrologic management has in some cases degraded habitat and reduced kite populations. Fires in these areas may have cumulative adverse impacts. These cumulative impacts are not likely to be significant because fires are not expected to strongly affect kites or their habitat, but the effects may be additive in some cases.

Alternative A would have short-term, minor to moderate adverse impacts to snail kites, and short- and long-term beneficial effects as a result of improved foraging and habitat maintenance, respectively. These impacts would be local. Alternative A may affect and is likely to adversely affect snail kites due to the potential for loss of snail kite nests.

Everglade Snail Kite Critical Habitat – Alternative A may result in temporary changes in the availability and condition of marsh vegetation in the short-term, which may have indirect effects on apple snails in the area. No long-term effects would be expected. Fires are not expected to substantially affect the amount or availability of habitat within the designated critical habitat, and consequently, Alternative A is not likely to adversely affect snail kite critical habitat. There would be short-term, negligible to minor adverse effects.

Wood Stork – Wood storks are in general not highly susceptible to the effects of fire. Under Alternative A, wildfires are expected to predominate within wood stork habitat. Risk to wood stork nests would be mitigated through avoidance of nesting colonies, and most nesting colonies are well-known and monitored. Fuels may tend to accumulate, leading to a risk of larger fires and more severe fires, particularly during dry periods. Because natural ignitions tend to occur most frequently in the early wet season and transition from dry to wet, there is a low likelihood of fires that occur

from natural ignitions affecting stork nests because storks usually fledge in the mid- to late dry season. However, fires that do occur may be less subject to effective management.

While there is some potential for adult and fledgling wood storks to be affected, the likelihood is very small because they are likely to move away from a fire or fire management disturbance, and they tend to forage in water 10-40 cm deep in open areas with only sparse emergent vegetation that would not be likely to burn, and avoid dense vegetation.

Under Alternative A, fires have the potential to improve stork foraging by reducing vegetation density that may interfere with access to prey. Fires may also help reduce encroachment of woody invasive species in some areas.

Fire management, aviation, wildfire operations, effects monitoring, and other fire-related activities could all cause disturbance to wood storks. Disturbance resulting from aviation activities and the presence of fire management and monitoring personnel may cause temporary changes in behavior that may affect normal breeding, feeding, and sheltering, and could increase risk of predation of eggs and nestlings if disturbances occur near a nesting colony. Disturbance of nesting birds is unlikely because of mitigation measures to avoid active nesting colonies. Foraging birds are likely to respond to disturbance by moving out of the area.

Alternative A would have short-term, minor adverse impacts to wood storks, and short-term beneficial effects. These impacts would be local. Alternative A may affect, but is not likely to adversely affect the wood stork.

Wading birds (little blue heron, snowy egret, tricolored heron, white ibis, roseate spoonbill) – The effects of Alternative A on these species would be very similar to those described for the wood stork. Wading birds are in general not highly susceptible to the effects of fire. Under Alternative A, wildfires are expected to predominate within wading bird habitats. Risk to wading bird nests would be mitigated through avoidance of nesting colonies, and most nesting colonies are well-known and monitored. Fuels may tend to accumulate in some areas, leading to a risk of larger fires and more severe fires when these conditions occur, particularly during dry periods. Because natural ignitions tend to occur most frequently in the early wet season and transition from dry to wet, there is a low likelihood of fires that occur from natural ignitions affecting wading bird nests because young usually fledge in the mid- to late dry season.

While there is some potential for adult and fledgling wading birds to be affected, the likelihood is small because they are likely to move away from a fire or fire management disturbance, and they tend to forage in open areas with only sparse emergent vegetation where they would be expected to be capable of fleeing fire in most cases.

Fire management, aviation, wildfire operations, effects monitoring, and other fire-related activities could all cause disturbance to wading birds. Disturbance resulting from aviation activities and the presence of fire management and monitoring personnel may cause temporary changes in behavior, and could increase risk of predation of eggs and nestlings if disturbances occur near a nesting colony. Disturbance of nesting birds is unlikely because of mitigation measures to avoid active nesting colonies. Foraging birds are likely to respond to disturbance by moving out of the area.

Alternative A would have short-term, minor adverse impacts to wading birds, and short- and long-term beneficial impacts. These impacts would be local.

Limpkin – Limpkin nests may be susceptible to fires since they sometimes nest in emergent vegetation in areas that may burn. Adult limpkins would normally be expected to simply fly away from oncoming fires. Because they place their nests in a variety of locations, including trees, there is a low likelihood that fires would affect all limpkin nests in an area.

Under Alternative A, wildfires are expected to predominate within limpkin habitats. Fuels may tend to accumulate in some areas over time, leading to a risk of larger fires and more severe fires when these conditions occur, particularly during dry periods. Because natural ignitions tend to occur most frequently in the early wet season and transition from dry to wet, there is a low likelihood of fires that occur from natural ignitions affecting limpkin nests because nesting generally occurs in the spring.

Fires may improve habitat for limpkin foraging in the short-term by making apple snails more available, as long as there is sufficient remaining emergent vegetation to maintain apple snail respiration.

Fire management, aviation, wildfire operations, effects monitoring, and other fire-related activities could all cause disturbance to limpkins. Disturbance resulting from aviation activities and the presence of fire management and monitoring personnel may cause temporary changes in behavior, and could increase risk of predation of eggs and nestlings if disturbances occur near a nest. Limpkins are not susceptible to disturbance during nesting, and would often remain on a nest until closely approached.

Alternative A would have short-term, minor to moderate adverse impacts, and short-term beneficial effects as a result of from improved foraging conditions. These impacts would be local.

Sandhill Crane – Because sandhill cranes nest in the marsh, their nests may be susceptible to fires. However, they generally build nests by removing all emergent vegetation from the area around the nest and piling it onto the nest structure, in addition to the mud, and they effectively create a moat around the nests that may provide a degree of protection from fires. Adult cranes would easily avoid fires.

Under Alternative A, wildfires (are expected to predominate, and fuels may tend to accumulate over time in some areas, leading to a risk of larger fires and more severe fires, particularly during dry periods. Because natural ignitions tend to occur most frequently in the early wet season and transition from dry to wet, there is a low likelihood of fires that occur from natural ignitions affecting sandhill crane nesting, which generally occurs in the early spring as water levels recede. Sandhill cranes generally select nest sites in low grasses, and would avoid areas of heavy fuels, and there would also be few habitat benefits resulting from fire.

Fire management, aviation, wildfire operations, effects monitoring, and other fire-related activities could all cause disturbance to sandhill cranes. Disturbance resulting from aviation activities and the presence of fire management and monitoring personnel may cause temporary changes in behavior, and could increase risk of predation of eggs and nestlings if disturbances occur near a nest. Nesting sandhill cranes are quite susceptible to disturbance.

Alternative A would have short-and long-term, negligible to minor adverse effects on the sandhill crane. These impacts would be site specific.

White-crowned Pigeon – White crowned pigeons are unlikely to be affected by fires since they are likely to fly away from fire, and nest in areas where fire does not occur. However, their reliance on the fruits produced in hardwood hammocks, tree islands and roadsides provides some potential to be affected. Under Alternative A, wildfires are expected to predominate. With the absence of prescribed fire for fuels treatment, fires are expected to be generally less frequent, and fuel accumulations would be expected to be greater in some areas over time, resulting in generally higher intensity and more complete burns with fewer unburned patches when these conditions occur. Fires may also be more likely to occur during dry periods when effects on vegetation would be more severe. Alternative A may be more likely to result in fires that burn into hammock, tree islands and

roadsides which would reduce forage production for pigeons. However, it is unlikely that fires would affect enough of the foraging habitat available to pigeons to substantially affect foraging.

The effects of Alternative A would be long-term, minor, and adverse due to potential forage degradation. These impacts would be local.

Reintroduced Pineland Birds (brown-headed nuthatch, eastern bluebird, and Florida wild turkey) – Under Alternative A, fuel treatment burns would not be implemented in designated wilderness. Prescribed fire may be used to control exotic invasive species populations in wilderness, but these would tend to be infrequent and relatively small burns. In the absence of prescribed fire for fuels treatment, fires are expected to be generally less frequent, and fuel accumulations would be expected to be greater over time in some areas, resulting in generally higher intensity and more complete burns with fewer unburned patches when these conditions occur. Fires may also be more likely to occur during dry periods which tend to coincide with nesting season for these species. This expected fire pattern would likely result in burning of many snags, but also creation of new snags. However, relatively few snags may be retained following a fire, possibly leading to less consistent availability of snags over time. Management under Alternative A would lead to maintenance of natural vegetation communities and suitable habitat condition to some extent for all three of these species in pine rocklands. However, the degree to which pine rockland is maintained would be less than that expected when prescribed fire is regularly conducted.

Alternative A would have short-term, minor to moderate adverse impacts to these species, and long-term negligible to minor beneficial effects. Because these species are restricted to pine rockland habitats within Everglades National Park, impacts would be local to regional.

Cumulative Impacts

Past projects impacting special status species include the acquisition of lands in the East Everglades addition under the Expansion Act. Acquisition of these areas has expanded the protected areas within Everglades National Park and has protected habitat for special status species, resulting in long-term beneficial impacts. Past, present, and future actions that impact special status species include all projects aimed at restoring habitat and delivering additional freshwater to the park. As a result of these actions, there would be additional habitat for special status species in the park. Use of wildfire by fire management has helped maintain and improve habitat for special status species over the long term. Activities that have and continue to adversely affect special status species in the park include trampling, collecting, diminished freshwater water flows, habitat fragmentation, past agricultural practices, and sea level rise,

The past, present, and reasonably foreseeable future actions described above would result in a mixture of long-term adverse and beneficial impacts on special status species. These impacts, when combined with the impacts from Alternative A, would result in generally beneficial cumulative impacts to special status species, due to the maintenance and improvement of habitat. The contribution of Alternative A to these impacts would be imperceptible or noticeable, depending on the amount, timing and intensity of fires that occur.

Section 7 Determination of Effect

Alternative A "may affect, but is not likely to adversely affect" the Stock Island tree snail, American crocodile, Florida manatee, and wood stork.

Alternative A "may affect and is likely to adversely affect" Blodgett's silverbush, pineland sandmat, Garber's spurge, Florida pineland crabgrass, Everglades bully, Florida leafwing, Bartram's hairstreak, Eastern indigo snake, Florida panther, Florida bonneted bat, Cape Sable seaside sparrow, and

Everglade snail kite. Adverse effects would generally be the result of injury (and in rare cases, death) to individuals rather than to long-term destruction of habitat or loss of entire populations. Some short-term disturbance to park habitats would occur, but over the long term, habitat conditions for affected species should be maintained or improved.

Conclusion

Alternative A would result in a wide range of impacts on special status species, as described for individual species in the above analysis. In general, continuing current fire management activities at the park, as called for under Alternative A, would have beneficial impacts on special status species. These beneficial impacts would result from the maintenance and improvement of areas of special status species' habitat in the park. However, beneficial impacts would be limited due to the current restrictions governing the use of prescribed fire in the park's designated wilderness, which constitutes the majority of land in the park. The park would continue to coordinate with the U.S. Fish and Wildlife Service and state resource agencies, and would continue to minimize adverse impacts to individuals of special status species caused by fire management activities. However, some adverse impacts would be unavoidable. Cumulative impacts to special status species would be generally beneficial in the zone of analysis. The contribution of Alternative A to these impacts would be noticeable.

ALTERNATIVE B: PREFERRED ALTERNATIVE

Impact Analysis

Plants. *Blodgett's Silverbush* – The direct impacts of fire on Blodgett's silverbush are not well understood. Periodic fire is critical in maintaining the open understory and species diversity in pine rocklands where this species occurs. Plants are perennial and resprouting from existing rootstock in moist marl soils or limestone bedrock is likely to occur following low intensity fires. However, mortality of some individuals probably results from fire events. Surveys following a prescribed fire in Pine Block B in 2008 led to the observation of significantly more plants than were previously known from the area. It is unclear if plants were present and became more easily observed following reduction in shrub cover from the fire or if the fire led to the expansion of the existing, known population. Currently, no information is available on differences in mortality or long-term population impacts resulting from wet or dry season burns. Indirect evidence suggests that burning in either season is suitable to maintain populations of this species in pine rocklands. Prescribed fire in the park was originally conducted during the dry season. Fire management was gradually shifted to wet season burning in an effort to better mimic natural lightning ignited fire patterns. As a result, pinelands in the park where this species occurs have historically been burned in both the wet season and dry season. Long-term maintenance of populations in those areas indicates that either practice would sustain populations of Blodgett's silverbush.

Under Alternative B, prescribed fire is planned for implementation in pine rockland habitat where Blodgett's silverbush is present. The larger of the two occurrences extends across two separate pine blocks which are planned to be burned during different years under the multi-year fuels treatment plan. This would prevent the entire population of Blodgett's silverbush from burning in any given year. It would also provide an opportunity for park staff to observe the impacts of fire on individuals of this species prior to implementing a second burn. Each block is proposed to be burned at a three year interval under Alternative B. This fire return interval is within the literature derived fire return interval and is expected to lead to the long-term maintenance of pine rockland habitat. It is anticipated that mortality of a small number of individuals of Blodgett's silverbush is likely to occur

with each prescribed fire. It is also anticipated that regularly recurring fire would maintain conditions required for establishment of new individuals of this species.

Fire management activities carried out under Alternative B would result in reduced fuel loads and subsequently lower intensity fires. These conditions are most likely to represent the greatest chance of long-term survival of Blodgett's silverbush in Long Pine Key. Park fire management staff would be more capable of ensuring that areas that require burning for maintenance would be burned. As a result, the timing, frequency, intensity and spatial area would be more predictable and can be modified as new data emerges. In this scenario, populations of Blodgett's silverbush would likely be stable over time. Mosaic patterned burning in pine rockland habitat would reduce the chances that habitat occupied by Blodgett's silverbush would burn during each prescribed fire. It is expected that over time, all areas within a given burn block would burn, resulting in maintenance of all occupied habitat.

Due to the potential for limited mortality of individuals with the application of prescribed fire, management under Alternative B would lead to short-term, negligible to minor adverse impacts to Blodgett's silverbush. Due to the potential for long-term maintenance of habitats required by Blodgett's silverbush, impacts of management under Alternative B would be long term and beneficial. Given the extremely limited distribution, impacts would be regional. Management under Alternative B may affect and is likely to adversely affect Blodgett's silverbush.

Pineland Sandmat – The impacts of fire on pineland sandmat are not well understood. Fire is necessary to maintain an open understory that is required by this species to persist in that habitat and is important in reducing exotic species infestations. Periodic fires may result in mortality of individuals if occupied habitat burns. However, Herndon (1998) indicates that the life history of this species includes a cryptic stage, making interpretation of mortality of aboveground parts difficult. This species is perennial and possesses a well-developed rootstock that is protected from fire. Resprouting of individuals following fire is likely to occur. Currently, no information is available on differences in mortality or long-term population impacts resulting from wet or dry season burns. Indirect evidence suggests that burning in either season is suitable to maintain populations of pineland sandmat in pine rocklands. Prescribed fire in the park was originally conducted during the dry season. Fire management was gradually shifted to wet season burning in an effort to better mimic natural lightning ignited fire patterns. As a result, pinelands in the park where pineland sandmat occurs have been burned in both the wet season and dry season. Long-term maintenance of populations in those areas indicates that either practice would sustain populations of pineland sandmat.

Under Alternative B, prescribed fire is planned for implementation in pine rockland habitat where pineland sandmat is present. Occurrences are widespread and found in a variety of higher elevation pine rockland area in Long Pine Key. As a result, only portions of the entire Long Pine Key population would burn during any given year under the multi-year fuels treatment plan. This would provide an opportunity for park staff to observe the impacts of fire on individuals of this species prior to implementing subsequent burns. Each block is proposed to be burned at a three year interval under Alternative B. This fire return interval is within the literature derived fire return interval and is expected to lead to the long-term maintenance of pine rockland habitat. It is anticipated that mortality of a small number of individuals of pineland sandmat is likely to occur with each prescribed fire. It is also anticipated that regularly recurring fire would maintain conditions required for establishment of new individuals of this species.

Fire management activities carried out under Alternative B would result in reduced fuel loads and subsequently lower intensity fires. These conditions are most likely to represent the greatest chance of long-term survival of pineland sandmat in Long Pine Key. Park fire management staff would be more capable of ensuring that areas that require burning for maintenance would be burned. As a

result, the timing, frequency, intensity and spatial area would be more predictable and can be modified as new data emerges. In this scenario, populations of pineland sandmat would likely be stable over time. Mosaic patterned burning in pine rockland habitat would reduce the chances that habitat occupied by pineland sandmat would burn during each prescribed fire. It is expected that over time, all areas within a given burn block would burn, resulting in maintenance of all occupied habitat.

Due to the potential for limited mortality of individuals with the application of prescribed fire, management under Alternative B would lead to short-term, negligible to minor adverse impacts to pineland sandmat. Due to the potential for long-term maintenance of habitats required by pineland sandmat, impacts of management under Alternative B would be long-term and beneficial. Given the relatively broad distribution of this species within Long Pine Key, impacts would be local to regional. Management under Alternative B may affect and is likely to adversely affect pineland sandmat.

Garber's Spurge – The impacts of fire on Garber's spurge are not entirely understood. Fire is necessary to maintain an open understory that is required by this species to persist in pine rockland habitat. Regular prescribed fire also reduces infestations of exotic species that may compete with Garber's spurge, particularly Brazilian pepper. Periodic fires result in mortality of individuals when occupied habitat burns (Herndon 1998). In addition, recruitment has been observed within one-year following fire (Herndon 1998) and it is likely that fire results in rapid turnover of populations that burn. Currently, no information is available on differences in mortality or long-term population impacts resulting from wet or dry season burns. Indirect evidence suggests that burning in either season is suitable to maintain populations of Garber's spurge in pine rockland. Prescribed fire in the park was originally conducted during the dry season. Fire management was gradually shifted to wet season burning in an effort to better mimic natural lightning ignited fire patterns. As a result, pinelands in the park where Garber's spurge occurs have been historically burned in both the wet season and dry season. Long-term maintenance of populations in those areas indicates that either practice would sustain populations of Garber's spurge.

The effects of fire on coastal populations of Garber's spurge have not been studied. Similar open, grass dominated habitats in the park and elsewhere in Florida typically require fire for long-term maintenance. However, no fire return interval has been established for the park's coastal grasslands. Periodic storm surges may also produce similar effects on reducing understory vegetation in these habitats. In 2004, coastal grasslands at NW Cape Sable were burned as a result of an unintentionally set wildfire. At least one major storm surge event impacted the area the following year. Garber's spurge is currently widespread and abundant in this area indicating that impacts from one or both of these events on Garber's spurge were short lived and probably beneficial. Additional studies on the impacts of fire on coastal populations of Garber's spurge may aid in developing specific prescriptions for those populations.

Under Alternative B, prescribed fire is planned for implementation in pine rockland habitat where Garber's spurge is present. Plants are known from two separate occurrences in Long Pine Key. This would prevent both occurrences from burning in any given year. It would also provide an opportunity for park staff to observe the impacts of fire on individuals of this species prior to implementing a second burn. Each block is proposed to be burned at a three year interval under Alternative B. This fire return interval is within the literature derived fire return interval and is expected to lead to the long-term maintenance of pine rockland habitat. It is anticipated that mortality of a number of individuals of Garber's spurge is likely to occur with each prescribed fire. It is also anticipated that regularly recurring fire would result in the rapid establishment of new individuals of this species.

Coastal habitats occupied by Garber's spurge are not proposed to be burned under the current multi-year fuels treatment plan. However, tropical storms appear to create disturbance effects in

coastal grasslands that are similar to those caused by fire. Therefore, in the absence of prescribed fire in coastal grassland of Cape Sable, habitat maintenance should still occur. As a result, Garber's spurge populations in these communities should be maintained in the absence or presence of fire. If prescribed fire is planned in subsequent modifications of the multi-year fuels treatment plan, implementation is expected to result in mortality of burned plants followed by rapid recruitment from seed.

Due to the potential for substantial mortality of individuals with the application of prescribed fire, management under Alternative B would lead to short-term, minor to moderate adverse impacts to Garber's spurge. Due to the anticipated population turnover and long-term maintenance of habitats required by Garber's spurge, impacts of management under Alternative B would be long-term and beneficial. Management under Alternative B may affect and is likely to adversely affect Garber's spurge.

Florida Pineland Crabgrass – The impacts of fire on Florida pineland crabgrass are not well understood. Fire is critical in maintaining the open understory and species diversity in marl prairies and wet pine rocklands where this species occurs. Mortality of some individuals may occur from prescribed fire and it is anticipated that mortality would increase with increasing fire intensities. Plants are perennial, so resprouting from existing rootstock in moist marl soils or limestone bedrock is likely to occur following low intensity fires. Herndon (1998) reported a significant population decline resulting from fire followed by flooding from a tropical storm in one of the occurrences of this species in Long Pine Key. It is not clear if this population has recovered since that time. Currently, limited information is available on differences in mortality or long-term population impacts resulting from wet or dry season burns. Indirect evidence suggests that burning in either season is suitable to maintain populations of Florida pineland crabgrass in pine rocklands. Prescribed fire in the park was originally conducted during the dry season. Fire management was gradually shifted to wet season burning in an effort to better mimic natural lightning ignited fire patterns. As a result, pinelands and marl prairies in the park where Florida pineland crabgrass occurs have been burned in both the wet season and dry season. Long-term maintenance of populations in those areas indicates that either practice would sustain populations of this species. However, Herndon (1998) suggested that summer or wet season burns increase the likelihood that the combined influence of fire and flooding would occur.

Under Alternative B, prescribed fire is planned for implementation in pine rockland and marl prairie habitat where Florida pineland crabgrass is present. Occurrences are widespread in Long Pine Key. As a result, only portions of the entire Long Pine Key population would burn during any given year under multi-year fuels treatment plan. This would provide an opportunity for park staff to observe the impacts of fire on individuals of this species prior to implementing subsequent burns. Each block is proposed to be burned at a three year interval under Alternative B. This fire return interval is within the literature derived fire return interval and is expected to lead to the long-term maintenance of pine rockland and marl prairie habitats. It is anticipated that mortality of a small number of individuals of Florida pineland crabgrass is likely to occur with each prescribed fire. It is also anticipated that regularly recurring fire would maintain conditions required for establishment of new individuals of this species.

Fire management activities carried out under Alternative B would result in reduced fuel loads and subsequently lower intensity fires. These conditions are most likely to represent the greatest chance of long-term survival of Florida pineland crabgrass in Long Pine Key. Park fire management staff would be more capable of ensuring that areas that require burning for maintenance would be burned. As a result, the timing, frequency, intensity and spatial area would be more predictable and can be modified as new data emerges. In this scenario, populations of Florida pineland crabgrass would likely be stable over time. Mosaic patterned burning in pine rockland habitat would reduce

the chances that habitat occupied by Florida pineland crabgrass would burn during each prescribed fire. However, it is expected that over time, all areas within a given burn block would burn, resulting in maintenance of all occupied habitat.

Due to the potential for limited mortality of individuals with the application of prescribed fire, management under Alternative B would lead to short-term, negligible to minor adverse impacts to Florida pineland crabgrass. Due to the potential for long-term maintenance of habitats required by this species, impacts of management under Alternative B would be long-term and beneficial. Given the relatively broad distribution of this species within Long Pine Key, impacts would be local to regional. Management under Alternative B may affect and is likely to adversely affect Florida pineland crabgrass.

Everglades Bully – The impacts of fire on Everglades Bully are not entirely understood. Fire is necessary to maintain an open understory that is required by this species to persist in marl prairies and pine rockland habitat and is important in reducing exotic species infestations. Periodic fires may result in mortality of individuals if occupied habitat burns. However, this species grows in wet marl soils and in soil deposits within crack in the limestone bedrock. This provides protection to the roots of this perennial species allowing plants to resprout following fire. Currently, no information is available on differences in mortality or long-term population impacts resulting from wet or dry season burns. Indirect evidence suggests that burning in either season is suitable to maintain populations of Everglades Bully in pine rocklands and marl prairie habitats. Prescribed fire in the park was originally conducted during the dry season. Fire management was gradually shifted to wet season burning in an effort to better mimic natural lightning ignited fire patterns. As a result, pinelands and marl prairies in the park where Everglades bully occurs have been burned in both the wet season and dry season. Long-term maintenance of populations in those areas indicates that either practice would sustain populations of Everglades bully.

Under Alternative B, prescribed fire is planned for implementation in pine rockland and marl prairie habitat where Everglades bully is present. Occurrences are widespread in Long Pine Key. As a result, only portions of the entire Long Pine Key population would burn during any given year under the multi-year fuels treatment plan. This would provide an opportunity for park staff to observe the impacts of fire on individuals of this species prior to implementing subsequent burns. Each block is proposed to be burned at a three year interval under Alternative B. This fire return interval is within the literature derived fire return interval and is expected to lead to the long-term maintenance of pine rockland and marl prairie habitats. It is anticipated that mortality of a small number of individuals of Everglades bully is likely to occur with each prescribed fire. It is also anticipated that regularly recurring fire would maintain conditions required for establishment of new individuals of this species.

Fire management activities carried out under Alternative B would result in reduced fuel loads and subsequently lower intensity fires. These conditions are most likely to represent the greatest chance of long-term survival of Everglades bully in Long Pine Key. Park fire management staff would be more capable of ensuring that areas that require burning for maintenance would be burned. As a result, the timing, frequency, intensity and spatial area would be more predictable and can be modified as new data emerges. In this scenario, populations of Everglades bully would likely be stable over time. Mosaic patterned burning in pine rockland habitat would reduce the chances that habitat occupied by Everglades bully would burn during each prescribed fire. However, it is expected that over time, all areas within a given burn block would burn, resulting in maintenance of all occupied habitat.

Due to the potential for limited mortality of individuals with the application of prescribed fire, management under Alternative B would lead to short-term, negligible to minor adverse impacts to Everglades bully. Due to the potential for long-term maintenance of habitats required by this species,

impacts of management under Alternative B would be long-term and beneficial. Management under Alternative B may affect and is likely to adversely Everglades bully.

Other Plant Species of Management Concern that Occur in Fire Dependent Habitats. The effect of fire on each of the 68 plant species considered in this analysis depends on a variety of factors. The likelihood of mortality depends not only on adaptations specific to each species but also on the behavior and characteristics of the fire. For example, low intensity fires that occur in habitats with lower fuel loading are thought to be less likely to result in injury and mortality than high intensity fires that would occur in habitats with greater fuel loading. Indirect impacts to plant species of management concern can also occur through successional processes that occur in the absence of regularly occurring fire. For example, unburned pine rockland may convert to rockland hammock resulting in habitat loss for plant species of management concern in a relatively short period of time. In general, it is assumed that if fire dependent habitats experience fire at intervals similar to those that occurred historically, they would persist in the landscape over time.

Under Alternative B, prescribed fire is planned for implementation in pine rockland and marl prairie habitat where these species occur. Occurrences are widespread throughout the park with concentrations in Long Pine Key pine rocklands and marl prairies. In cases where a species considered here has a very limited distribution, the entire population could burn during any given year under the multi-year fuels treatment plan. Pre burn notification and coordination between fire management staff with the park botanist is carried out to determine if any sensitive plant populations are known and if burn specific mitigations are needed to protect those species. It is anticipated that mortality of a small number of individuals of species that are exposed to fire is likely to occur with each prescribed fire. It is also anticipated that regularly recurring fire would maintain conditions required for reproduction and establishment of new individuals of this species.

Fire management activities carried out under Alternative B would result in reduced fuel loads and subsequently lower intensity fires. These conditions are most likely to represent the greatest chance of long-term survival of Everglades bully in Long Pine Key. Park fire management staff would be more capable of ensuring that areas that require burning for maintenance would be burned. As a result, the timing, frequency, intensity and spatial area would be more predictable and can be modified as new data emerges. In this scenario, populations of plant species considered here would likely be stable over time. Mosaic patterned burning in pine rockland habitat would reduce the chances that all habitat occupied by one or more of these would burn during each prescribed fire. However, it is expected that over time, all areas within a given burn block would burn, resulting in maintenance of all occupied habitat.

Due to the potential for mortality of individuals with the application of prescribed fire, management under Alternative B may lead to short-term, negligible to moderate adverse impacts to these species. Due to the potential for long-term maintenance of habitats required by this species, impacts of management under Alternative B would be long-term and beneficial. Impacts would range from site specific to regional and would depend on the distribution of the species within the park. Pre-burn coordination and burn-specific mitigations may be implemented when small populations or habitat of species that are particularly sensitive to prescribed fire are expected from a planned burn.

Invertebrates. *Florida Leafwing* – Fire has the potential to directly and indirectly impact Florida leafwings. Adults are mobile and likely to leave the area when fires occur, particularly if adjacent to unburned suitable habitat. Larvae are essentially immobile and individuals would be killed if the host plants burn or are defoliated. Fire is also necessary to maintain suitable habitat for butterflies and host plants. Pineland croton resprouts rapidly after fire and with significant regrowth within 6 months to 1 year. Burned areas may be recolonized by Florida leafwings within 3-6 months (Salvato and Salvato 2010). Regular fire also reduces understory growth and prevents the establishment and

spread of exotic invasive plant species, both of which would otherwise impact pineland croton and the butterflies that it supports. Fire control activities, including vehicular activity and the creation of fire breaks, represent potential threats to this species in areas where host plants occur. Creation of fire breaks in undisturbed pine rockland habitat is not a frequent occurrence. However, previous control efforts required the creation of fire breaks to protect sensitive hammocks in Long Pine Key. Impacts of fire control activities are not anticipated to pose more than a localized threat to pineland croton or Florida leafwings but quantifying these impacts is not possible with existing information and the uncertain nature of fire behavior. Heavy rains from tropical storms immediately following fire have led to substantial mortality of pineland croton in parts of Long Pine Key and failure of these areas to be recolonized by both pineland croton and Florida leafwings followed the event (Salvato and Salvato 2010).

Under Alternative B, prescribed fire is planned for implementation in pine rockland and marl prairie habitat where pineland croton and Florida leafwings are likely to be present. Occurrences of this species and its host plant are widespread in Long Pine Key. As a result, only portions of the entire Long Pine Key population would be subjected to fire during any given year under the multi-year fuels treatment plan. This would provide an opportunity for park staff to observe the impacts of fire on individuals of this species prior to implementing subsequent burns. Each block is proposed to be burned at a three year interval under Alternative B. This fire return interval is within the literature derived fire return interval and is expected to lead to the long-term maintenance of pine rockland and marl prairie habitats.

Fire management activities carried out under Alternative B would result in reduced fuel loads and subsequently lower intensity fires in pine rockland habitat. These conditions are most likely to represent the greatest chance of long-term survival of Florida leafwings and pineland croton in Long Pine Key. Park fire management staff would be more capable of ensuring that areas that require burning for maintenance would be burned. As a result, the timing, frequency, intensity and spatial area would be more predictable and can be modified as new data emerges. In this scenario, populations of Florida leafwing would likely be stable over time. Mosaic patterned burning would reduce the chances that habitat occupied by pineland croton and Florida leafwings would burn during each prescribed fire. It is anticipated that over time, all areas within a given burn block would burn.

When croton populations in habitat being utilized by the Florida leafwing are burned, mortality of larvae would occur. Mosaic pattern burning is expected to result in burning of 50-95 percent of understory cover. As a result, burning of the above ground portions of 50-95 percent of the pineland croton plants in the unit is expected. Mortality of Florida leafwing larvae utilizing these croton plants in a given burn unit is also expected to occur. Adult leafwings are expected to be able to relocate when fires occur. As a result of the mitigation separating prescribed fire in adjacent blocks by a period of at least one year, suitable, unburned habitat for adults would be available for this to occur.

Due to the potential for mortality of individuals with the application of prescribed fire, management under Alternative B would lead to short-term, minor to moderate adverse impacts to the Florida leafwing. Due to the potential for long-term maintenance of habitats required by this species and its host plant, impacts of management under Alternative B would be long-term and beneficial. While this species has a relatively broad distribution throughout Long Pine Key, it does not occur at any sites outside of the park. Therefore, impacts would be regional. Management under Alternative B may affect and is likely to adversely affect the Florida leafwing.

Under Alternative B, implementation of regular prescribed fire would ensure that a disturbance regime that mimics naturally occurring disturbance patterns would be in place. Regular prescribed fire would also result in maintenance of predominately native vegetation and sufficient host plant with minimal levels of non-native species within proposed critical habitat. Short term impacts to the abundance of host plant would occur when units within proposed critical habitat are burned but

host plant populations are expected to recover quickly following fire events. Implementation of activities described under Alternative B would not lead to adverse modification of proposed critical habitat.

Bartram's Scrub Hairstreak – Fire has the potential to directly and indirectly impact Bartram's hairstreak. Adults are mobile and may be able to leave the area when fires occur, particularly if fires occur adjacent to unburned suitable habitat. However, adult Bartram's hairstreaks are generally observed close to host plants (Salvato and Salvato 2008) and have been reported to primarily remain within 5m of host plants. Larvae are basically immobile and individuals would be killed if the host plants burn. Thus, both adults and larvae are believed to be very susceptible to mortality from fire. Fire is also necessary to maintain suitable habitat for butterflies and host plants. Pineland croton resprouts rapidly after fire with significant regrowth within a few months of a burn event. Burned areas are recolonized by adult Bartram's hairstreaks but the amount of time required for recolonization following fire is unclear. Regular fire also reduces understory growth and prevents the establishment and spread of exotic invasive plant species, both of which would otherwise impact pineland croton and the butterflies that it supports. Fire control activities, including vehicular activity and the creation of fire breaks, represent potential threats to this species in areas where host plants occur. Creation of fire breaks in undisturbed pine rockland habitat is not a frequent occurrence. However, previous control efforts required the creation of fire breaks to protect sensitive hammocks in Long Pine Key. The impacts of fire control activities are not anticipated to pose more than a localized threat to pineland croton or Bartram's hairstreak but quantifying these impacts is not possible with existing information and the uncertain nature of fire behavior. Heavy rains from tropical storms immediately following fire have led to substantial mortality of pineland croton in parts of Long Pine Key and failure of these areas to be recolonized by both pineland croton following the event (Salvato and Salvato 2010).

Under Alternative B, prescribed fire is planned for implementation in pine rockland and marl prairie habitat where pineland croton and Bartram's hairstreak are likely to be present. Occurrences of this species and its host plant are widespread in Long Pine Key. As a result, only portions of the entire Long Pine Key population would be subjected to fire during any given year under the multi-year fuels treatment plan. This would provide an opportunity for park staff to observe the impacts of fire on individuals of this species prior to implementing subsequent burns. Each block is proposed to be burned at a three year interval under Alternative B. This fire return interval is within the literature derived fire return interval and is expected to lead to the long-term maintenance of pine rockland and marl prairie habitats.

Fire management activities carried out under Alternative B would result in reduced fuel loads and subsequently lower intensity fires in pine rockland habitat. These conditions are most likely to represent the greatest chance of long-term survival of Bartram's hairstreak and pineland croton in Long Pine Key. Park fire management staff would be more capable of ensuring that areas that require burning for maintenance would be burned. As a result, the timing, frequency, intensity and spatial area would be more predictable and can be modified as new data emerges. In this scenario, populations of Bartram's hairstreak would likely be stable over time. Mosaic patterned burning planned as a mitigation measure would reduce the chances that habitat occupied by pineland croton and Bartram's hairstreak would burn during each prescribed fire. It is anticipated that over time, all areas within a given burn block would burn.

When croton populations in habitat being utilized by the Bartram's hairstreak are burned, mortality of larvae would occur. Mosaic pattern burning is expected to result in burning of 50-95 percent of understory cover. As a result, burning of the above ground portions of 50-95 percent of the pineland croton plants in the unit is expected. Mortality of Bartram's hairstreak larvae utilizing these croton plants in a given burn unit is also expected to occur. Adult Bartram's hairstreaks may be able to

relocate when fires occur. However, adults typically do not move far from host plants and some mortality of adults is also expected when fires occur. As a result of the mitigation separating prescribed fire in adjacent blocks by a period of at least one year, suitable, unburned habitat for adults would be available if adults are capable of relocating during fires.

Due to the potential for mortality of individuals with the application of prescribed fire, management under Alternative B would lead to short-term, minor to moderate adverse impacts to the Bartram's hairstreak. Due to the potential for long-term maintenance of habitats required by this species and its host plant, impacts of management under Alternative B would be long-term and beneficial. Given the relatively broad distribution throughout Long Pine Key, impacts would be local to regional. Management under Alternative B may affect and is likely to adversely affect the Bartram's hairstreak.

Under Alternative B, implementation of regular prescribed fire would ensure that a disturbance regime that mimics naturally occurring disturbance patterns would be in place. Regular prescribed fire would also result in maintenance of predominately native vegetation and sufficient host plant with minimal levels of non-native species within proposed critical habitat. Short term impacts to the abundance of host plant would occur when units within proposed critical habitat are burned but host plant populations are expected to recover quickly following fire events. Implementation of activities described under Alternative B would not lead to adverse modification of proposed critical habitat.

Stock Island Tree Snail – Under Alternative B, fires would not be expected to affect Stock Island tree snails because the hardwood hammocks where these snails occur are unlikely to be affected by fire. Fire management activities would also be unlikely to affect snails because they would generally be limited to work in fuels outside of tropical hardwood hammocks. Fuels treatment in wilderness areas in the Flamingo area could reduce fuels before they reach levels where fire severity would be high, and this would limit potential impacts to tree snails. Relatively low-intensity fires on the periphery of the hammocks could scorch small portions of hammocks, potentially reducing the suitability of limited areas of habitat for use by snails. Such fires could affect snails through exposure to heat and smoke, resulting in temporary behavioral responses. These effects would not be expected to reach a level where injury or death of snails may occur, and consequently, the effects would be insignificant and discountable, and implementation of Alternative B would not likely adversely affect Stock Island tree snails. The effects of fire could have site-specific, short-term, minor adverse effects on this species. Management of fuels adjacent to hammocks would tend to protect and perpetuate hammocks, resulting in long-term benefits to tree snail habitat.

Florida Tree Snail – The effects of Alternative B on Florida tree snails would be nearly identical to the effects on Stock Island tree snails. Under Alternative B, fires would not be expected to affect Florida tree snails because the hardwood hammocks and tree islands where they occur are unlikely to be affected by fire. Fire management activities would also be unlikely to affect snails because they would generally be limited to work in fuels outside of tropical hardwood hammocks. Fuels treatment in wilderness areas could reduce fuels before they reach levels where fire severity would be high, and this would limit potential impacts to tree snails. Relatively low-intensity fires on the periphery of the hammocks could scorch small portions of hammocks, potentially reducing the suitability of limited areas of habitat for use by snails. Such fires could affect snails through exposure to heat and smoke, resulting in temporary behavioral responses. These effects would generally not be expected to reach a level where injury or death of snails may occur. The effects of Alternative B would be site-specific to local, short-term, minor, and adverse. Management of fuels adjacent to hammocks would tend to protect and perpetuate hammocks, resulting in long-term benefits to tree snail habitat.

Reptiles. *American Crocodile* – American crocodiles would be unlikely to be affected by wildfire within FMU 1 because these fires would be very infrequent in the mangrove communities and estuarine waters where crocodiles generally occur. Fires on the coastal dunes could result in disturbance to basking crocodiles, but injury or death of crocodiles is unlikely. Under Alternative B, fires may occur slightly more frequently in the vicinity of crocodile nesting areas, including beaches and artificial uplands. Fires are unlikely to affect crocodile nests because most fires would be prescribed fires conducted under planned environmental and fire behavior parameters that are expected to prevent burning of organic soils. Fire management and operational activities, including helicopter use, presence of fire management personnel, and fire effects monitoring activities, may disturb adult and juvenile crocodiles, causing temporary changes in behavior, including changes in breeding, feeding, and sheltering. These effects are never expected to reach a level where injury or death occurs. These effects are insignificant and discountable, and Alternative B would not likely to adversely affect American crocodiles. Adverse effects of Alternative B on American crocodiles would be site specific, short-term and negligible to minor.

Alternative B may result in temporary changes in the conditions of vegetation in potential nesting areas, but is otherwise not expected to affect the availability, suitability, or amount of suitable crocodile nesting habitat, sheltered low-salinity estuarine waters, or the availability of prey, which are the primary constituent elements of crocodile critical habitat. Alternative B would not likely adversely affect designated American crocodile critical habitat. Alternative B would have short-term, negligible adverse effects on crocodile critical habitat.

Eastern Indigo Snake – Under Alternative B, fuel treatment burns would be implemented throughout the park to manage fuel loads. Prescribed fire may also be used to control exotic invasive species populations. Under this alternative, fuel accumulations would be expected to be reduced in general, and less continuous. Prescribed fires would occur under environmental and fire behavior parameters designed to create a mosaic of burned and unburned vegetation within a unit. Although Eastern indigo snakes move across the landscape quickly and retreat to burrows or other refugia when disturbed, some snakes may become caught in fires and these individuals may be injured or killed. If snakes are present at the fringes of habitats that don't typically burn they may move into these habitats during fires. The less intense fire behavior and the presence of refugia within a burn unit that is expected under Alternative B likely reduce the likelihood of injury or death of snakes.

Multiple ignition locations, as is expected under a prescribed fire scenario, has the potential to increase the risk of snakes becoming trapped in a prescribed fire but this risk may be ameliorated by burning under conditions expected to result in less intense fire behavior and unburned refugia. Prescribed fire for exotic plant management includes some activities that may cause mulch piles, fallen logs, and stumps that could serve as dens, but mitigation actions that remove debris piles promptly to prevent eastern indigo snakes from inhabiting those temporary piles would reduce potential for burning dens.

Alternative B would be expected to maintain the mosaic of habitat types that indigo snakes prefer, and also a mosaic of vegetation conditions within a vegetation type due to the expected mosaic of burned and unburned vegetation, and these qualities are expected to be favorable for Eastern indigo snakes.

Fire management, wildfire operations, and effects monitoring could all cause disturbance to Eastern indigo snakes. Disturbance resulting from the presence of fire management and monitoring personnel may cause temporary changes in behavior that may affect normal breeding, feeding, and sheltering. Because mechanical ground disturbance related to fires within the park is very limited, the likelihood of injury or death of snakes during fire management and operational activities is very low. However, operation of vehicles during fires has the potential to injure or kill snakes.

Alternative B would have short-term, minor to moderate adverse effects, and short- and long-term beneficial effects through mosaic burns and maintenance of natural habitat characteristics. These effects would be site specific to local. Fire management under Alternative B may affect, and is likely to adversely affect Eastern indigo snakes due to the potential for injury or death of individuals.

Gopher Tortoise – Prescribed fires in gopher tortoise habitat on fore and back dunes of FMU 1 are likely to be infrequent and fire is not likely significant in maintaining habitat on Cape Sable. If fires occur, individual tortoises may be stranded if away from burrows, and injured or killed either in fire or by dehydration. However, tortoises generally find refugia from fires in burrows, and the likelihood of injury or death due to fire is low. Prescribed fire may result in impacts to tortoises in FMU 3 if they are present. Management under Alternative B would include application of prescribed fire in wilderness areas on Cape Sable, although no prescribed burns are currently proposed under the current multi-year fuels treatment plan. Prescribed fire may be used in most areas of FMU 1 for exotic plant control and hazardous fuels reduction. Reduction of exotic plants through managed fire and fuels reduction would contribute to improving the native plant communities that sustain gopher tortoises, reduces old vegetation, and promotes new growth, which increases the quality and quantity of forage available for gopher tortoises.

Under Alternative B, management of wildfire would likely have short-term, minor to moderate adverse impacts and long-term beneficial impacts to the gopher tortoise. These impacts would be site specific to local. Alternative B may result in temporary disturbance to gopher tortoises, and may injure or kill individuals in very limited circumstances. As a result, implementation of Alternative B may affect and is likely to adversely affect gopher tortoises.

Mammals. *Florida Panther* – Under Alternative B, fuel treatment burns would be implemented throughout the park to manage fuel loads. Prescribed fire may also be used to control exotic invasive species populations. Under this alternative, fuel accumulations would be expected to be reduced in general, and less continuous. Prescribed fires would occur under environmental and fire behavior parameters designed to create a mosaic of burned and unburned vegetation within a unit. Less intense fire behavior and the presence of unburned refugia within a burn unit is expected under Alternative B. While adult panthers are expected to successfully avoid fires under nearly all conditions, panther kittens up to 5-6 months of age that occur in an area that burns are likely could be injured if they occur in vegetation types that may burn. There would be potential for Florida panther kitten mortality, but this would be unlikely. Panthers use a variety of habitat types for denning, but thick, dense vegetation is the consistent characteristic. Within the park, these conditions are often associated with hardwood hammocks and dense Brazilian pepper, but long-unburned patches of dense sawgrass, palmetto, or other highly combustible vegetation may also be used. Considering the lack of detailed telemetry monitoring of panthers within the park, it is unlikely that panther den locations would be known in an area subject to fire, and suppression actions would therefore likely be insufficient to protect panther dens. Because of the small number of panthers in the park and the relatively low chances that a den would be located within burnable vegetation types, it is unlikely that a panther den would be lost in any one fire, unless it burns a large portion of the pinelands in one fire. However, the likelihood that at least one panther den would be affected by fire is substantial when considering a program of fire management conducted over large areas and over many years.

Alternative B would generally be expected to maintain the mosaic of habitat types that panthers use, as well as generally suitable habitat conditions. The mosaic of burned and unburned patches within an individual burn unit would provide favorable conditions for panthers by providing cover adjacent to the habitat conditions that would attract prey, and more frequent fires would tend to maintain habitat in a better condition for panther hunting. The expected lower intensity and severity of fires

expected under Alternative B due to reduced fuel loads and burning under most favorable conditions would tend to prevent fires from entering hardwood hammocks and Brazilian pepper where dens may occur. Regular fuels treatment may tend to reduce the likelihood of dense combustible vegetation that panthers may select as dens. This effect could reduce availability of den sites, but would also tend to reduce likelihood of loss of kittens due to fire.

Fire management, aviation, wildfire operations, effects monitoring, and other fire-related activities could all cause disturbance to Florida panthers. Disturbance resulting from the presence of fire management and monitoring personnel may cause temporary changes in behavior that may affect normal breeding, feeding, and sheltering, and could increase risk of predation of young kittens. Operation of vehicles during fires also has the potential to injure or kill panthers.

Alternative B would be expected to have short-term, minor to moderate adverse effects on Florida panthers, and short- and long-term beneficial effects by maintaining natural habitat characteristics. These impacts would be site specific. Fire management under Alternative B may affect, and is likely to adversely affect Florida panthers due to the potential for injury of kittens during fires.

Florida Manatee – Wildfire is not expected to affect manatees or their habitat. Potential boat use would be limited in scope and would be in accordance with normal boat operation, including compliance with manatee protection zones. However, the presence of fire management personnel, helicopter operations and fire wildfire management actions, and fire effects monitoring personnel may cause temporary changes in manatee behavior, including breeding, feeding, and sheltering. These effects would be insignificant and discountable, and Alternative B may affect, but is not likely to adversely affect manatees. The impacts of Alternative B would be limited to site-specific, short-term, and negligible adverse.

Florida Bonneted Bat – Considering the lack of knowledge of the habitat use of the bonneted bat and its response to fire, it is difficult to predict the impacts of alternative fire management strategies. Under Alternative B, fuel treatment burns would be implemented throughout the park to manage fuel loads. Prescribed fire may also be used to control exotic invasive species populations. Under this alternative, fuel accumulations would be expected to be reduced in general, and less continuous. Prescribed fires would occur under environmental and fire behavior parameters designed to create a mosaic of burned and unburned vegetation within a unit. Less intense fire behavior and the presence of unburned refugia within a burn unit is expected under Alternative B. This expected fire pattern would be expected to burn a portion of existing snags, retain a portion of the snags, and create some new snags. This pattern of snag effects would tend to lead to a consistent availability of snags over time that would support bat roosting. Few bats would be expected to perish in fires, and Alternative B would maintain favorable habitat in the park by maintaining snags and natural habitat conditions that would be expected to maintain prey availability. If Florida bonneted bats are roosting in habitats not affected by fire, including hardwood hammocks or structures, impacts to those individuals would not occur under Alternative B.

Alternative B would have negligible to minor, short-term adverse impacts to Florida bonneted bats, and long-term beneficial effects. These impacts would be site specific. Due to the possibility that Alternative B may result in loss of individual bats in some instances, Alternative B may affect and is likely to adversely affect this species.

Everglades Mink – There is little information about the potential effects of fire on the mink. Under Alternative B, fuel treatment burns would be implemented throughout the park to manage fuel loads. Prescribed fire may also be used to control exotic invasive species populations. Under this alternative, fuel accumulations would be expected to be reduced in general, and less continuous.

Prescribed fires would occur under environmental and fire behavior parameters designed to create a mosaic of burned and unburned vegetation within a unit. Less intense fire behavior and the presence of unburned refugia within a burn unit is expected under Alternative B. Mink may be susceptible to fires, but there is insufficient information to assess effects in detail, though they are presumed to be susceptible to fires in rare instances. Adults would generally be able to avoid fires by seeking refugia or open water. Predominance of prescribed fire would tend to increase availability of both refugia and open water during fires. Their apparent rarity within the park also makes effects from fire unlikely. The impacts of Alternative B on Everglades mink would be site specific, negligible to minor, and adverse.

Big Cypress Fox Squirrel – There is little information available on the effects of fire on Big Cypress fox squirrel. Because they frequently occupy forested areas subject to frequent fire, we assume that they are generally fire-adapted. In Everglades national Park, they occupy mangrove habitats extensively, and these areas are largely unaffected by fires. They generally appear to benefit from maintenance of forested habitats of many types in a natural condition. Under Alternative B, fuel treatment burns would be implemented throughout the park to manage fuel loads. Under this alternative, fuel accumulations would be expected to be reduced in general. Prescribed fires would occur under environmental and fire behavior parameters designed to create a mosaic of burned and unburned vegetation within a unit. Less intense fire behavior and the presence of unburned refugia within a burn unit is expected under Alternative B. These conditions would tend to perpetuate forested habitats used by fox squirrels and provide refugia during fires. The impacts of Alternative B would be short-term, negligible to minor, and adverse, as well as long-term and beneficial. These impacts would be local to regional due to extensive nature of mangrove habitat used by this species.

Birds. *Cape Sable Seaside Sparrow* – Fire has been documented to affect Cape Sable seaside sparrows, both directly and indirectly. The most obvious effect is that fires have the potential to kill individuals. Sparrow eggs, nestlings, and young fledglings are susceptible to fires because they occupy the combustible marsh grasses that burn during fires, and they have limited ability to escape fires. Because the sparrow nests primarily during the dry season when wildfires are most likely both to occur and to spread, eggs and young are likely to be lost to wildfires. Sparrow eggs and young may be lost during any fires that occur in sparrow habitat between March1 and August 31, though fires occurring in April through June, which corresponds with the peak in sparrow nesting activity, would have the greatest impact on eggs and nestlings. In these instances, all nests, eggs, and recently fledged young that occur within a burned area would be expected to be killed. Adult and independent young Cape Sable seaside sparrows may be able to fly out of harm's way, but under some circumstances, even adults may be killed. La Puma et al. (2007) reported that none of the 35 color-banded adult sparrows that had occupied the area burned by the Lopez fire in subpopulation E in 2001 were seen again following the fire.

Following a fire, sparrows do not nest within burned areas for a period of 2-3 years (La Puma 2010; La Puma et al. 2007), and this is likely a result of the relatively sparse density of vegetation that does not support a nest structure, and/or does not provide sufficient cover for nests. Any unburned patches within a large burned area may still be suitable for sparrow nesting, so in patchy burns, there is a greater potential for sparrows to retain the ability to nest following fires. After 2-3 years, suitable nesting habitat generally recovers, and sparrows resume nesting with approximately the same density and success as before fires (La Puma et al. 2007).

Under circumstances when fires are followed by heavy rainfall that causes rapidly rising water levels to overtop the growing graminoid vegetation, nearly all vegetation can be killed. Under these circumstances, recovery of vegetation sufficient to support sparrow nesting may not occur for a

decade or more. The rate of vegetation recovery may be affected by a variety of factors, including soil depth and post-fire hydrologic conditions.

Fire management and wildfire management actions also have the potential to affect sparrows. During nesting season, sparrow eggs, nestlings, and recently fledged young may be injured or killed by water drops, both from buckets suspended by helicopters, and by air tankers. The likelihood of this occurring is low due to the relatively low probability that a nest would occur at the location where water is dropped, but it may occur.

The presence of fire management personnel, helicopter and aircraft operation, and other equipment, during suppression activities, fire effects monitoring, and related activities can also disturb sparrows, causing changes in normal behavior which may increase predation risk and interfere with normal breeding, feeding, and sheltering activity. During nesting season, activities that flush females from nests may increase the chances of nest loss.

Fires have little benefit to sparrow populations (La Puma et al. 2007) or to occupied suitable habitat, but there are some beneficial effects. Fire does tend to promote the growth of C4 grasses over C3 grasses, and most of the grass species that are associated with sparrow occupancy are C4 grasses (Sah et al. 2010). In areas occupied by sparrows, this effect may have limited benefit to sparrows because the habitat is already in a suitable condition, but in areas that are suboptimal sparrow habitat such as sawgrass dominated areas, fire may help improve suitability under some conditions. This beneficial effect has not been well-documented in the Everglades system, and may warrant further study. Fires have been shown to be very effective in reducing and controlling woody vegetation, and in some areas, this effect can improve habitat. Fire also has the beneficial effect of reducing the risk of future fires. Relatively small fires within a larger unit of sparrow habitat would reduce the likelihood of an entire habitat patch burning, and would increase the likelihood of successful suppression by creating discontinuities in fuel loading. As wildfires encounter areas of lower fuel loading, their severity and rate of spread can be reduced, allowing for more successful control and increasing likelihood that they would be extinguished by high humidity or light rainfall.

Alternative B allows for greater use of prescribed fire within sparrow habitat. While this could equate to increased impacts if more sparrow habitat is burned, this alternative would result in conditions that are less susceptible to catastrophic fires that would have the potential to extirpate or significantly reduce a subpopulation. Additionally, application of prescribed fire under carefully planned environmental and fire behavior parameters may result in a mosaic of burned and unburned patches that would support continued sparrow nesting while also reducing risk of catastrophic fire. Implementation of the Cape Sable seaside sparrow fire management strategy, close coordination with researchers and natural resources staff, and the intent and ability to incorporate refined guidance for managing fires in sparrow habitat further reduce the chances that fire would have significant population-level effects on Cape Sable seaside sparrows. Lastly, Alternative B provides the opportunity to plan fires in conjunction with water management plans so that prescribed burns can be conducted to minimize the risk and likelihood of having the most severe effects on sparrow habitat.

There are cumulative impacts that result from the addition of fire management to the impacts that have occurred and would continue to occur through hydrologic restoration and water management activities. Throughout subpopulation A and portions of other subpopulations, hydrologic management has in some cases degraded habitat and reduced sparrow populations. Fires in these areas may have cumulative adverse impacts. These cumulative impacts are minimized in Alternative B by providing for planned fires that can explicitly minimize these potential impacts.

Throughout their history, fires have affected Cape Sable seaside sparrows in the Everglades in this manner, and taking this into account, the impacts of Alternative B, including cumulative effects, would be moderate, short and long-term, and adverse, with long-term beneficial effects as a result of

reduced risk of catastrophic fires and restored habitat. Due to the limited range of sparrows, impacts would be local to regional.

Because of the potential for fires and fire management to affect sparrows both directly and indirectly, Alternative B may affect, and is likely to adversely affect Cape Sable seaside sparrows.

Cape Sable Seaside Sparrow Critical Habitat – Fire and fire management have the potential to affect two of the three primary constituent elements of sparrow critical habitat. Fires can temporarily affect the cover of herbaceous vegetation, and reduce cover of these species below the 15 percent identified as a PCE. However, under most circumstances, herbaceous cover of these species would recover rapidly following fire, and would usually be reestablished within weeks to months following fire. Only under cases where recently burned habitat is flooded, resulting in mortality of herbaceous vegetation, would fire remove PCEs. Alternative B minimizes the likelihood of this by providing for application of fire when the risk of long-term impacts is smallest. This also reduces the likelihood that a large portion of critical habitat would be significantly degraded.

Fires have the potential to substantially improve the openness of critical habitat (PCE 3) through control of woody vegetation. Alternative B would provide for application of prescribed fire to accomplish these benefits, through adoption of guidance, application of science to fire management, and the close coordination with researchers and natural resources staff.

Similar to impacts to sparrows, there are cumulative impacts that result from the combination of fire impacts and hydrologic management impacts on sparrow critical habitat. Hydrologic management also has the potential to affect all PCEs, and some areas of critical habitat may have been degraded by hydrologic management in the past.

The impacts of Alternative B on Cape Sable seaside sparrow critical habitat, including cumulative impacts, would be short- and long- term, moderate, and adverse, with long-term beneficial impacts as a result of maintaining the openness of critical habitat and possibly promoting growth of herbaceous species identified primary constituent elements. Alternative B may affect, but is not likely to adversely modify designated Cape Sable seaside sparrow critical habitat.

Everglade Snail Kite – Fire has the potential to directly and indirectly affect the Everglade snail kite. Kites nest within the Everglades marshes in areas that are subject to fire, and if the marshes burn when kites are nesting, eggs, nestlings, and young fledglings may be injured or killed by fires. Because kites generally nest over water, some nests in trees or shrubs that are in areas with relatively sparse emergent vegetation may not burn because of insufficient fuels around nests. However, kites often nest in dense vegetation, including within dense stands of sawgrass or cattail that would be likely to burn in fires regardless of whether there were water underneath the nests. Because of the variability in kite nesting areas and substrate, not all kite nests within a burned area would be expected to burn during fires. Surveys for snail kite nesting within the park are not regularly conducted, and consequently, it is unlikely that all snail kite nests that occur within a particular FMU, burn unit, or area would be identified. Nests that are identified would be avoided, and suppression efforts implemented to minimize risk of nest loss to fires.

Under Alternative B, fuels treatment burns and exotic vegetation treatment burns would be conducted within kite habitat in FMU 2. Risk to snail kites would be mitigated through avoidance of known nests. Fuels would tend to be treated before they reached heavy accumulations. Because prescribed fires would predominate, the likelihood of fires occurring during the peak kite nesting season, when water levels are generally moderate and falling, may be more likely to occur. However, the fires that result are expected to be less severe, and may be less likely to burn kite nests.

Under Alternative B, fires are not expected to substantially affect the suitability of habitat for kites. Areas that burn may support better kite foraging due to improved visibility of snails, but they may also support fewer suitable nest sites. In general, these changes are not anticipated to significantly improve conditions for or limit snail kites.

Fire management, aviation, wildfire operations, effects monitoring, and other fire-related activities could all cause disturbance to Everglade snail kites. Disturbance resulting from aviation activities and the presence of fire management and monitoring personnel may cause temporary changes in behavior that may affect normal breeding, feeding, and sheltering, and could increase risk of predation of eggs and nestlings if adults are flushed from the nest. Rotor wash from helicopters also has the potential to dislodge kite nests from substrate, causing nest failure.

There are cumulative impacts that result from the addition of fire management to the impacts that have occurred and would continue to occur through hydrologic restoration and water management activities. Throughout the park and the rest of the snail kite range, hydrologic management has in some cases degraded habitat and reduced kite populations. Fires in these areas may have cumulative adverse impacts. These cumulative impacts are not likely to be significant because fires are not expected to strongly affect kites or their habitat, but the effects may be additive in some cases.

Alternative B would have site-specific, short-term, minor to moderate adverse impacts to snail kites, and short- and long-term beneficial effects as a result of improved foraging conditions and habitat maintenance, respectively. Alternative B may affect and is likely to adversely affect snail kites due to the potential for loss of snail kite nests.

Everglade Snail Kite Critical Habitat – Alternative B may result in temporary changes in the availability and condition of marsh vegetation in the short-term, which may have indirect effects on apple snails in the area. No long-term effects would be expected. Fires are not expected to substantially affect the amount or availability of habitat within the designated critical habitat, and consequently, Alternative B is not likely to adversely affect snail kite critical habitat. There would be short-term negligible to minor adverse effects.

Wood stork – Wood storks are in general not highly susceptible to the effects of fire. Under Alternative B, prescribed fires would predominate within wood stork habitat. Risk to wood stork nests would be mitigated through avoidance of nesting colonies, and most nesting colonies are well-known and monitored. Fuels treatment fires and selection of conditions under which prescribed fires occur would also help to reduce severe effects of fire. Prescribed fires may be proposed and carried out during stork nesting season under Alternative B depending on conditions that are required to successfully accomplish the objectives of the burn. However, these burns would be conducted with the intention of avoiding potential impacts to storks.

While there is some potential for adult and fledgling wood storks to be affected, the likelihood is very small because they are likely to move away from a fire or fire management disturbance, and they tend to forage in water 10-40 cm deep in open areas with only sparse emergent vegetation that would not be likely to burn, and avoid dense vegetation.

Under Alternative B, fires have the potential to improve stork foraging by reducing vegetation density that may interfere with access to prey. Fires may also help reduce encroachment of woody invasive species in some areas.

Fire management, aviation, suppression, effects monitoring, and other fire-related activities could all cause disturbance to wood storks. Disturbance resulting from aviation activities and the presence of fire management and monitoring personnel may cause temporary changes in behavior that may affect normal breeding, feeding, and sheltering, and could increase risk of predation of eggs and

nestlings if disturbances occur near a nesting colony. Disturbance of nesting birds is unlikely because of mitigation measures to avoid activity near nesting colonies. Foraging birds are likely to respond to disturbance by moving out of the area.

Alternative B would have short-term, minor adverse impacts on the wood stork, and short-term beneficial effects. These impacts would be local. Alternative B may affect, but is not likely to adversely affect the wood stork.

Wading Birds (little blue heron, snowy egret, tricolored heron, white ibis, roseate spoonbill) – The effects of Alternative B on these species is very similar to those described for wood storks. Under Alternative B, prescribed fires would predominate within wading bird habitat. Risk to wading bird nests would be mitigated through avoidance of nesting colonies, and most nesting colonies are well-known and monitored. Prescribed fuels treatment fires and selection of conditions under which prescribed fires occur would also help to reduce severe effects of fire. Prescribed fires may be more likely to occur within wading bird habitat during nesting season under Alternative B because the meteorological conditions when prescribed fires would be preferred in FMU 2 are more likely to occur during these times. However, because the conditions when burns would occur are selected, there is a high likelihood that fires would be conducted to avoid potential impacts.

While there is some potential for adult and fledgling wading birds to be affected, the likelihood is small because they are likely to move away from a fire or fire management disturbance, and they tend to forage in open areas with only sparse emergent vegetation where they would be expected to be capable of fleeing fire in most cases.

Fire management, aviation, suppression, effects monitoring, and other fire-related activities could all cause disturbance to wading birds. Disturbance resulting from aviation activities and the presence of fire management and monitoring personnel may cause temporary changes in behavior, and could increase risk of predation of eggs and nestlings if disturbances occur near a nesting colony. Disturbance of nesting birds is unlikely because of mitigation measures to avoid active nesting colonies. Foraging birds are likely to respond to disturbance by moving out of the area.

Alternative B would have short-term, minor adverse impacts to wading birds, and short- and long-term beneficial impacts. These impacts would be local.

Limpkin – Limpkin nests may be susceptible to fires since they sometimes nest in emergent vegetation in areas that may burn. Adult limpkins would normally be expected to simply fly away from oncoming fires. Because they place their nests in a variety of locations, including trees, there is a low likelihood that fires would affect all limpkin nests in an area.

Under Alternative B, prescribed fires would predominate within limpkin habitat. Prescribed fuels treatment fires and selection of conditions under which prescribed fires occur would also help to reduce severe effects of fire. Prescribed fires may be more likely to occur within limpkin habitat during nesting season under Alternative B because the meteorological conditions when prescribed fires would be preferred are more likely to occur during these times.

Fires may improve habitat for limpkin foraging in the short-term by making apple snails more available, as long as there is sufficient remaining emergent vegetation to maintain apple snail respiration.

Fire management, aviation, suppression, effects monitoring, and other fire-related activities could all cause disturbance to limpkins. Disturbance resulting from aviation activities and the presence of fire management and monitoring personnel may cause temporary changes in behavior, and could increase risk of predation of eggs and nestlings if disturbances occur near a nest. Limpkins are not

susceptible to disturbance during nesting, and would often remain on a nest until closely approached.

Alternative B would have short-term, minor to moderate adverse impacts, and short-term beneficial impacts that would result from improved foraging. These impacts would be local.

Sandhill Crane – Because sandhill cranes nest in the marsh, their nests may be susceptible to fires. However, they generally build nests by removing all emergent vegetation from the area around the nest and piling it onto the nest structure, in addition to the mud, and they effectively create a moat around the nests that may provide a degree of protection from fires. Adult cranes would easily avoid fires.

Under Alternative B, prescribed fires would predominate within crane habitat. Prescribed fuels treatment fires and selection of conditions under which prescribed fires occur would also help to reduce severe effects of fire. Prescribed fires may be more likely to occur within crane habitat during nesting season under Alternative B because the meteorological conditions when prescribed fires would be preferred are more likely to occur during these times.

Fire management, aviation, suppression, effects monitoring, and other fire-related activities could all cause disturbance to sandhill cranes. Disturbance resulting from aviation activities and the presence of fire management and monitoring personnel may cause temporary changes in behavior, and could increase risk of predation of eggs and nestlings if disturbances occur near a nest. Nesting sandhill cranes are quite susceptible to disturbance.

Alternative B would have site-specific, short-and long-term, negligible to minor adverse effects on sandhill cranes.

White-crowned Pigeon – White crowned pigeons are unlikely to be affected by fires since they are likely to fly away from fire, and nest in areas where fire does not occur. However, their reliance on the fruits produced in hardwood hammocks, tree islands and roadsides provides some potential to be affected. Under Alternative B, prescribed fires would predominate. Prescribed fuels treatment fires and selection of conditions under which prescribed fires occur would also help to reduce severe effects of fire on vegetation, and would tend to protect and maintain tree island and hammock vegetation. The effects of Alternative B would be local, short and long-term, negligible, and adverse as a result of potential forage degradation.

Reintroduced Pineland Birds (brown-headed nuthatch, eastern bluebird, and Florida wild turkey) – Under Alternative B, fuel treatment burns would be implemented throughout FMU 3 to manage fuel loads. Prescribed fire may also be used to control exotic invasive species populations. Under this alternative, fuel accumulations would be expected to be reduced in general. Prescribed fires would occur under more controlled conditions, and would be more likely to create a mosaic of burned and unburned vegetation within a unit. Less intense fire behavior and the presence of unburned refugia within a burn unit is expected under Alternative B. This expected fire pattern would be expected to burn a portion of existing snags, retain a portion of the snags, and create some new snags. This pattern of snag effects would tend to lead to a consistent availability of snags over time that would provide consistent availability of cavities for cavity-nesting birds. Alternative B would maintain favorable habitat in the pinelands by maintaining snags and natural understory vegetation conditions that would be expected to maintain relatively consistent prey availability. The mosaic of burned and unburned patches would also provide a good combination of favorable turkey foraging habitat in recently burned areas and good nesting habitat in unburned patches.

Alternative B would have short-term, insignificant to minor adverse impacts to these species, and long-term beneficial effects. Because these species are restricted to pine rockland habitats within Everglades National Park, impacts would be local to regional.

Cumulative Impacts

Past projects impacting special status species include the acquisition of lands in the East Everglades addition under the Expansion Act. Acquisition of these areas has expanded the protected areas within Everglades National Park and has protected habitat for special status species, resulting in long-term beneficial impacts. Past, present, and future actions that impact special status species include all projects aimed at restoring habitat and delivering additional freshwater to the park. As a result of these actions, there would be additional habitat for special status species in the park. Use of wildfire by fire management has helped maintain and improve habitat for special status species over the long term. Activities that have and continue to adversely affect special status species in the park include trampling, collecting, diminished freshwater water flows, habitat fragmentation, past agricultural practices, and sea level rise,

The past, present, and reasonably foreseeable future actions described above would result in a mixture of long-term adverse and beneficial impacts on special status species. These impacts, when combined with the impacts of Alternative B, would result in generally beneficial cumulative impacts to special status species, due to the maintenance and improvement of habitat. The contribution of Alternative B to these impacts would be noticeable.

Section 7 Determination of Effect

It is anticipated that Alternative B, as described above, "may affect, but is not likely to adversely affect" the Stock Island tree snail, American crocodile, Florida manatee, and wood stork.

Alternative B "may affect and is likely to adversely affect" Blodgett's silverbush, pineland sandmat, Garber's spurge, Florida pineland crabgrass, Everglades bully, Florida leafwing, Bartram's hairstreak, Eastern indigo snake, Florida panther, Florida bonneted bat, Cape Sable seaside sparrow, and Everglade snail kite. Adverse effects would generally be the result of injury (or in rare cases, death) to individuals rather than long-term destruction of habitat. Some short-term disturbance of park habitats would occur, but over the long term, habitat conditions for affected species should be maintained or improved.

Conclusion

Alternative B would result in a wide range of impacts on special status species, as described for individual species in the above analysis. In general, Alternative B would have beneficial impacts on special status species, due primarily to the maintenance and improvement of special status species' habitat in the park. These beneficial impacts would be more extensive under Alternative B than under Alternative A. The benefits of Alternative B would stem in large part from the multi-year fuels plan, which would allow the park to conduct necessary large-scale burning in designated wilderness, which constitutes the majority of land in the park. The park would continue to coordinate with the U.S. Fish and Wildlife Service and state resource agencies, and would continue to minimize as much as possible impacts to individuals of special status species caused by fire management activities. However, some adverse impacts would be unavoidable. Cumulative impacts to special status species would be generally beneficial in the zone of analysis. Alternative B would contribute a noticeable amount to these impacts.

CULTURAL RESOURCES

AFFECTED ENVIRONMENT

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 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 to (1) locate, test, and provide baseline condition assessments for potential archeological sites in the East Everglades Addition; and (2) test a geographic information system 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 2002a, 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 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 2006c).

Another project (begun 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, comprising predominantly 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. 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 2002a).

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 2002a).

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 2002a). 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. Archeological data associated with historical domestic settlement are 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 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.

Historical Structures, Sites, and Districts

Historical structures are defined as constructed works, consciously created to serve some human activity. Historical 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, NPS 1998a). 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 2000a, 2009c).

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 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 2009c) 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. Physical integrity of these historical 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 salt water 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 2009c). 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 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 U.S. 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 2003c, 1998d).

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 2003c).

Nike Missile Base Site HM-69 was listed in 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 2003c). 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 2009c). 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 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).

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 (Wiss, Janney et al. 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. 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.

Several of the park employee residences at Pine Island were constructed during the Mission 66 period, and some are relatively unchanged from the time of construction. 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 flat roofs replaced with new gable roofs, which has diminished their historical integrity. 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. Formal determinations of National Register eligibility have not been completed for these buildings.

Other minor developments along the main park road are also considered potentially eligible for the National Register. A project begun 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 of these structures contain furniture and appliances and discarded debris (e.g., generators, propane tanks, auto batteries, and other trash), which 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 2004b).

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 is 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 Development 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 (Wiss, Janney et al. 2011a).

The Nike Missile Base (HM-69) has been determined to be a cultural landscape, and a cultural landscape inventory has been completed (Wiss, Janney et al. 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 Independent Traditional Seminole Nation of Florida represents nonfederally recognized tribal members. Everglades National Park managers consult with the Independent Traditional Seminole Nation of Florida 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 consults 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 Miccosukee 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 Miccosukee 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 "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 2010). 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 (CERP) and the CERP Master Recreation Plan. A literature review and oral interviews with selected members of the 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 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.

ENVIRONMENTAL CONSEQUENCES

Impact Analysis Methods

Section 106 of the National Historic Preservation Act of 1966 requires federal agencies to consider the effects of their undertakings on properties listed or eligible for listing on the National Register of Historic Places. All actions affecting the parks' cultural resources must comply with this legislation.

The National Environmental Policy Act requires analysis of the impacts of federal actions on the human environment (the natural and physical environment and its relationship with human culture); and directs that these important historical, cultural and natural aspects of our national heritage be preserved.

The physical attributes of cultural resources are, with few exceptions, nonrenewable. Once the historical fabric of a resource is gone, nothing can restore its authenticity or gain information that might have been found through analysis. NPS Director's Order #28 (NPS 1998a) provides guidance for management and protection of the cultural resources in National Park Service custody.

Impacts to cultural resources are described in terms of type, context, duration, and intensity, which is consistent with the regulations of the Council on Environmental Quality that implement the National Environmental Policy Act. Cultural resources are nonrenewable; therefore, adverse impacts to cultural resources would be long-term and extend well beyond implementation of the project.

These impact analyses are intended to comply with the requirements of both the National Environmental Policy Act and Section 106 of the National Historic Preservation Act. Accordingly, NPS is following the procedures for coordinating Section 106 with NEPA set forth in 36 CFR 800.8. In accordance with the Advisory Council on Historic Preservation's regulations implementing Section 106 of the National Historic Preservation Act (36 CFR Part 800, *Protection of Historic Properties*), effects to historic properties were identified and evaluated by (1) determining the area of potential effects; (2) identifying cultural resources present in the area of potential effects that are either listed in or eligible to be listed in the National Register of Historic Places; (3) applying the criteria of adverse effect to affected, National Register eligible or listed cultural resources; and (4) considering ways to avoid, minimize or mitigate adverse effects.

Under the Advisory Council's regulations, a determination of either *adverse effect* or *no adverse effect* must also be made for affected National Register listed or eligible cultural resources. An *adverse effect* occurs whenever an effect alters, directly or indirectly, any characteristic of a historic property that qualifies it for inclusion in the National Register, for example diminishing the integrity (or the extent to which a resource retains its historic appearance) of its location, design, setting, materials, workmanship, feeling, or association. Adverse effects also include reasonably foreseeable effects caused by the alternatives that would occur later in time, be farther removed in distance or be cumulative (36 CFR 800.5, *Assessment of Adverse Effects*). A determination of *no adverse effect* means there is an effect, but the effect would not diminish the characteristics of the cultural resource that qualify it for inclusion in the National Register.

Council on Environmental Quality regulations and the *Director's Order #12 Conservation Planning, Environmental Impact Analysis and Decision Making* also call for a discussion of mitigation, as well as an analysis of how effective the mitigation would be in reducing the intensity of a potential impact, for example reducing the intensity of an impact from major to moderate or minor. Any resultant reduction in intensity of impact due to mitigation, however, is an estimate of the effectiveness of mitigation under the National Environmental Policy Act only. It does not suggest that the level of effect as defined by Section106 is similarly reduced. Cultural resources are non-renewable resources and adverse effects generally consume, diminish, or destroy the original historic materials or form, resulting in a loss in the integrity of the resource that can never be recovered. Therefore, although

actions determined to have an adverse effect under Section 106 may be mitigated, the effect remains adverse.

A Section 106 summary is included under each impact analysis section for historic structures and archeological resources. The Section 106 summary is an assessment of the effect of the undertaking (implementation of the alternative), based on the criterion of effect and criteria of adverse effects found in the Advisory Council's regulations.

The following discussion correlates the different requirements of National Historic Preservation Act and National Environmental Policy Act to disclose potential effects on cultural resources and to achieve compliance with both laws.

The area analyzed for possible effects on cultural resources includes the entire park.

Thresholds for Archeological Resources

Threshold	Definition
Negligible	Impact is at the lowest level of detection. Impacts would be measurable but with no perceptible consequences. For purposes of Section 106, the determination of effect would be no adverse effect.
Minor	Disturbance of a site(s) results in little loss of integrity. The determination of effect for Section 106 would be no adverse effect.
Moderate	Site(s) is disturbed but not obliterated. The determination of effect for Section 106 would be adverse effect.
Major	Site(s) is obliterated. The determination of effect for Section 106 would be adverse effect.
Short-term	Impacts would last less than five years.
Long-term	Impacts would persist for five or more years.
Permanent	Impacts would last indefinitely.
Imperceptible	The incremental effect contributed by the alternative to the overall cumulative impact is such a small increment that it is impossible or extremely difficult to discern.
Noticeable	The incremental effect contributed by the alternative, while evident and observable, is still relatively small in proportion to the overall cumulative impact.
Appreciable	The incremental effect contributed by the alternative constitutes a large portion of the overall cumulative impact.

Thresholds for Historic Structures

Threshold	Definition
Negligible	Impacts would be at the lowest levels of detection – barely perceptible and measurable. For purposes of Section 106, the determination of effect would be no adverse effect.
Minor	Impacts would affect character-defining features but would not diminish the overall integrity of the building or structure. For purposes of Section 106, the determination of effect would be no adverse effect.
Moderate	Impacts would alter a character-defining feature(s), diminishing the overall integrity of the building or structure to the extent that its National Register eligibility could be jeopardized. For purposes of Section 106, the determination of effect would be adverse effect.
Major	Impacts would alter character-defining features, diminishing the integrity of the building or structure to the extent that it would no longer be eligible to be listed in the National Register. For purposes of Section 106, the determination of effect would be adverse effect.
Short-term	Impacts would last less than five years.
Long-term	Impacts would persist for five or more years.
Permanent	Impacts would last indefinitely.

Imperceptible	The incremental effect contributed by the alternative to the overall cumulative impact is such a small increment that it is impossible or extremely difficult to discern.
Noticeable	The incremental effect contributed by the alternative, while evident and observable, is still relatively small in proportion to the overall cumulative impact.
Appreciable	The incremental effect contributed by the alternative constitutes a large portion of the overall cumulative impact.

Impact Thresholds for Cultural Landscapes

Threshold	Definition
Negligible	Impacts would be at the lowest levels of detection-barely perceptible and measurable. For purposes of Section 106, the determination of effect would be no adverse effect.
Minor	Impacts would affect character-defining features or patterns but would not diminish the overall integrity of the landscape. For purposes of Section 106, the determination of effect would be no adverse effect.
Moderate	Impacts would alter character-defining features or patterns, diminishing the overall integrity of the landscape to the extent that its National Register eligibility would be jeopardized. For purposes of Section 106, the determination of effect would be adverse effect.
Major	Impacts would alter character-defining features or patterns, diminishing the overall integrity of the landscape to the extent that it would no longer be eligible to be listed in the National Register. For purposes of Section 106, the determination of effect would be adverse effect.
Short-term	Impacts would last less than five years.
Long-term	Impacts would persist for five or more years.
Permanent	Impacts would last indefinitely.
Imperceptible	The incremental effect contributed by the alternative to the overall cumulative impact is such a small increment that it is impossible or extremely difficult to discern.
Noticeable	The incremental effect contributed by the alternative, while evident and observable, is still relatively small in proportion to the overall cumulative impact.
Appreciable	The incremental effect contributed by the alternative constitutes a large portion of the overall cumulative impact.

Impact Thresholds for Ethnographic Resources

Threshold	Definition
Negligible	Impacts would be at the lowest levels of detection and barely perceptible. Impacts would neither alter resource conditions, such as traditional access or site preservation, nor alter the relationship between the resource and the associated group's body of practices and beliefs. For purposes of Section 106, the determination of effect would be no adverse effect.
Minor	Impacts would be slight but noticeable and would neither appreciably alter resource conditions, such as traditional access or site preservation, nor alter the relationship between the resource and the associated group's body of beliefs and practices. For purposes of Section 106, the determination of effect would be no adverse effect.
Moderate	Impacts would be apparent and would alter resource conditions or interfere with traditional access, site preservation, or the relationship between the resource and the associated group's beliefs and practices, even though the group's practices and beliefs would survive. For purposes of Section 106, the determination of effect would be adverse effect.
Major	Impacts would alter resource conditions. Proposed actions would block or greatly affect traditional access, site preservation, or the relationship between the resource and the associated group's body of beliefs and practices to the extent that survival of a group's beliefs and/or practices would be jeopardized. For purposes of Section 106, the determination of effect would be adverse effect.
Short-term	Impacts would last less than five years.
Long-term	Impacts would persist for five or more years.

Permanent	Impacts would last indefinitely.
Imperceptible	The incremental effect contributed by the alternative to the overall cumulative impact is such a small increment that it is impossible or extremely difficult to discern.
Noticeable	The incremental effect contributed by the alternative, while evident and observable, is still relatively small in proportion to the overall cumulative impact.
Appreciable	The incremental effect contributed by the alternative constitutes a large portion of the overall cumulative impact.

ARCHEOLOGICAL RESOURCES IMPACTS OF ALTERNATIVE A: NO ACTION / CONTINUE CURRENT MANAGEMENT

Impact Analysis

Under Alternative A, the park would continue to manage fire under current management practices operating under the most recent Federal Wildland Fire and National Park Service policies and the existing 1995 fire management plan. Current management provides a basis for protection of archeological resources in the park and identifies a range of vulnerability to fire in the park from low for features such as shell mounds to high for sites with wood or other organic matter. It also establishes procedures to protect archeological resources. These procedures include coordination with the park's cultural resource staff, personnel briefings, and coordination with the appropriate tribal groups. Resource protection measures included in the existing fire management plan serve to provide long-term, beneficial impacts to archeological resources.

Regardless of the above cultural resource protection measures in place as part of the existing plan, both planned and unplanned fire management activities have the potential to affect archeological resources. For instance, fire suppression or mechanical fuels reduction activities could include ground disturbing activities such as the use of equipment or hand tools that may mix soil strata and expose or fragment archeological resources. Such ground disturbance could result in permanent, minor adverse effects.

Many of the park's archeological resources were likely subjected to fire at some point in the past; however, these resources may nevertheless be adversely affected by extreme temperatures. Fires can damage sites by destroying or degrading building materials; or by burning down into the soil, charring bone, shell, and pottery. These impacts can, in turn, skew attempts at dating archeological resources, rendering identification and documentation more difficult.

However, the amount of damage is dependent on the severity and duration of the fire, as well as whether artifacts are on the surface of the ground or buried. More specifically, fast-moving fires typically burn through an area at a low heat with minimal damage to buried resources, while some damage would likely occur to surface resources. On the other hand, slow fires tend to burn at more extreme temperatures and can damage both surface and subsurface resources.

While intentional impacts to archeological resources would obviously be avoided to the greatest extent possible, the potential for impacts resulting from high intensity fires cannot be completely eliminated. Avoidance techniques and other typical mitigation measures can generally reduce the effects of planned events with good success, while unplanned events pose the potential for increased impacts. As such, heat damage to archeological resources under Alternative A could result in permanent, minor to moderate, adverse impacts.

In addition to the immediate impacts of fire on archeological resources, other impacts could include soil erosion and loss of vegetation, which in turn could potentially increase cases of artifact looting due to the resultant exposure. These indirect impacts would be permanent, negligible, and adverse.

Overall, continuing current management as proposed in Alternative A would result in long-term beneficial impacts and permanent, minor to moderate, adverse impacts to archeological resources.

Cumulative Impacts

The park's archeological resources are subject to a variety of disturbances, including erosion and other natural processes and forces such as hurricane winds that can overturn trees and dislodge adjacent sites; invasive exotic plants such as Brazilian pepper whose deep roots can disturb buried sites; ground-disturbing construction and rehabilitation activities; inadvertent visitor use impacts; and artifact looting. These factors could contribute to permanent, minor to moderate adverse impacts on archeological resources as sites face risks from storm damage, erosion, and possible human-caused disturbance.

Some foreseeable projects, such as the restoration of disturbed areas in the East Everglades Addition and Pine Island (including restoring natural topography and removing non-historic structures and invasive exotic vegetation) could adversely affect archeological resources because of ground disturbance. In consultation with the state historic preservation office, associated tribes, and others, archeological assessments and investigations would be completed for all proposed project areas to ensure that significant sites would be avoided or that adverse impacts would be adequately mitigated before these construction activities are undertaken. Any adverse impacts on archeological resources would be permanent and of minor to moderate intensity.

The above disturbances could have minor to moderate, permanent, adverse impacts on the integrity of archeological resources because the potential of impacted sites to yield important prehistoric or historic information could be diminished and/or irretrievably lost.

However, regional prehistory and history can be better understood as archeological information continues to be acquired from ongoing research and perhaps from data recovery investigations carried out to fulfill mitigation requirements. Information acquired from research and investigations would have long-term beneficial impacts.

Implementation of Alternative A would have long-term beneficial impacts and permanent, minor to moderate, adverse impacts on the park's archeological resources. The impacts of this alternative, in combination with the predominantly minor to moderate adverse impacts of other past, present, and reasonably foreseeable future actions, would result in a permanent, minor to moderate, adverse cumulative impact. The beneficial and adverse effects of the no action alternative would be a noticeable component of the overall adverse cumulative impacts.

Conclusions

Alternative A would have long-term, beneficial and permanent impacts, and minor to moderate, adverse impacts on archeological resources, and would be a noticeable component of the resulting overall permanent, minor to moderate, adverse cumulative impacts.

Section 106 Summary

After applying the Advisory Council on Historic Preservation's criteria of adverse effects (36 CFR Part 800.5, *Assessment of Adverse Effects*), the National Park Service concludes that implementation of Alternative A would have an *adverse effect* on the archeological resources within the project area at Everglades National Park.

HISTORIC STRUCTURES IMPACTS OF ALTERNATIVE A: NO ACTION / CONTINUE CURRENT MANAGEMENT

Impact Analysis

Under Alternative A, continuation of current management would provide a high priority for fire protection in areas containing historic structures. Resources such as the Nike Missile site historic district and the buildings located at the Flamingo visitor center and administrative area are major components of the park's infrastructure. Other resources such as the Ingraham Highway and Tamiami Trail are vital transportation corridors. As such, existing fire management goals and objectives provide for the safeguarding of these resources in the interest of public and park staff safety, as well as for protection of critical park infrastructure. Continued emphasis on protection of these and all of the park's National Register eligible or listed historical structures would result in long-term, beneficial impacts to historic structures.

For the reasons described above, any prescribed fire occurring under Alternative A would account for the presence of known historic structures, avoiding any adverse impacts. However, wildfires are unpredictable; and it is sometimes difficult or impossible to avoid impacts to historic structures when these fire types occur. Nonetheless, the risk for these fires is relatively low. Furthermore, fire suppression responses during emergency actions would likely reduce impact intensities. Wildfire could result in short- to long-term, negligible to minor, adverse effects to historic structures.

Cumulative Impacts

Historical structures and buildings in the park are often damaged by exposure to severe storms/ hurricanes and humid climatic conditions. Several of the NPS Mission 66 buildings at Flamingo (including the marina store, maintenance buildings, and lodge) were substantially damaged by recent hurricanes and were subsequently determined ineligible for the National Register because of lost or diminished historical integrity. All new construction at Flamingo, such as measures proposed by the Flamingo Commercial Services Plan to rehabilitate or replace visitor and staff facilities, would be sensitively carried out to ensure the protection and preservation of contributing Mission 66 buildings. Adverse impacts would be minor to moderate and permanent.

Other foreseeable projects, such as the placement of culverts under park roads to reestablish more natural water flow, could adversely affect historic structures. The Old Ingraham Highway and associated canals are eligible for listing in the National Register as a historic district, although the integrity of these structures was previously altered by activities such as removal or widening of some road sections and the placement of canal plugs. Constructing culverts under the Ingraham Highway would not be expected to substantially diminish the road's overall integrity because the road would continue to retain its existing configuration and character. Such construction would also contribute to the park's conservation efforts. Adverse impacts would be long-term or permanent and minor.

Impacts associated with implementation of Alternative A would have long-term beneficial and short- to long-term, negligible to minor, adverse impacts on the park's historic structures. The beneficial and adverse impacts of this alternative, in combination with the predominantly minor to moderate adverse impacts of other past, present, and reasonably foreseeable future actions, would result in a long-term or permanent, minor to moderate, adverse cumulative impact. Adverse effects of the no action alternative would be a noticeable component of the adverse cumulative impact.

Conclusions

Alternative A would have long-term, beneficial and short- to long-term, negligible to minor, adverse impacts on historic structures and would be a noticeable component of the resulting overall long-term or permanent, minor to moderate, adverse cumulative impacts.

Section 106 Summary

After applying the Advisory Council on Historic Preservation's criteria of adverse effects (36 CFR Part 800.5, *Assessment of Adverse Effects*), the National Park Service concludes that implementation of Alternative A would have *no adverse effect* on the historic structures within the project area at Everglades National Park.

CULTURAL LANDSCAPES IMPACTS OF ALTERNATIVE A: NO ACTION / CONTINUE CURRENT MANAGEMENT

Impact Analysis

The cultural landscapes within the park with potential to be affected are, for the most part, tied to those resources discussed in the historic structures analysis. The Flamingo Mission 66 Development Area, Nike Missile Base, Old Ingraham Highway, and Tamiami Trail are all resources that may be considered cultural landscapes as well as historic structures. In addition, the network of hardwood hammock tree islands detailed in the archeology sections may also be considered a cultural landscape. Therefore, effects attributed to continuation of current fire management would be the same as previously described. Alternative A would result in long-term beneficial and short- to long-term, negligible to minor, adverse impacts to cultural landscapes.

In addition to these previously detailed impacts, other effects to cultural landscapes resulting from fire management activities could include the planned or unplanned burning of vegetation. For instance, royal palms and exotic fruit trees were planted during the Civilian Conservation Corps era and could be damaged by fire. Conversely, fire could beneficially impact the Old Ingraham Highway by reducing vegetation on road shoulders, thereby restoring the historic viewshed of the time period during which the road was established. Overall, impacts to vegetation contributing to cultural landscapes could range from short- and long-term beneficial to long-term, negligible to minor, and adverse.

Cumulative Impacts

Cultural landscapes in the park are often at risk from damage by severe storms/hurricanes. Storm winds and surges can also uproot ornamental vegetation planted as part of designed landscapes (such as that planted at Flamingo during the 1950s), and they can severely erode or obliterate other elements such as trails, roads, and small-scale features. All new construction at Flamingo, including measures proposed by the Flamingo Commercial Services Plan to rehabilitate or replace visitor and staff facilities, would be sensitively carried out to ensure the protection and preservation of contributing Mission 66 cultural landscape elements. The above disturbances and proposed actions would have a minor to moderate, adverse impact on cultural landscapes.

Other foreseeable construction projects, such as the placement of culverts under park roads to reestablish more natural water flow, could adversely affect cultural landscape features associated with historic structures. The Old Ingraham Highway and its associated canals are eligible for listing in the National Register as a historic district, although the integrity of these structures was previously altered by actions such as the removal or widening of some road sections and the placement of canal

plugs. However, constructing culverts under the Ingraham Highway would not be expected to substantially diminish the overall integrity of cultural landscape features because the road would continue to retain its existing configuration and character. Also, these actions would contribute to the park's conservation efforts. Adverse impacts resulting from these projects would be long-term and minor.

The impacts from storms and other natural processes, together with the ongoing or foreseeable construction activities mentioned above, could also diminish the integrity of the Ten Thousand Islands shellworks sites. This would result from the loss or damage of character-defining features such as contributing buildings and structures, vegetation, patterns of circulation, and topography. These impacts would have a minor to moderate adverse impact.

Implementation of Alternative A would have long-term beneficial and long-term, negligible to minor adverse impacts on the park's cultural landscapes. Adverse impacts of this alternative, in combination with the predominantly long-term, minor to moderate adverse impacts of other past, present, and reasonably foreseeable future actions, would result in long-term, minor to moderate, adverse cumulative impacts. The beneficial and adverse effects of the no action alternative would be a noticeable component of the adverse cumulative impacts.

Conclusions

Alternative A would have long-term, beneficial and long-term, negligible to minor adverse impacts on cultural landscapes and would be a noticeable component of the resulting overall long-term, minor to moderate, adverse cumulative impacts.

Section 106 Summary

After applying the Advisory Council on Historic Preservation's criteria of adverse effects (36 CFR Part 800.5, *Assessment of Adverse Effects*), the National Park Service concludes that implementation of Alternative A would have *no adverse effect* on the cultural landscapes within the project area at Everglades National Park.

ETHNOGRAPHIC RESOURCES IMPACTS OF ALTERNATIVE A: NO ACTION / CONTINUE CURRENT MANAGEMENT

Impact Analysis

Although an ethnographic study was not conducted, it is known that culturally affiliated tribes assign ethnographic importance to many of the park's prehistoric and historic archeological sites. The tribes want these sites to be protected and left undisturbed. As discussed in the analysis for archeological resources, elements of current fire management are associated with both beneficial and adverse impacts to these resources.

Resource protection measures implemented under the current fire management program serve to provide long-term, beneficial impacts to archeological resources. However, ground disturbance associated with fire suppression would result in permanent, minor adverse effects. In addition, heat damage to archeological resources under Alternative A could result in permanent, minor to moderate, adverse impacts. Other more indirect impacts from fire events could include soil erosion and loss of vegetation, which in turn could potentially increase cases of artifact looting due to the resultant exposure. Such impacts would be permanent, negligible, and adverse. Overall, these impacts under Alternative A would result in long-term beneficial impacts and permanent, minor to

moderate, adverse impacts to archeological resources, and therefore to ethnographic resources as well.

Any effects to ethnographic resources attributed to the Gladesmen would generally result from any changes to the group's folk customs and independent lifeways. Because the Gladesmen have used the park for generations, it is assumed they are accustomed to adaptations during and after occurrences of both prescribed fire and wildfire. Furthermore, the park's cultural staff is aware of the locations of structures likely to hold ethnographic importance to the Gladesmen, and would conduct fire management activities that account for and protect any such structural resources. Therefore, implementation of Alternative A would result in long-term, negligible, adverse impacts to ethnographic resources associated with the Gladesmen.

Overall, Alternative A would result in long-term, beneficial and long-term, negligible to minor impacts to ethnographic resources.

Cumulative Impacts

A variety of factors can disturb the park's ethnographic resources and disrupt the cultural connections between resources and associated groups, including erosion and other natural processes and forces such as hurricane winds that can overturn trees and dislodge adjacent sites; ground-disturbing construction activities; inadvertent visitor use impacts; and site looting. These factors could contribute to adverse impacts on ethnographic resources as sites face risks from storm damage, erosion, and possible human-caused disturbances. Adverse impacts would be minor to moderate and long-term or permanent.

Foreseeable projects, such as restoration of disturbed areas in the East Everglades Addition and Pine Island (including restoring natural topography and removing non-historic structures and invasive exotic vegetation), could adversely affect ethnographic resources as a result of ground disturbance. In accordance with Section 106 procedures and consultation requirements, ethnographic assessments and investigations would be completed for all proposed project areas to ensure that ethnographic resources are avoided or that adverse impacts are adequately mitigated before construction activities. Resulting adverse impacts would be long-term and minor.

Implementation of Alternative A would have long-term beneficial and long-term or permanent, negligible to minor, adverse impacts on the park's ethnographic resources. Adverse and beneficial impacts of this alternative, in combination with the predominantly minor to moderate adverse impacts of other past, present, and reasonably foreseeable future actions, would result in a long-term or permanent, minor to moderate, adverse cumulative impact. The beneficial and adverse effects of the no action alternative would have an imperceptible offset on the overall adverse cumulative impact.

Conclusions

Alternative A would have long-term beneficial impacts, and long-term or permanent, negligible to minor, adverse impacts on ethnographic resources. These impacts would have an imperceptible offset on the overall long-term or permanent, minor to moderate, cumulative adverse impacts.

Section 106 Summary

After applying the Advisory Council on Historic Preservation's criteria of adverse effects (36 CFR Part 800.5, *Assessment of Adverse Effects*), the National Park Service concludes that implementation of Alternative A would have an *adverse effect* on the ethnographic resources within the project area at Everglades National Park.

ARCHEOLOGICAL RESOURCES IMPACTS OF ALTERNATIVE B: NATIONAL PARK SERVICE PREFERRED ALTERNATIVE

Impact Analysis

Under Alternative B, a new fire management plan would be implemented. The proposed fire management plan contains many of the same resource protection measures described in Alternative A, but would also expand on the existing plan to provide better identification and protection of archeological resources. In particular, the NPS Southeast Archeological Center has developed a predictive model for the probability of encountering currently unknown archeological sites in unsurveyed areas of the park. This model will be utilized to guide archeological pedestrian survey in advance of prescribed burns in low and moderately low archeological site probability areas, and as a means of identifying areas (via vegetation and landform type) where prescribed burning should not be undertaken without prior subsurface archeological testing and associated consultation with the Florida State Historic Preservation Office and the park's consulting Tribes. The model (*GIS Model for Archeological Site Prediction and Survey Planning at EVER*) can be referenced in Appendix B below. Alternative B and the new fire management plan also provide a framework for collaborative post-burn archeological survey that will further refine and improve the accuracy of the predictive model and potentially identify new archeological sites (and bring them under management) within the park. Overall, Alternative B includes more well defined management considerations and constraints that ensure a high degree of consideration and coordination in relation to archeological resources (see "Mitigation Measures" section of Chapter 2, above).

Alternative B also includes a greater emphasis on prescribed fire to achieve desired resources conditions within the park. Hardwood hammocks or tree islands are home to a high concentration of archeological resources. Planned ignitions would be used to reduce fuel loading adjacent to these sensitive areas, thereby providing enhanced protection from unwanted fire spread. Soil moisture levels would also be monitored and considered in the planning and implementation of planned ignition treatments to ensure conditions are within the prescription parameters to prevent fire spread into high probability cultural site, including tree islands and hammocks.

In addition, there is a greater likelihood that, under the prescriptive measures proposed in Alternative B, fires would burn under natural conditions and processes more often than under human-caused fires. Natural fire breaks up the fuels in such a way as to create a mosaic. Under natural conditions, soil hammock moistures are higher and thus fires are generally excluded from their interiors, except for in extreme drought conditions.

Alternative B also utilizes an adaptive management approach so that new information and technology can be implemented within the plan. The use of adaptive management, along with the more advanced and targeted use of prescriptive fire would result in direct, long-term beneficial impacts to archeological resources.

As discussed in the analysis of Alternative A, in spite of the management framework in place, adverse impacts to archeological resources during fire events cannot be completely eliminated. However, the more extensive resource protection and mitigation measures included in Alternative B would generally lessen or avoid the impacts of planned events with greater success in comparison to Alternative A. On the other hand, as with Alternative A, unplanned events would continue to pose the potential for impacts resulting from heat damage and ground disturbance. However, reductions in fuel loads adjacent to resources would likely reduce the frequency, duration, and intensity of wildfire. Adverse impacts to archeological resources resulting from fire events in the park would be direct, permanent, minor, and adverse.

Overall, the fire management plan proposed in Alternative B would result in long-term beneficial impacts and permanent, minor, adverse impacts to archeological resources.

Cumulative Impacts

The cumulative impacts on archeological resources would be the same as described in Alternative A. Implementation of Alternative B would have long-term beneficial and permanent, minor, adverse impacts on the park's archeological resources. Impacts of this alternative, in combination with the predominantly minor to moderate adverse impacts of other past, present, and reasonably foreseeable future actions, would result in a permanent, minor, adverse cumulative impact. The beneficial and adverse effects of the action alternative would have an imperceptible offset on the overall adverse cumulative impacts.

Conclusions

Alternative B would have both long-term, beneficial and permanent, minor, adverse impacts on archeological resources. The beneficial impacts would have an imperceptible offset on the resulting overall permanent, minor, adverse cumulative impacts.

Section 106 Summary

After applying the Advisory Council on Historic Preservation's criteria of adverse effects (36 CFR Part 800.5, *Assessment of Adverse Effects*), the National Park Service concludes that implementation of Alternative B would have *no adverse effect* on the archeological resources within the project area at Everglades National Park.

HISTORIC STRUCTURES IMPACTS OF ALTERNATIVE B: NATIONAL PARK SERVICE PREFERRED ALTERNATIVE

Impact Analysis

Impacts from the proposed fire management plan would be very similar to those described in Alternative A. Similar emphasis on and protection of the park's historic resources would occur under Alternative B, resulting in long-term, beneficial impacts. Meanwhile, risk from wildfire could result in short- to long-term, negligible to minor, adverse impacts.

However, Alternative B would include increased measures to reduce potential impacts from fire, such as a Multi-Year Fuels Treatment Plan. The plan would feature an interdisciplinary team that includes the chief of cultural resources and would be expected to reduce the risk and impacts of unwanted fire near the park's historic structures through planned ignition treatments. Measures included in the action alternative would result in additional long-term, beneficial impacts.

Cumulative Impacts

The cumulative impacts on historic structures would the same as described in Alternative A. Implementation of Alternative B would have long-term beneficial and short- to long-term, negligible to minor, adverse impacts on the park's historic structures. Beneficial and adverse impacts of this alternative, in combination with the predominantly minor to moderate adverse impacts of other past, present, and reasonably foreseeable future actions, would result in long-term or permanent, minor, adverse cumulative impacts. Beneficial and adverse effects of the action alternative would have an imperceptible offset on the overall adverse cumulative impact.

Conclusions

Alternative B would have long-term beneficial and short- to long-term, negligible to minor, adverse impacts on historic structures and would have an imperceptible offset on the resulting overall long-term or permanent, minor to moderate, adverse cumulative impacts.

Section 106 Summary

After applying the Advisory Council on Historic Preservation's criteria of adverse effects (36 CFR Part 800.5, *Assessment of Adverse Effects*), the National Park Service concludes that implementation of Alternative B would have *no adverse effect* on the historic structures within the project area at Everglades National Park.

CULTURAL LANDSCAPES IMPACTS OF ALTERNATIVE B: NATIONAL PARK SERVICE PREFERRED ALTERNATIVE

Impact Analysis

Impacts from the proposed fire management plan would be very similar to those described in Alternative A. Similar emphasis on and protection of the park's cultural landscapes would occur, but Alternative B would also include the added protection provided through implementation of the multi-year fuels treatment plan, resulting in long-term, beneficial impacts. Meanwhile, risk from wildfire could result in short- to long-term, negligible to minor, adverse impacts. Finally, the impacts to vegetation contributing to cultural landscapes could range from short- and long-term beneficial to long-term, negligible to minor, and adverse.

Cumulative Impacts

The cumulative impacts on cultural landscapes would be the same as described in Alternative A. Implementation of Alternative B would have short- and long-term beneficial and long-term, negligible to minor adverse impacts on the park's cultural landscapes. Adverse impacts of this alternative, in combination with the predominantly long-term, minor to moderate adverse impacts of other past, present, and reasonably foreseeable future actions, would result in long-term, minor, adverse cumulative impacts. Beneficial and adverse effects of Alternative B would have an imperceptible offset on the adverse cumulative impacts.

Conclusions

Alternative B would have short- and long-term, beneficial and long-term, negligible to minor, adverse impacts on cultural landscapes and would have an imperceptible offset on the resulting overall long-term, minor, adverse cumulative impacts.

Section 106 Summary

After applying the Advisory Council on Historic Preservation's criteria of adverse effects (36 CFR Part 800.5, *Assessment of Adverse Effects*), the National Park Service concludes that implementation of Alternative B would have *no adverse effect* on the cultural landscapes within the project area at Everglades National Park.

ETHNOGRAPHIC RESOURCES IMPACTS OF ALTERNATIVE B: NATIONAL PARK SERVICE PREFERRED ALTERNATIVE

Impact Analysis

As discussed in the analysis of Alternative A, an ethnographic study was not conducted. However, it is known that culturally affiliated tribes assign ethnographic importance to many of the park's prehistoric and historic archeological sites. Therefore, impacts to ethnographic resources holding significance to the culturally affiliated tribes would be very similar to those described in the archeological resources analysis.

More specifically, the increased degree and range or protection to archeological resources, greater emphasis on prescribed fire to achieve desired resources conditions, reductions in fuel loads adjacent to resources, utilization of an adaptive management approach incorporating new information and technology, and ground disturbance during unavoidable unplanned fire events would all combine to result in long-term beneficial and permanent, minor, adverse impacts to archeological resources, and therefore to ethnographic resources as well.

Impacts to ethnographic resources attributed to the Gladesmen would be the same as those described in Alternative A. Therefore, implementation of Alternative B would result in long-term, negligible, adverse impacts to ethnographic resources associated with the Gladesmen.

Cumulative Impacts

The cumulative impacts on ethnographic resources would be the same as described in Alternative A. Implementation of Alternative B would have long-term beneficial impacts, and long-term or permanent, negligible to minor, adverse impacts on the park's ethnographic resources. Adverse and beneficial impacts of this alternative, in combination with the predominantly minor to moderate adverse impacts of other past, present, and reasonably foreseeable future actions, would result in a long-term or permanent, minor, adverse cumulative impact. Beneficial and adverse effects of Alternative B would have an imperceptible offset on the overall adverse cumulative impact.

Conclusions

Alternative B would have long-term, beneficial and long-term or permanent, negligible to minor, adverse impacts on ethnographic resources. These impacts would have an imperceptible offset on the resulting overall long-term or permanent, minor, adverse cumulative impacts.

Section 106 Summary

After applying the Advisory Council on Historic Preservation's criteria of adverse effects (36 CFR Part 800.5, *Assessment of Adverse Effects*), the National Park Service concludes that implementation of Alternative B would have *no adverse effect* on the ethnographic resources within the project area at Everglades National Park.

WILDERNESS CHARACTER

AFFECTED ENVIRONMENT

The 1964 Wilderness Act defines wilderness:

> A wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean in this Act an area of undeveloped federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value.

The Wilderness Act, NPS *Management Policies 2006*, and Director's Order 41, "Wilderness Preservation and Management" provide guidance for wilderness management. Policies state that "if a compromise of wilderness resource or character is unavoidable, only those actions that preserve wilderness character and/or have localized, short-term adverse impacts would be acceptable. Wilderness should be an area where the earth and its community of life are untrammeled by humans. It should retain its primeval character and influence without permanent improvements. The purpose of wilderness in the national parks includes the preservation of wilderness character and wilderness resources in an unimpaired condition (NPS 2006a).

NPS *Management Policies 2006* also address the management of public use of wilderness and state that the National Park Service will "encourage and facilitate those uses of wilderness that require the wilderness environment and do not degrade wilderness resources and character." As stated in the Wilderness Act, these areas are for public purposes of recreational, scenic, scientific, educational, conservation, and historical uses. Visitors are encouraged to comply with the concept of minimum impact wilderness use.

No temporary roads, motor vehicles, motorized equipment or motorboats, landing of aircraft, other form of mechanical transport (including bicycles), and structures or installations are allowed on wilderness lands. Temporary exceptions for emergency situations are allowed. The Wilderness Act does allow agencies the use of certain facilities and activities essential to management of a specific wilderness, such as remote automated weather stations essential to fire management, and hydrological monitoring stations essential to natural resource management. Administrative use of motorized or mechanized equipment is allowed only if 1) such use is required for management of the wilderness and 2) the equipment is the minimum required to conduct the task.

NPS *Management Policie*s 2006 Section 4.5 Fire Management and Director's Order 18 provide direction for the implementation of fire management activities on NPS lands. NPS Director's Order 41 provides the authority to implement fire management actions in Wilderness. Section 6.7 of Director's Order 41 states that "In many NPS wilderness areas fires resulting from natural ignitions are considered a natural process that contributes to ecosystem function and are necessary to maintain wilderness in an unimpaired condition. As a result of many factors including past fire management actions within wilderness and the need to control wildfires on adjacent lands, fire may not be adequately functioning as a natural change agent. In those cases, augmenting natural ignitions with prescribed fire or other fuel treatments within wilderness may be necessary to restore or maintain ecological function. . . ."

Wilderness in Everglades National Park

Nearly 87 percent of Everglades National Park is currently designated wilderness. This wilderness area, originally named "Everglades Wilderness," was created by Congress in 1978, and comprises nearly 1.3 million acres of Everglades National Park's 1.5 million acres, the largest designated wilderness area east of the Rocky Mountains (see Figure 24: Wilderness Areas within the Fire Management Units). In 1997 the name was changed to "Marjory Stoneman Douglas Wilderness." The Marjory Stoneman Douglas Wilderness includes most of the park's undeveloped lands and inland waters, and includes submerged marine lands, which are a special case (see below).

At the same time that wilderness was originally designated within Everglades National Park, 82,000 acres in several parcels were designated "Potential Wilderness," meaning they will be converted to wilderness if or when outstanding mineral rights are acquired or nonconforming uses end. In the interim, these lands are managed as if they were wilderness, to the extent that is legal and practical to do so. Examples include the Hole-in-the-Donut area in the center of the park, which would become wilderness when restoration efforts are complete, and some parcels in the northwestern part of the park that contain nonfederal mineral rights. Existing wilderness and potential wilderness areas are managed under the Wilderness Act of 1964, NPS *Management Policies 2006*, and the *Everglades National Park Backcountry Management Plan* (1981).

The submerged marine (marine waters) portion of the Marjory Stoneman Douglas Wilderness, approximately 530,000 acres in extent, is very unusual in that it includes the marine bottom (benthic surface), but not the water column or the water surface. This distinction, which allows motorboating on the water surface, was included in the original wilderness recommendation and was carried forward in Congress's designation. Due to the underwater nature of this portion of the wilderness and the fact that fire management would not occur here, it will not be discussed in detail in this fire management plan environmental assessment.

Fire within Wilderness in Everglades National Park

Fire is a natural component of the Everglades ecosystem and contributes to the character of the wilderness while also benefiting its flora and fauna. Human-induced changes, however, such as the construction of canals and roads outside the wilderness area, as well as changes in water levels inside the park resulting in the loss of free movement of water, have also resulted in the loss of free movement of fire. Consequently, each fire requires some level of management action. In some cases fire suppression is needed to protect sensitive cultural or natural areas or to protect human safety. At other times, ignition is used to benefit vegetative communities, restoring natural habitats through prescribed burns. The 1978 wilderness designation recognized that the administrative use of airboats and helicopters was necessary to protect park resources and provide access for research in the park interior. Since then, a wide variety of mechanized equipment and motorized vehicles have been used in the fire management program, including fire suppression, ignition, monitoring, and accessing weather stations.

Wilderness Character

Wilderness character is ideally described as the unique combination of a) natural environments that are relatively free from modern human manipulation and impacts; b) opportunities for personal experiences in environments that are relatively free from the encumbrances and signs of modern society; and c) symbolic meanings of humility, restraint, and interdependence in how individuals and society view their relationship to nature (Landres et al. 2008). Based on section 2(c), "Definition of Wilderness" from the Wilderness Act of 1964, four qualities of wilderness make the idealized description of wilderness character relevant, tangible, and practical to the management and stewardship of all wildernesses, regardless of size, location, or other unique place-specific attributes

(Landres et al. 2008):

- *Untrammeled:* "an area where the earth and its community of life are untrammeled by man." This means that wilderness is essentially unhindered and free from modern human control or manipulation. Actions that intentionally manipulate or control ecological systems inside wilderness degrade the untrammeled quality of wilderness character, even though they may be taken to restore natural conditions.
- *Natural:* "protected and managed so as to preserve its natural conditions…" This means areas largely free from the effects of modern civilization. It also refers to maintenance of natural ecological relationships and processes, continued existence of native wildlife and plants in largely natural conditions, and absence of distractions (for example, large groups of people; mechanization; and evidence of human manipulation, unnatural noises, signs, and other modern artifacts).
- *Undeveloped:* "an area of undeveloped federal land retaining its primeval character and influence without permanent improvements or human habitation…" This refers to areas that are essentially without permanent structures, enhancements, or modern human occupation. To retain its primitive character, a wilderness ideally is managed without the use of motorized equipment or mechanical transport. Wilderness retains its primeval character and influence and is essentially without permanent improvement or modern human occupation.
- *Solitude or Primitive and Unconfined Recreation:* "has outstanding opportunities for solitude or a primitive and unconfined type of recreation…" Solitude means encountering few, if any, people, and experiencing privacy and isolation. Primitive and unconfined recreation refers to freedom to explore with few restrictions, and the ability to be spontaneous. It means self sufficiency without support facilities or motorized transportation, and experiencing weather, terrain, and other aspects of the natural world with minimal shelter or assistance from devices of modern civilization.

Untrammeled. Historically, the larger Everglades area was 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 2009a). Today, human intervention is required to undo or mitigate many hydrologic changes that alter the natural hydrologic regime.

Human intervention is required to control the invasive exotic plant and animal species that have taken hold in the Everglades. Also, human intervention or control is required to restore seagrass areas 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. 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.

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 research plots marked with stakes, posts, or tags. This equipment is used for research and monitoring primarily in freshwater and marine environments for a wide range of scientific and resource management purposes (including investigating water quality or monitoring threatened and endangered species, vegetation, or habitat).

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 Wilderness Waterway is open to paddlers; 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, areas adjacent to 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 (NPS 2011c). Administrative and research activities conducted with the aid of helicopters or airboats also affect opportunities for solitude within the national park. In 2009 the park recorded more than 3,000 helicopter 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.

Figure 24: Wilderness Areas within the Fire Management Units

Climate Change Effects on Wilderness Character

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.

Climate change is anticipated to affect the natural and outstanding opportunities for solitude or primitive, unconfined recreation wilderness characters of the park because of the projected increases in annual temperature, changes in precipitation patterns, and increases in severity of storms, which could impact the landscape of the park's wilderness, the survival of native flora and fauna, and visitor accessibility. However, the rate and magnitude of these changes and the impact on specific areas would vary widely based on localized features such as elevation and slope aspect, and on the competitive advantage that climate change gives to insects, diseases, and nonnative or invasive species.

Coastal ecosystems are particularly sensitive to climate change and climate variability because of their proximity to rising ocean levels. Slight changes in temperature and precipitation regimes, or in the magnitude and frequency of extreme climatic events, can substantially alter composition, abundance, and distribution of species and in turn the landscape.

ENVIRONMENTAL CONSEQUENCES

Impact Analysis Methods

As directed by Director's Order # 41, lands designated as wilderness must be managed to preserve their wilderness character and values.

The technique used to assess wilderness from management activities in this document is in accordance with NPS *Management Policies 2006* (NPS 2006a) and *Director's Order #41: Wilderness Stewardship* (NPS 2011b). The evaluation method considered the four qualities identified in the Definition of Wilderness Section 2(c) from the Wilderness Act of 1964, untrammeled, natural, undeveloped, and opportunities for solitude or primitive and unconfined recreation. These all interact to determine the degree of impact for an activity.

Steps for assessing impacts included determining the potential impacts on wilderness caused by actions under each alternative. These analyses of impacts on wilderness character are qualitative and are assessed given the degree to which implementation of the proposed fire management plan would change conditions compared to the existing.

The other plans and projects whose effects could cumulatively combine with the effects of fire management alternatives were presented in chapter 1.

It is assumed the mitigation measures described in chapter 2 of this environmental assessment would be implemented under the action alternative in accordance with the park's fire management plan. These mitigation measures are intended to minimize impacts of the action alternative on wilderness character.

The geographic area considered for the impact topic is the terrestrial portion of Everglades National Park designated or proposed as wilderness.

Minimum Requirement Analysis

Implementation of some restoration actions associated with the action alternative would require a minimum requirement analysis. Rationale for the use of helicopters, motorized equipment, and rebar plot marker installations in and over wilderness is included in the minimum requirement decision guide appendix of the proposed fire management plan for Alternative B and in the annual minimum requirement decision guides for the existing fire management plan on file with the park. Primary reasons for using motorized tools are to afford effective access, ensure safety, and manage fire effectively.

Thresholds

Threshold	Definition
Negligible	A change in the wilderness character could occur, but it would be so small that it would not be of any measurable or perceptible consequence.
Minor	A change in the wilderness character and associated values would occur, but it would be small and, if measurable, highly localized.
Moderate	A change in the wilderness character and associated values would occur. It would be measurable but localized.
Major	A noticeable change in the wilderness character and associated values would occur. It would be measureable and have a substantial or possibly permanent consequence.
Short-term	Impacts would last less than five years.
Long-term	Impacts would persist for five or more years.
Imperceptible	The incremental effect contributed by the alternative to the overall cumulative impact is such a small increment that it is impossible or extremely difficult to discern.
Noticeable	The incremental effect contributed by the alternative, while evident and observable, is still relatively small in proportion to the overall cumulative impact.
Appreciable	The incremental effect contributed by the alternative constitutes a large portion of the overall cumulative impact.

ALTERNATIVE A: NO ACTION / CONTINUE CURRENT MANAGEMENT

Impact Analysis

Mechanical and/or chemical fuel reductions are not used in wilderness under Alternative A and thus would not affect any of the characteristics associated with wilderness.

Untrammeled. Under Alternative A, prescribed fire treatments in wilderness would be planned on an annual basis for exotic vegetation management only. Under this alternative, no hazardous fuel reduction prescribed fire treatments would be conducted in designated wilderness. (See categorical exclusion 3.4 G(1) in the NPS DO-12 Handbook.) Thus, the ecological process of fire would continue to be controlled and manipulated by fire managers within each FMU. Implementation of prescribed fire, the suppression of wildfires, and the use of mechanized equipment to complete these tasks would affect the untrammeled quality of the wilderness. Impact on the untrammeled character of the wilderness would be adverse, but minor to moderate, due to the relatively limited use of prescribed fire under this alternative. Over the long-term, evidence from human manipulation of a naturally occurring process would be slight and impacts to the untrammeled wilderness character would be moderate and adverse.

In FMUs 1, 2, and 3, opportunities would exist to safely and effectively manage naturally occurring wildfire without full suppression, thereby reducing hazardous fuel levels in the park and around

values at risk. In these cases, impacts to the untrammeled quality would be long-term, negligible, and adverse due to the limited manipulation needed to manage wildfires in these FMUs.

Collectively, impacts on the untrammeled quality of wilderness would be minor to moderate and adverse over both the short and long terms.

Undeveloped. The actual implementation of fire on the ground would leave little imprint as a man-made effect since fire is a natural process for the ecosystems in question. In FMU 3 pinelands, vehicles are restricted to essential wilderness roads, elsewhere in FMU 3 and in the other FMUs, vehicles are approved for travel as described in the annual individual FMP minimum requirement decision guide. The presence of these vehicles, motorized equipment, airboats, and helicopters to manage prescribed fire in the wilderness would result in short-term, moderate, and adverse effects to the undeveloped wilderness quality; however, due to the terms of their use, these effects would only last as long as the equipment and vehicles were present in the area.

Under Alternative A, wildfire in FMUs 1, 2, 3, and 4 would be managed to protect life and property and whenever possible achieve resource benefits. The use of motorized equipment to create trails and fire breaks for these actions would result in short-term, minor to moderate adverse impacts to the undeveloped wilderness quality resulting from evidence of their use. Impacts would vary from minor to moderate because vegetation flattening depends on frequency of impact and water depth, and because the tracks from vehicles, while small, can sometimes last over a year. Impacts would be short-term because the substrate would remain intact during installation of these features and allow for vegetation regrowth. Impacts to vegetation and soils are described in depth in the "Vegetation" section. Within the Miccosukee Reserved Area and specific hammocks containing culturally important resources, some hazard fuel reduction and fire suppression actions could be taken using specialized motorized vehicles, such as bombardiers or rolligons. The use of the specialized equipment would result in short-term, moderate adverse impacts similar to those for trails and fire breaks in all FMUs, but the impacts would be longer lasting than those created with standard motorized equipment. Under Alternative A, the type of vehicle, areas in which they are used, and options for use are limited, which limits the amount of trails created and areas where the undeveloped quality is affected.

Under Alternative A, rebar would be installed for fire effects monitoring plots in all FMUs. Rebar could be considered a man-made structure; however, it would be small in diameter, difficult to detect through casual observation, and would most likely go unnoticed by most visitors. Therefore, the presence of the rebar would result in long-term, minor adverse impacts to the undeveloped wilderness quality.

Collectively, impacts on the undeveloped wilderness quality would be short-term, moderate, and adverse.

Natural. Under Alternative A, exotic vegetation prescribed fire treatments would be conducted in wilderness annually under categorical exclusion 3.4 E(2). However, prescribed fire would be used solely to control exotic vegetation, and no hazardous fuel reduction prescribed fire treatments would be conducted in designated wilderness. As a result, the amount of prescribed fire actually taking place in wilderness would be limited in any given year. Effects to the natural quality of wilderness character would be correspondingly adverse, as fire is needed in all FMUs to maintain fire-adapted vegetation communities and biological diversity.

Within all FMUs, such fire management activities as did occur would enhance the natural quality of the wilderness through the maintenance and management of natural processes of fire. Restoration and maintenance of natural communities, the use of fire management to control exotic species, and

the protection of flora, fauna, and natural habitats at risk from unwanted fire impacts would help maintain fire-adapted vegetation communities and biological diversity, resulting in long-term beneficial impacts to the natural wilderness quality.

With the approval of the park superintendent, airboats could be used for transportation of personnel and equipment and for direct and indirect fire control operations. To the extent possible, airboats would utilize existing airboat trails though exceptions would be made to complete holding lines. The limited use of airboats off existing trails could damage sawgrass and result in localized short-term, negligible to minor, adverse impacts to the natural quality of wilderness.

Noise generated from the use of aircraft and equipment in all FMUs for fire management activities would result in short-term, negligible to moderate, adverse impacts to the natural quality of wilderness.

Collectively, impacts to the natural wilderness quality could be long-term, adverse, and moderate to major, depending on the amount of prescribed fire and wildfire that occurred in the park. Adverse impacts would primarily be the result of the limited use of prescribed fire called for by this alternative. Impacts in the localized areas where burns did take place would typically be long-term and beneficial.

Outstanding opportunities for solitude or a primitive and unconfined type of recreation. Impacts to opportunities for solitude or primitive and unconfined type of recreation under Alternative A would be relatively small except on a very short-term basis. During prescribed fire operations and wildfires, visitors may be excluded from certain areas within the wilderness for safety reasons until the fire is officially declared out. These exclusions would result in short-term, negligible to moderate adverse impacts depending on the location, the fire management actions taken, and extent of the closures.

Other fire management activities, such as treatment preparation and reconnaissance may require the use of aircraft and equipment, motorized vehicles on wilderness roads, and airboats, which can be heard up to 3 miles away. The visual presence and noise produced from the crews and the use of mechanized equipment would result in short-term, negligible to moderate, adverse impacts to this wilderness quality depending on proximity, but impacts would last only as long as the equipment was present in the area. However, fire management activities are widely dispersed and as such result in less of an overall impact to this wilderness quality.

Collectively, impacts to the wilderness quality of outstanding opportunities for solitude or a primitive and unconfined type of recreation would be short-term, negligible to moderate, and adverse.

Cumulative Impacts

The area that was considered for cumulative impacts was designated, proposed, and eligible wilderness within Everglades National Park.

Past, current, and reasonably foreseeable actions impacting wilderness character include sights and sounds of human activity, air pollution, inholdings, spread of invasive and exotic species, and resource management.

The spread of invasive exotic species in the region threatens natural resources and ecosystems. Over 200 species of exotic plants and grasses occur in Everglades National Park, most occurring within wilderness. Non-native species may be inadvertently introduced to wilderness areas by visitors, boats, water currents, wind, and by other species. Controlling exotic vegetation in the wilderness under implementation of the South Florida and Caribbean Parks Exotic Management Plan would

cause short-term, minor to moderate, adverse effects on the natural and untrammeled qualities of wilderness through adversely affecting resources, such as soils, water quality, and soundscape in a manner that would be apparent to observant visitors. The more recent focused mechanical removal of exotic vegetation (primarily melaleuca, Brazilian pepper, and Australian pine) in the East Everglades area (FMU 4) allowed for a reintroduction of prescribed fire in this area. Previously, the presence of exotic species, particularly melaleuca, which has a very high reproductive potential increased by fire, had limited the use of prescribed fire in an effort to prevent additional seed dispersal (see the "Vegetation" section of chapter 3). Reintroduction of prescribed fire within FMU 4 allowed for restoration of native plant communities resulting in long-term beneficial effects to the natural wilderness quality and outstanding opportunities for solitude or a primitive and unconfined type of recreation.

Other past ecosystem restoration projects and resource management plans include the Modified Waters Deliveries Project, the Tamiami Trail Vista Clearing Project, the Comprehensive Everglades Restoration Plan, and the Hole-in-the-Donut Restoration Project. These projects are designed to restore natural conditions to the park. In the short term, the work associated with these projects would have minor to moderate, adverse impacts on the untrammeled quality of the Everglades wilderness, but in the long term, these projects would improve the natural and undeveloped qualities of the wilderness. Overall, these natural resource management projects would result in more natural conditions than currently exist and would provide a long-term, beneficial effect on the natural quality of wilderness, particularly for terrestrial wilderness.

Management of the existing network of trails and backcountry campsites in the park would be restricted to areas that were previously disturbed. Noise generated by trail crews would generate short-term, localized, and negligible to moderate impacts on the primitive quality of wilderness. The presence and visitor use of these facilities would continue to contribute localized, negligible to minor adverse effects on the untrammeled and natural qualities of a site from trash or human activity that degrades the naturalness of a locale, particularly in relation to the natural soundscape.

Opportunities for solitude fluctuate with visitor use depending on the seasons and day of the week. Intrusion on the quality of solitude for visitors in the wilderness may come from impacts on the natural soundscape from other visitors, motorized boats, or aircraft. The general intrusion of visitors into the wilderness, which can be in large numbers in some areas, would create a long-term, minor to moderate, adverse effect on wilderness character.

Collectively, the long-term effects on wilderness within the park caused by past, current, and foreseeable future actions would be short-term, minor, and adverse as well as long-term and beneficial.

Alternative A would result in short- and long-term, negligible to moderate adverse, and long-term beneficial impacts on the untrammeled, undeveloped, natural, and opportunities for solitude or primitive and unconfined recreation qualities of wilderness The cumulative impacts on wilderness would continue to be short-term, minor, and adverse and long-term beneficial. Actions associated with Alternative A would make a notceable contribution to these cumulative impacts on wilderness character within the park.

Conclusions

Under the Alternative A, fire management actions would have a variety of impacts on wilderness character. Impacts on the untrammeled quality of wilderness would be minor to moderate and adverse over both the short and long terms. Impacts on the undeveloped quality would be short-term moderate and adverse. Impacts on the natural quality could be long-term, adverse, and moderate to major, depending on the amount of prescribed fire and wildfire that occurred in the park. Impacts on the quality related to solitude or primitive and unconfined recreation would be

short-term, negligible to moderate, and adverse. Cumulative impacts on wilderness would be short-term, minor, and adverse and long-term beneficial. This alternative's contribution to these effects would be noticeable.

ALTERNATIVE B: NATIONAL PARK SERVICE PREFERRED ALTERNATIVE

Impact Analysis

The multi-year fuels treatment plan would allow for limited use of mechanical and/or chemical treatment of excess fuel loads in wilderness. Each application would be evaluated to assure the use of minimum requirements in wilderness. These tools would not be expected to be used frequently because in the absence of sensitive resources such as a development or particularly sensitive resource, prescribed fire would be the preferred method to reduce fuel loads in the parks wilderness.

Untrammeled. Under the preferred alternative, the National Park Service would use science based fire management to maintain and enhance the wilderness character of the Marjory Stoneman Douglas Wilderness.

The ecological process of fire would be controlled and manipulated by fire managers within each FMU. To a substantially greater extent than under Alternative A, the implementation of prescribed fire and the suppression of wildfires and the use of mechanized equipment to complete these tasks would affect the untrammeled quality of the wilderness. The increased use of prescribed fire and commensurate human manipulation would mean more manipulation of natural processes in the short term than under Alternative A. Over the long-term, evidence of human manipulation would be noticeable at more points in the wilderness than under Alternative A. Impacts to the untrammeled wilderness character would therefore be moderate and adverse, and both short and long term. These adverse impacts would be offset in the long-term by enhancement of the natural quality of wilderness (see below).

In other areas, opportunities would exist to safely and effectively manage naturally occurring wildfire without full suppression, thereby reducing hazardous fuel levels in the park and around values at risk. In these cases, impacts to the untrammeled quality would be long-term, negligible, and adverse due to the limited manipulation needed to manage wildfires in these areas.

Collectively, impacts on the untrammeled quality of wilderness would be moderate and adverse over both the short and long terms.

Undeveloped. As under Alternative A, the actual implementation of fire on the ground would leave little imprint as a man-made effect since fire is a natural process for the ecosystems in question. Within all FMUs, the temporary presence of mechanized equipment and helicopters for fire management activities would be similar to those described under Alternative A and would result in short-term, moderate, and adverse effects to the undeveloped wilderness quality; however, these effects would only last as long as the equipment and vehicles were present in the area.

Under the preferred alternative, wildfire in all FMUs would be managed to protect life and property and whenever possible achieve resource benefits. As described under Alternative A, the use of aircraft and motorized equipment to create trails and fire breaks would result in short-term, moderate adverse impacts; however, the frequency of fire suppression could be lessened under the preferred alternative as a result of limiting suppression of beneficial wildfires in FMU 4. Relative to Alternative A, this could result in long-term beneficial impacts.

Within FMU 4, some trails and fire breaks would be created using specialized motorized vehicles, such as bombardiers. As under Alternative A, the use of the specialized equipment would result in

longer lasting short-term, moderate adverse impacts than those created with standard motorized equipment. Under the preferred alternative, the type of vehicle, areas in which they are used, and options for use are limited, which limits the amount of trails created and areas where the undeveloped quality is affected.

As described for Alternative A, rebar would be installed for fire effects monitoring plots in all FMUs under Alternative B. Rebar could be considered a man-made structure; however, it would be small in diameter, difficult to detect through casual observation, and would most likely go unnoticed by most visitors. Therefore, the presence of the rebar would result in long-term, minor adverse impacts to the undeveloped wilderness quality.

Collectively, impacts on the undeveloped wilderness quality would be short- and long-term, minor to moderate, and adverse. Some impacts would be long-term and beneficial as compared to Alternative A.

Natural. Under Alternative B, natural ignitions would be supplemented by a program of planned prescribed burning that potentially could cover all of the park's wilderness. Unlike Alternative A, prescribed burning in wilderness would not be limited to control of exotic vegetation. Prescribed fire fuels treatments would be planned for multiple years and would occur as part of a moving 'window' of current and out-year treatments in a multi-year fuels treatment plan. This fuels treatment plan would be extended annually as part of the annual FMP review and update.

Due to the multi-year fuels treatment plan, fire management activities under Alternative B would enhance the natural quality of the wilderness to a substantially greater extent than Alternative A. Within all FMUs, the natural processes of fire would be maintained and enhanced. Restoration and maintenance of natural communities, the use of fire management to control exotic species, and the protection of flora, fauna, and natural habitats at risk from unwanted fire impacts would help maintain fire-adapted vegetation communities and biological diversity, resulting in long-term beneficial impacts to the natural wilderness quality.

Under the preferred alternative, monitoring activities and fuels management would support the implementation of fire as a natural ecological process and allow managers to use fire to enhance and maintain the natural quality of the wilderness resulting in long-term beneficial impacts.

Airboats may be used to manage prescribed fire. As described under Alternative A, to the extent possible, airboats would utilize existing airboat trails though exceptions would be made to complete holding lines. Impacts from the limited use of airboats off of existing trails would be the same as described under Alternative A and would result in localized short-term, negligible to minor, adverse impacts to the submerged undeveloped wilderness quality.

Noise generated from the use of aircraft and equipment in all FMUs for fire management activities would be the same as under Alternative A and would result in short-term, negligible to moderate, adverse impacts to the natural quality of wilderness.

Collectively, impacts to the natural wilderness quality would be long-term and beneficial. Some activities would result in impacts that were short-term, negligible to moderate, and adverse.

Outstanding opportunities for solitude or a primitive and unconfined type of recreation. Impacts to opportunities for solitude or primitive and unconfined type of recreation under the preferred alternative would be the same as under Alternative A and would be short-term, negligible to moderate adverse depending on the location, the fire management actions taken, and extent of the closures.

Other fire management activities, such as treatment preparation, fire effects monitoring, and reconnaissance may require the use of aircraft and equipment in all FMUs and the use of motorized vehicles and airboats in FMUs 2, 3, and 4. As described under Alternative A, the visual presence and noise produced from the use of mechanized equipment would result in short-term, negligible to moderate, adverse impacts to this wilderness quality depending on proximity, but impacts would last only as long as the equipment was present in the area.

Collectively, impacts to the wilderness quality of outstanding opportunities for solitude or a primitive and unconfined type of recreation would be short-term, negligible to moderate, and adverse. Impacts would be greater than under Alternative A due to a higher degree of active management.

Cumulative Impacts

Impacts from other plans, projects, and activities would be the same as described in the no action alternative with short-term minor adverse effects and long-term beneficial impacts on the wilderness character. Sources of these impacts would include various ecosystem restoration projects, implementation of vegetation and wildlife management plans, management of existing trails and campsites, and use of the park.

Alternative B would result in short- and long-term, negligible to moderate adverse, and long-term beneficial impacts on the untrammeled, undeveloped, natural, and opportunities for solitude or primitive and unconfined recreation qualities of wilderness The cumulative impacts on wilderness would continue to be short-term, minor, and adverse, and long-term beneficial. Actions associated with Alternative B would make a noticeable contribution to these cumulative impacts on wilderness character within the park.

Conclusions

Under the preferred alternative, fire management actions would have a variety of impacts on wilderness character. Impacts on the untrammeled quality of wilderness would be moderate and adverse over both the short and long terms. Impacts on the undeveloped quality would be short- and long-term, minor to moderate, and adverse. Some impacts would be long-term and beneficial as compared to Alternative A. Impacts on the natural quality would be long-term and beneficial. Some activities would result in impacts that were short-term, negligible to moderate, and adverse. Impacts on the quality related to solitude or primitive and unconfined recreation would be short-term, negligible to moderate, and adverse. Impacts would be greater than under Alternative A due to a higher degree of active management. Cumulative impacts on wilderness would continue to be short-term, minor, and adverse as well as long-term and beneficial. This alternative's contribution to these effects would be noticeable.

VISITOR USE AND EXPERIENCE

AFFECTED ENVIRONMENT

Visitation from 2001-2010 at Everglades National Park averaged roughly one million visitors per year (NPS 2011e). Peak visitation occurs during the dryer winter months when the weather is cooler, insects are fewer, and wildlife viewing opportunities are optimal. Recreational opportunities for which the park is known include wildlife viewing, walking/hiking, bicycling, horseback riding, fishing, canoeing or kayaking, boating, camping (both front country and wilderness), photography, and attending ranger or concessioner-led interpretive programs.

There is presently no public transportation to the park. Therefore, the majority of visitors arrive in private vehicles, although tours, special interest groups, and students may arrive by bus. Additionally, an unknown number of vessels enter park waters from the Florida Keys or the west coast of the state. The only in-park facility to accommodate these users is the marina located at Flamingo.

Visitor Use Statistics

Two recent visitor surveys were conducted by the Park Studies Unit at the University of Idaho in Everglades National Park during winter (February 26 – March 3) and spring (April 29 – May 5) of 2008. The following text provides excerpted survey results from the 2008 winter and spring survey (Papadogiannaki et al. 2008):

- Fifty-one percent of winter visitor groups and 55 percent of spring visitor groups consisted of two people; 29 percent of winter visitor groups and 26 percent of spring visitor groups were in groups of four or more. Sixty percent of winter visitor groups and 69 percent of spring visitor groups were family groups.
- The most commonly visited sites for winter visitor groups were Shark Valley Visitor Center (43%), Royal Palm Anhinga Trail (38%) and Flamingo (33%). For spring visitor groups the most visited places were Royal Palm Anhinga Trail (38%), Flamingo (33%) and Ernest Coe Visitor Center (37%).
- The most common self-guided activities in the park included nature viewing/bird watching (75% winter, 5% spring), walking/hiking (74% winter, 71% spring), and photography / painting / drawing (55% winter, 59% spring). The most common guided activities included tram tour (45% winter, 38% spring), boat tour (34% winter, 47% spring) and airboat tour (32% winter, 42% spring).
- The average length of stay in the park was 1.2 days for winter visitor groups and 0.6 day for spring visitor groups.
- Sixty-six percent of both winter and spring visitor groups stayed overnight away from home within Everglades National Park and/or in the surrounding area (Florida Keys, Florida City, Homestead, Miami, and Naples). The most common types of lodging used inside the park were tent camping in campground (43% winter, 38% spring) and RV/trailer camping (38% winter, 23% spring).

Visitor Use and Experience

Interpretive opportunities are concentrated around several developed areas within the park: the Coe Visitor Center, Royal Palm Visitor Center, and the Anhinga Trail; the Flamingo complex; the Gulf

Coast Visitor Center; and the Shark Valley Visitor Center and Tower. The visitor centers offer exhibits, information services provided by staff, and interpretive programming.

Self-guided interpretive trails are located adjacent to almost all developed areas in the park, as well as along the Main Park Road. The park also offers wheelchair accessible, paved ½ mile or less, interpretive trails and/or boardwalks. The Anhinga Trail (freshwater slough), along the Main Park Road, is most popular among visitors. Other trails include the Gumbo Limbo (tropical hardwood hammock), Pa-Hay-Okee Overlook (sawgrass marsh), the Pineland Trail (pine rockland), Mahogany Hammock (hardwood hammock), West Lake (mangrove forest), and Eco Pond (seasonal bird viewing).

At Shark Valley, the Bobcat Boardwalk, the Otter Cave Trail, and the Tram Trail (the 15-mile paved road) are popular. Interpretation is provided by either park staff or volunteers at most of these locations, with services available year-round at the Anhinga Trail and at Shark Valley (via the tram) and seasonally at other locales. Other terrestrial trails include the Long Pine Key Trail, Snake Bight Trail, Rowdy Bend, the Christian Point Trail, Coastal Prairie Trail, and the Guy Bradley Trail.

More adventurous visitors may choose to hike cross-country, oftentimes in water, to areas such as cypress domes or hardwood hammocks. The park offers ranger-guided trips to various off-trail areas. While most of these activities occur in the high-use season, they can occur anytime, particularly when accommodating special requests from groups. Terrestrial backcountry users may choose to hike or bicycle the Old Ingraham Highway, either as a day trip or to camp at one of two backcountry campsites. Clubhouse Beach (west of Flamingo) is also accessible by hiking at certain (dry) times of year.

Water trails are also a key resource for visitors. In the Flamingo Mission 66 District, these include Nine Mile Pond, Noble Hammock, Hells Bay, West Lake, and the Buttonwood Canal. Canoeing and kayaking are also popular in Florida Bay. Visitors may provide their own craft in these areas, rent them from the concessioner, or participate in National Park Service conducted fee-interpretation trips (peak season only). In the Everglades City area, the Turner River and Halfway Creek canoe trails begin outside the park along Highway 41 (the Tamiami Trail) and lead into the park. Turner River and Halfway Creek canoe trails are day-trip routes only, providing visitors opportunity for self-guided trips or to be part of a guided NPS trip. Visitors also may participate in day trips in the Ten Thousand Island area.

Each year, a substantial number of visitors take multi-day trips by watercraft in the park. The Wilderness Waterway, a 99-mile marked route between Everglades City and Flamingo, is a popular visitor activity. The permit system is required for all wilderness users, including hand- or motor-powered craft, staying on board their own vessel or camping. Wilderness use permits serves as a campsite reservation system for users, and may be obtained at the Flamingo or Gulf Coast Visitor Centers, or at the Main Entrance Station.

Everglades National Park offers one of the oldest curriculum-based education programs in the National Park Service. Each year, approximately 15,000 students, teachers and chaperones come to the park for a ranger-led experience. While the majority of these students engage in day-visits at either Royal Palm or Shark Valley (over 250 separate classes), about 3,000 students participate in a two-night, three day experience in the park at the Loop Road Environmental Education Center (located in Big Cypress National Preserve) and at the Hidden Lake Environmental Education Center (located near the entrance to the Old Ingraham Highway and Research Road).

Figure 25: College Students learn about fire ecology and its role in the Everglades Ecosystem

Climate Change Effects on Visitor Use and Experience

Climate change may 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 fire frequency, seasonal migration and access for dispersed recreation. 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. Climate change might also affect the vegetation and wildlife resources that draw many visitors to the park. 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.

ENVIRONMENTAL CONSEQUENCES

Impact Analysis Methods

Impacts on visitor use and experience were evaluated using the process described in "Methods for Analyzing Impacts." Impact threshold definitions are as follows. The area analyzed for possible effects on visitor use and experience includes the entire park.

The major assumptions used in the analysis of effects on visitor use and experience are: (1) natural ignitions primarily occur during the summer months (May through August), and prescribed fire can occur throughout the year; (2) fires may occur during the visitor season; (3) over the past 50 years there was a 0 to 1 percent chance of natural ignition from November to March; (4) peak visitation at Everglades National Park occurs during the dry winter months, between December and April; and (5) mitigation measures described in the park's Fire Management Plan would be implemented under Alternative B therefore limiting potential impacts to visitor use and experience.

Thresholds

Threshold	Definition
Negligible	Visitors would likely be unaware of any effects associated with implementation of the alternative. There would be no noticeable change in visitor use and experience or in any defined indicator of visitor satisfaction or behavior.
Minor:	Changes in visitor use and/or experience would be slight but detectable, but would not appreciably diminish or enhance the desired visitor experience. Visitor satisfaction would remain stable.
Moderate:	Few characteristics of the desired visitor experience would change and/or the number of participants engaging in an activity would be altered. Visitors would be aware of the effects associated with implementation of the alternative and would likely express an opinion about the changes. Visitor satisfaction would begin to change as a direct result of the effect.
Major:	Multiple characteristics of the desired visitor experience would change and/or the number of participants engaging in an activity would be greatly reduced or increased. Visitors would be aware of the effects associated with implementation of the alternative and would likely express strong opinions about the change. Visitor satisfaction would markedly change.
Short-term:	Occurs only during the management action.
Long-term:	Occurs after the management action.
Imperceptible	The incremental effect contributed by the alternative to the overall cumulative impact is such a small increment that it is impossible or extremely difficult to discern.
Noticeable	The incremental effect contributed by the alternative, while evident and observable, is still relatively small in proportion to the overall cumulative impact.
Appreciable	The incremental effect contributed by the alternative constitutes a large portion of the overall cumulative impact.

ALTERNATIVE A: NO ACTION / CONTINUE CURRENT MANAGEMENT

Impact Analysis

Visitor Use. Temporary disruption of access and use in certain area, including roads, visitor facilities or other park areas (campgrounds, visitors centers, interpretative trails, wilderness waterway backcountry campsites, East Everglades camps) would result in short-term negligible to moderate adverse effects to visitor use in the park. Temporary road closures that disrupt traffic to the park may also impact visitor use. Adverse effects due to road closures are primarily on the Main Park Road, with one reported incident in 14 years where visitors where delayed and missed a flight. Implementation of Alternative A would potentially have short-term negligible to moderate adverse effects on visitation to the park due to temporary road closures and disruption of access.

Potential closures of visitor use areas (including but not limited to: Park Headquarters/ Pine Island/ Long Pine Key Campground, Royal Palm, Main Park Road to Flamingo, Flamingo/ Whitewater Bay/ Cable Sable/ Adjacent Florida Bay, Gulf Coast/ Everglades City – day use paddling area, concession tour routes, Sandfly Island, Florida Bay, Main Park Road boardwalks, East Everglades Camps – Hidden Lake and Loop Road, Commercial Airboats in East Everglades, Wilderness waterway, other backcountry sites, Chekika, and Long Pine Key Trails) as a result of fire management activities would depend on the area impacted, time of year, and duration of impact. However, these would generally result in short-term, negligible to moderate, adverse effects. These impacts would also apply to park trails. Since 1990 the park has temporarily closed portions of the Anhinga Trail three times. Closures occurred for no more than one hour and are a rare event (over the past 15 years). In the past six years, Shark Valley was burned twice without interfering with tram tours and public use. Prescribed fire and wildfires may occur during the visitor season, including some winter burns.

Overall, impacts to visitor use as a result of management actions under Alternative A would be short-term, negligible to moderate, and adverse.

Visitor Experience. Possible impacts to visitor experience during or following a fire event include reduced visibility (scenic vistas, wildlife viewing, alteration of wildlife patterns, night sky), adverse health and safety effects (comfort, smoke exposure), closures (described above), noise intrusions (aircraft), increased interpretative opportunities (fire management observation, pre- and post- burn areas), and potential loss of interpretative media such as signs, boardwalks, and infrastructure.

Impacts of fire management activities within the park on visitor experience would be highly localized and dependent on individual perceptions of fire in the park. Impacts to visitor experience would be primarily associated with developed areas and other high visitor use trails; however, these areas would be protected from fire management activities or cleared prior to management actions. Smoke may obstruct viewsheds and impact visibility causing short-term, moderate and adverse effects. Impacts to the park's natural soundscape are expected as mechanized equipment and firefighters manage fire within the park resulting in short-term, negligible to minor adverse effects. Sensitive groups (those with respiratory illnesses or asthma) may experience irritation from smoke, causing short-term, negligible to moderate adverse effects; however, these would be highly variable based on individual condition. Visitor use areas near and within fire management activities would be cleared prior to management actions as needed to reduce impacts to visitor experiences. Interpretive opportunities would also provide beneficial effects as fire management activities would provide opportunities to educate visitors about the park's fire-adapted ecosystem and resource management goals, providing short- and long-term beneficial effects. Conversely, short-term, minor to moderate adverse effects may occur as interpretive programming is cancelled or relocated as a result of fire management activities.

Overall, impacts to visitor experience as a result of management actions under Alternative A would have short-term, negligible to moderate adverse impacts as well as short- and long- term beneficial effects.

Cumulative Impacts

Other past, present, and reasonably foreseeable actions or plans that may affect visitor use and experience in the park would include population growth, transportation projects, Everglades restoration, and other regional planning efforts (see the "Relationship to Other Plans and Policies" section in chapter 1for more information on these actions).

Continued population growth and development in the Treasure Coast and South Florida area may potentially increase the amount of local visitors to the park. Increased visitation during fire events may cause both long-term beneficial effects as visitors are given the opportunity to learn about the parks fire-adapted ecosystem and its importance in resource management, as well as short-term minor to moderate adverse effects associated with closure of areas within the park or disruption in transportation networks in and around the park; however, these events would be rare and temporary in nature.

Resource management and habitat restoration effort, including the Comprehensive Everglades Restoration Plan, The Modified Water Deliveries Project, and other hydrologic restoration projects would continue to provide long-term beneficial effects to visitor use and experience (see the "Relationship to Other Plans and Policies" section in chapter 1). Through habitat and hydrologic restoration, visitors would have the opportunity to experience the greater Everglades ecosystem in its more natural state that includes active fire management.

Plans for improving the Flamingo area, would provide improved visitor services in this area of the park potentially increasing the amount of visitors and traffic to this area. However, this area is and would continue to be protected during fire management activities, providing both long-term beneficial effects from protection and enhancement and short-term negligible to moderate adverse effects as potential disruption in traffic and other visitor services at Flamingo may occur as a result of fire management.

Resurfacing and other improvements to the Main Park Road from the main entrance to Flamingo would provide visitors with better access, safety, and viewing opportunities. These improvements would improve shoulders and add turning lanes providing improved traffic safety if firefighting equipment is present on the Main Park Road. Resurfacing the physical road structure would reduce potential impacts as heavy equipment is used for fire management activities. Park road improvements would have long-term beneficial effects on visitor use and experience.

Regional park planning efforts, greenways, and paddling trails in the greater Everglades natural area would provide the public with the opportunity to explore and learn about the Everglades ecosystem and the importance of fire ecology resulting in long-term beneficial effects. Greenways and park systems directly connected to the Everglades ecosystem may experience short-term, negligible to moderate adverse effects as a result of smoke from fire management activities.

When the short-term negligible to moderate adverse and long-term beneficial effects of other past, on-going, and future plans, projects, and activities affecting visitor use and experience are combined with the short-term negligible to moderate adverse and long- and short-term beneficial effects under Alternative A, collectively, the resulting cumulative effects would be considered short-term, negligible to moderate, and adverse as well as long-term and beneficial. Beneficial and adverse effects of Alternative A would contribute an imperceptible amount to the overall beneficial and adverse cumulative impacts.

Conclusions

Overall, continuation of current management under Alternative A would have short-term, negligible to minor adverse, and long- and short-term beneficial effects on visitor use and experience. When the effects of other past, on-going, and future plans, projects, and activities affecting visitor use and experience are combined with the effects under Alternative A, the resulting cumulative effects would be considered short-term, negligible to moderate, and adverse as well as long-term and beneficial. Beneficial and adverse effects of Alternative A would contribute an imperceptible amount to the overall beneficial and adverse cumulative impacts.

ALTERNATIVE B: NATIONAL PARK SERVICE PREFERRED ALTERNATIVE

Impact Analysis

Visitor Use. Effects on visitor use under Alternative B would be similar to those described under Alternative A, with only incrementally greater adverse effects from Alternative B as a result of increased used of prescribed burning.

Wildfire would be managed for resource benefits, thereby creating the potential for short-term, negligible to moderate adverse effects on access to campgrounds, camps, and other visitor facilities. Additionally, fire management in FMU 4 would also create the potential for short-term, negligible to moderate adverse effects on access to Chekika and air boat tours based in this FMU. Active management of fire throughout the park to reduce hazardous fuels and achieve resource management goals would provide long-term beneficial effects on visitor use.

Overall, impacts on visitor use as a result of management actions under Alternative B would have short-term, negligible to moderate adverse impacts as well as long- term beneficial effects.

Visitor Experience. The impacts of fire management activities within the park on visitor experience would be highly localized and dependent on individual perceptions of fire in the park. Impacts to visitor experience under management actions proposed in Alternative B would be similar to those effects described under Alternative A. However, impacts to visitors' experience may be incrementally greater under Alternative B with fire management changes (greater use of prescribed fire). The National Park Service would coordinate with concessioners to limit impacts on operations and visitor experiences. Control of exotics and habitat restoration as a result of fire management activities would provide visitors an opportunity to experience a more natural Everglades environment, providing long-term beneficial effects.

Similar to Alternative A, Alternative B would provide for management of wildfire and prescribed fire to achieve resource management goals and therefore reduce need for suppression activities. Suppression activities include the use of tools, equipment, and people, and therefore less suppression activity would diminish amount of noise and overall disturbance to the visitor experience in the park. Limitation of suppression activities under Alternative B would have short- and long-term beneficial effects.

Overall, impacts to visitor experience as a result of management actions under Alternative B would be short-term, negligible to moderate, and adverse, with short- and long-term beneficial effects.

Cumulative Impacts

Impacts associated with other past, present and reasonably foreseeable actions are similar to those described under Alternative A, namely, short-term, negligible to moderate adverse impacts and long-term beneficial effects. When the effects of other past, on-going, and future plans, projects, and activities affecting visitor use and experience are combined with the short-term, negligible to moderate adverse impacts and long- and short-term beneficial effects of Alternative B, collectively, the resulting cumulative effects would be considered short-term, negligible to moderate, and adverse as well as short- and long-term and beneficial. The beneficial effects of Alternative B would contribute an imperceptible amount to the overall cumulative impacts.

Conclusions

Overall, Alternative B would have short-term, negligible to minor adverse impacts, and short- and long-term beneficial effects on visitor use and experience. When the effects of other past, on-going, and future plans, projects, and activities affecting visitor use and experience are combined with the effects of Alternative B, the resulting cumulative effects would be considered short-term, negligible to moderate, and adverse as well as short- and long-term and beneficial. The beneficial effects of Alternative B would contribute an imperceptible amount to the overall cumulative impacts.

LAND USE

AFFECTED ENVIRONMENT

Land Use

Everglades National Park is adjacent to a major urban population area in metropolitan Miami. Approximately 3.9 million people, within three different counties, live within 25 miles of the parks northern and eastern boundaries. Communities adjacent to the national park are called gateway communities and include Florida City, Homestead, Key Largo, Everglades City, Chokoloskee, Naples, and greater Miami.

Everglades National Park shares administrative boundaries along its northern and eastern boarders with the Miccosukee Tribe of Indians, Big Cypress National Preserve, Florida Fish and Wildlife Conservation Commission, the South Florida Water Management District, and adjacent private lands. Big Cypress National Preserve is managed by the National Park Service using the same policies and guidelines as Everglades National Park. Fire management activities on the South Florida Water Management District property are managed by the state Forest Service and Miami-Dade County Fire Rescue. Everglades National Park coordinates fire management activities with these agencies in accordance with a memorandum of understanding between the National Park Service, the Florida Forest Service, and the U.S. Fish and Wildlife Service.

Along the park's eastern boundary, adjacent to FMU 4, is an area characterized by scattered private residences, ranches, agricultural lands, and state government operated water management structures. A small community known as the 8.5 Square Mile Area is immediately adjacent to the park's eastern boundary. Homestead General Aviation Airport, Tamiami Executive Airport and the Southern Glades Youth Camp (a detention facility) managed by Miami-Dade County are also in proximity to the park's eastern boundary. Two correctional facilities, the Everglades Correctional Institution and the Krome Detention Center, are also located along the eastern park boundary adjacent to FMU 4.

Wildland urban interface refers to areas where wildfire may threaten homes, communities and other development areas. The wildland urban interface zone is defined as any area that can be impacted by a wildfire within an 8-hour period, one operational period, from the park boundary. The following wildland urban interface values within and adjacent to the park were identified by NPS staff for the following FMUs:

- FMU 2 - Miccosukee Reserved Area, Shark Valley tram tour concessions and visitor center, airboat tour and restaurant businesses, U.S. Highway 41, park campsites, and Loop Road Environmental Education Center.
- FMU 3 - Pine Island housing and administrative complex, park headquarters, Beard and Robertson buildings, Coe and Royal Palm Visitor Center, Anhinga Trail boardwalk, Hidden Lake Environmental Education Center, Boy Scout in-holding, Long Pine Key campground, Coe campground, Main Park Road, Entrance station, Anhinga Highway, and U.S. Highway 1.
- FMU 4 - 8.5 Square Mile Area residential and agricultural community, Chekika Visitor Use Area and associated infrastructure, nurseries and other businesses, airboat association, U.S. Highway 41, Krome Avenue, former hunt camps, private and commercial establishments, radio towers, and the Osceola Indian Camp.

Figure 26: National Park Service Response to a Lightning-Ignited Fire Within a Wildland Urban Interface Near the Northern Boundary of the Park

The Miccosukee Reserved Area, the 8.5-Square Mile Area, and the Pine Island and park headquarters complex are identified as wildland urban interface communities at risk due to the location of the communities in the vicinity of federal lands at high risk from wildfire (GPO 2001). Other park infrastructures potentially at risk from wildfire are located in Long Pine Key, Flamingo, East Everglades, and Shark Valley.

Within the park boundaries, the Miccosukee Reserved Area occupies 697 acres along the northern boundary of FMU 2. Everglades National Park coordinates fire management operations with the Miccosukee Tribe of Indians to prevent the spread of unwanted fire into their lands and communities. The Miccosukee Tribe of Indians operates a popular gaming resort near the park's northeast corner, outside of the Miccosukee Reserved Area.

Everglades National Park has a number of private in-holdings located in established FMUs 1, 3, and 4. Within FMU 1, there is one private in-holding that is a small camp known as Nauti Buoy. Within FMU 3, the Boy Scouts of America own 230 acres of pineland habitat. Fire management for this land is directed by the park in coordination with local contacts for Boy Scouts of America. FMU 4 is closest to the Miami area and contains commercial airboat businesses, the Osceola Indian encampment (located on the northern boundary of the park immediately south of the Tamiami Trail/U.S. Highway 41), and Florida Power and Light property. An environmental assessment regarding the acquisition of the Florida Power and Light property in the East Everglades Addition is currently under review. When completed, the environmental assessment will decide whether to carry out a land exchange or to acquire the Florida Power and Light land.

Transportation

The majority of park visitors arrive by motor vehicle along the road network that services the park and south Florida communities. A small number of visitors enter the park via alternative

transportation (buses, bicycles, and hiking) and a limited number access the park via the marine waters (Florida Bay from the Keys, and the Ten Thousand Islands from the Gulf of Mexico offshore from southwest Florida) without using park or regional road networks. The park is a national and international destination, with visitors arriving from nearby airports, including Miami, Fort Lauderdale, and Palm Beach International Airports on the east coast, and Naples and Fort Meyers Airports on the west coast. Numerous car rental facilities in the area provide transportation needs for people arriving by plane.

Peak visitation to Everglades National Park occurs between December and April and accounts for approximately 30,000 to 40,000 vehicles per month. During these months, visitation is often three to seven times greater than between May and November (6,000 to 10,000 vehicles per month). In addition to visitor traffic, park employees, concessionaires, deliveries, researchers, and park partners also access the park throughout the year. These visits range from 20 trips per day in some park districts such as Key Largo to up to 50 or more trips per day at Shark Valley, Gulf Coast, and Pine Island. Park headquarters administrative building and the Dan Beard Center and Robertson Building serve as an administrative area for resource managers and fire management. These facilities are occupied by more than 100 employees, and on weekdays there are often 200 or more trips per day.

Regional Road Network. The park's surrounding roadways are maintained by various agencies, including the Florida Department of Transportation Districts 1 and 6, Miami-Dade County Public Works, Collier County Public Works, and Monroe County Public Works. The majority of the roadways providing primary access to the park, including Tamiami Trail/U.S. Highway 41 (State Road 90), U.S. Highway 1 (State Road 5), and Krome Avenue (State Road 997) are managed by the state highway system and are maintained and improved by the Florida Department of Transportation. Primary access to the park is along State Road 9336 in Homestead/Florida City. Each of the park's three surrounding counties is responsible for the maintenance of various local roads not maintained by the state, such as County Road 29 in Collier County, which provides access to Everglades City and the Gulf Coast Visitor Center. All roadways within or adjacent to Everglades National Park are two-lane undivided highways. Florida's Turnpike and U.S. Highway 41 Tamiami Trail (between the Turnpike and Krome Avenue) are important access routes consisting of four- to six-lane, divided, limited access highways.

Intersection improvements at the U.S. Highway 41 and Krome Avenue intersection and road-widening project along Tamiami Trail between the Turnpike and Krome Avenue were recently completed. No additional major capacity improvements are programmed or identified in the Florida Department of Transportation Needs Plan for this section of U.S. Highway 41. U.S. Highway 1/State Road 5 between mile markers 126 and 106 is scheduled for reconstruction and safety improvements, due to its high accident rate. Krome Avenue/State Road 997 was also scheduled for safety improvements.

Park Roads. Due to the large area of designated wilderness, there is a limited road network within the park and along its boundary. The Main Park Road, a 38-mile two-lane road connecting the Ernest F. Coe Visitor Center with Flamingo, is the primary road and the largest developed area in the park. There are a number of short roads (less than one mile to several miles in length) that spur off the Main Park Road and service administrative and/or visitor use areas in the park.

The park's road and parking network is deficient in a number of ways due to their age and the harsh weather conditions within south Florida. Road shoulders are limited to non-existent along many park roads, particularly along Tamiami Trail and the Main Park Road. Pavement conditions within the park are deteriorating from asphalt separation and swelling due to poor drainage. Parking demand is often exceeded during peak winter and spring visitation at Shark Valley, as well as employee parking at park headquarters. Congestion also occurs during peak season at the Flamingo

campground exit, Ernest F. Coe Visitor Center, and the entrance to Shark Valley. Traffic congestion is experienced in Everglades City on the way to the Gulf Coast Visitor Center during community events and occasionally during peak season.

Climate Change Effects on Land Use

Projected sea level rise, as a result of climate change, may cause substantial changes to land uses inside and outside the park as low lying areas become inundated or as tidal areas are extended farther inland. In addition, projected increases in the frequency and intensity of storms may cause a greater potential for lightning-caused wildfires and physical damage to park and neighboring structures. Due to the uncertainty and variability of outcomes associated with climate change and the limited five-year planning horizon of this environmental assessment, specific effects to land use in the park cannot be determined at this time.

ENVIRONMENTAL CONSEQUENCES

Impact Analysis Methods

Impacts on land use were evaluated using the process described in "Methods for Analyzing Impacts." For the purpose of this environmental assessment, impacts on land use are defined as those potentially affecting neighboring communities (including both public and private property), inholdings, and the transportation network inside and directly adjacent to park lands. Impact threshold definitions are as follows.

The area analyzed for possible effects on land use and includes the entire park, inholdings and tribal lands, and its neighboring communities (including Florida City, Homestead, Key Largo, Everglades City, Chokoloskee, Naples, and greater Miami).

The major assumptions used in the analysis of effects on land use are: (1) under Alternative A, the existing fire management direction within the park would be extended into the future; (2) fire management has specific mitigation measures in place to prevent to the degree practicable impacts to wildland urban interface values, and these mitigation measures are defined in the park's Fire Management Plan; (3) firefighter and public safety is the first priority of all fire management activities; (4) fire is a natural component of the Everglades ecosystem – fire management actions taken by the National Park Service support resource management efforts and protection of developed areas inside and outside the park through hazardous fuel reduction providing long-term beneficial effects; (5) smoke from fire management activities is also addressed under air quality; and (6) the National Park Service would continue to provide opportunities for education and outreach regarding fire management and the natural role of fire in the Everglades under both alternatives discussed in this environmental assessment.

Thresholds

Threshold	Definition
Negligible	Park neighbors would not be affected, or effects would be below or at the level of detection. Park neighbors would not likely be aware of the effects associated with the alternative.
Minor:	Effects to park neighbors would be detectable, although the changes would be slight. Park neighbors could be aware of the effects associated with the alternative, but only slightly.
Moderate:	Effects to park neighbors would be readily apparent. Park neighbors would be aware of the effects associated with the alternative ad would likely be able to express an opinion about the impacts of the alternative on their property or lifestyle.
Major:	Effects to park neighbors would be readily apparent and would have important consequences. Park Neighbors would be aware of the effects associated with the alternative and would likely express a strong opinion about the impacts of the alternative on their property or lifestyle.
Short-term:	Occurs only during the management action
Long-term:	Occurs after the management action.
Imperceptible	The incremental effect contributed by the alternative to the overall cumulative impact is such a small increment that it is impossible or extremely difficult to discern.
Noticeable	The incremental effect contributed by the alternative, while evident and observable, is still relatively small in proportion to the overall cumulative impact.
Appreciable	The incremental effect contributed by the alternative constitutes a large portion of the overall cumulative impact.

ALTERNATIVE A: NO ACTION / CONTINUE CURRENT MANAGEMENT

Impact Analysis

Land Use. Under Alternative A, existing fire management activities would continue to occur in the park, although some elements would be discontinued with the expiration of the categorical exclusions in 2015. Effects of fire management would continue to occur from localized areas within the park to park neighbors in greater south Florida (communities such as Florida City and Miami), and would primarily be associated with smoke.

Adjacent park properties include structures and landscaping, cell towers, a variety of plant and animal habitats, picnic tables and picnic shelters, fishing and hunting camps, and equipment. In the history of the fire management program there has been no loss of neighboring structures or equipment. Evacuations occurred in the past in response to wildfire threat; however, these incidents are rare and not the result of NPS fire management activity. In addition, fuel reduction efforts to restore habitats in the park have reduced hazardous fuels in the vicinity of neighboring properties, providing long-term beneficial effects.

The Boy Scouts of America use a private camp (Camp Everglades) located within the pinelands of FMU 3 in winter. Wildfires are not likely in the pinelands during winter; however, smoke from surrounding block fire management activities may potentially impact camp users. In the last four years, park fire managers have not received any complaints about smoke from park neighbors.

Everglades National Park performs hazardous fuel reduction, suppression, and conducts prescribed fire, for the benefit of inholders and the Miccosukee Reserve Area. Park fire management efforts reduce threats associated with fire, including structural damage. Implementation of Alternative A would provide long-term beneficial effects to park inholders and the Miccosukee Reserve area

through continued fire management. Fire management staff and equipment presence during these management actions may cause temporary disruption in use of inholdings or areas within the Miccosukee Reserve Area, causing short-term, minor adverse effects.

Implementation of Alternative A would continue to cause short-term, negligible to minor adverse, and long-term beneficial effects on land use in and near Everglades National Park.

Transportation. Smoke related impacts to park, local, and regional roads from fire management activities may continue to occur under Alternative A. Implementation of Alternative A may potentially have short-term, negligible to minor adverse effects on safe driving conditions along U.S. Highway 41 (Tamiami Trail), U.S. Highway 1 ("18-mile stretch"), State Road 9336 (outside the main park entrance), Krome Avenue (S.W. 177 Avenue), and Richmond Drive to Chekika. There would be no effect on State Road 29 or the Florida Turnpike from smoke associated with park fire events due to their distance from the park.

Temporary closure (up to 2 hours) of roads directly bordering or leading into the park as a result of smoke and visibility concerns may continue to occur. However, smoke related impacts would generally be localized and of short duration during park fire management activities. Implementation of Alternative A would potentially have short-term, negligible adverse impacts associated with visibility and road closures.

Fire events may also potentially disrupt flight operations at Homestead General Airport and Tamiami Airport due to visibility concerns associated with smoke. Implementation of Alternative A may have short-term, negligible adverse impacts on flight operations.

Fire management efforts provide long-term beneficial effects to transportation both within the park and to the nearby regional transportation network by controlling hazardous fuels and therefore limiting more intense and potentially destructive wildfires.

Implementation of Alternative A would continue to have short-term, negligible to minor adverse impacts as well as long-term beneficial effects on transportation in and around Everglades National Park.

Cumulative Impacts

Other past, present, and reasonably foreseeable actions or plans that may affect land use and transportation in and around the park would include past land uses and agriculture practices, population growth, transportation projects, utilities projects, and other regional planning efforts (see the "Relationship to Other Plans and Policies" section in chapter 1 for more information on these actions).

Continued population growth and development in the Treasure Coast and south Florida area may potentially encroach on more wildland urban interface areas of the park, causing both beneficial and adverse effects. Increased populations within close proximity to the park may experience short-term, negligible to minor adverse effects resulting from smoke from fire management activities. Fire management actions in turn provide long-term beneficial effects as hazardous fuels are controlled to protect life and property.

An environmental impact statement regarding the acquisition of the Florida Power and Light property in the East Everglades Addition is currently under review. The environmental impact statement will decide whether or not to carry out the land exchange or to acquire the Florida Power and Light land, and depending on the alternative selected, impacts on land use could range from beneficial to adverse.

Continued coordination with local and regional communities and planning agencies would provide beneficial effects to areas near the park boundaries within urban wildland interface areas. In addition, regional park planning efforts and greenways in the greater Everglades natural area would provide the public with the opportunity to explore and learn about the Everglades ecosystem and the importance of fire ecology resulting in long-term beneficial effects. Greenways and park systems directly connected to the Everglades ecosystem may experience short-term, negligible to minor adverse effects as a result of smoke from fire management activities.

Improvements to park roads would reduce impacts to the physical road structure as firefighting equipment accesses areas of park resulting in long-term beneficial effects.

When the short-term, negligible to minor adverse impacts and long-term beneficial effects of other past, on-going, and future plans, projects, and activities affecting land use and transportation are combined with the effects of Alternative A, collectively, the resulting cumulative effects would be considered short-term, negligible to minor and adverse, as well as long-term and beneficial. The beneficial and adverse effects of Alternative A would contribute an imperceptible amount to the overall beneficial and adverse cumulative impacts.

Conclusions

Overall, continuation of current management under Alternative A would have short-term, negligible to minor adverse impacts and long-term beneficial effects on land use and transportation. When the effects of other past, on-going, and future plans, projects, and activities affecting land use and transportation are combined with the short-term effects of Alternative A, the resulting cumulative effects would be considered short-term, negligible to minor and adverse, as well as long-term and beneficial. The beneficial and adverse effects of Alternative A would contribute an imperceptible amount to the overall beneficial and adverse cumulative impacts.

ALTERNATIVE B: NATIONAL PARK SERVICE PREFERRED ALTERNATIVE

Impact Analysis

Land Use. Implementation of Alternative B would have similar impacts on operational support for other agencies, fire activities to benefit inholders and the Miccosukee Reserved Area, local businesses, and park neighbors' properties, and transportation as described under Alternative A. However, the greatest potential for impacts to land uses and park neighbors occurs near the East Everglades addition (FMU 4) as prescribed fire and wildfire are used to achieve resource management goals. Fire management in FMU 4 may potentially impact areas not previously exposed to fire or smoke, especially those areas near the park's eastern boundary of FMU 4. Developed areas along the eastern boundary of the park may experience short-term negligible to moderate adverse effects from smoke and other fire management related operations. As a result of fire management activities in FMU 3 and 4, the reduction of hazardous fuels would provide long-term beneficial effects to neighboring communities and transportation routes near the park.

With more opportunity for more wildland fire, particularly prescribed fire, under Alternative B, there would be an increase in the potential for smoke to affect park neighbors. However, this increase would only be incrementally greater and not vary substantially from the effects described for Alternative A. Thus the impacts on land use and park neighbors from fire management would be short-term, negligible to minor, and adverse as well as long-term and beneficial.

Under Alternative B, non-fire treatments could occur where the use of planned ignitions would not be feasible. Non-fire treatments buffers would provide smoke and fire breaks near developed areas

creating long-term beneficial effects. Under Alternative B the park would also monitor urban expansion to identify communities at risk and coordinate fire management activities.

Implementation of Alternative B would continue to have short-term, negligible to minor adverse impacts as well as long-term beneficial effects on land use near Everglades National Park.

Transportation. Implementation of Alternative B would have similar effects on safe driving conditions, temporary road closures, traffic disruption, and flight operations as described in Alternative A. However, under Alternative B, there could be an incremental increase in the adverse effects to transportation compared to those described for Alternative A, although the effects would still be categorized as short-term, negligible to minor, and adverse, as well as long-term and beneficial. Non-fire treatments buffers, if used, would provide smoke and fire breaks near developed areas creating long-term beneficial effects.

Cumulative Impacts

Impacts associated with other past, present and reasonably foreseeable actions are similar to those described under Alternative A. However, continued development in the Treasure Coast and south Florida may potentially encroach on wildland urban interface areas of the park. However, these areas are monitored by the National Park Service to identify new communities at risk under the Everglades Fire Management Plan. Coordination with new communities would cause long-term beneficial effects to communities as fire management would reduce hazardous fuel loading in areas in proximity to private property.

When the effects of other past, on-going, and future plans, projects, and activities affecting land use and transportation are combined with the effects of Alternative B, the resulting cumulative effects would be considered short-term, negligible to minor, and adverse, as well as long-term and beneficial. The beneficial and adverse effects of Alternative B would contribute an imperceptible amount to the overall adverse and beneficial cumulative impacts.

Conclusions

Overall, Alternative B would have short-term, negligible to minor adverse impacts and long- and short-term beneficial effects on land use and transportation. When the effects of other past, on-going, and future plans, projects, and activities affecting land use and transportation are combined with the effects of Alternative B, the resulting cumulative effects would be considered short-term, negligible to minor, and adverse, as well as long-term and beneficial. The beneficial and adverse effects of Alternative B would contribute an imperceptible amount to the overall adverse and beneficial cumulative impacts.

PARK OPERATIONS

AFFECTED ENVIRONMENT

Everglades National Park has 195 staff divided into seven operational divisions, including fire and aviation operations, resource and visitor protection, maintenance, interpretive, resource management, resource monitoring, and concessions management. The following section describes those divisions that primarily deal with fire management in Everglades National Park.

Fire and Aviation Operations

Fire and aviation management is a branch of the South Florida Natural Resources Center. The program is led by the fire management officer and staffed with 34 positions. Of these positions, 23 are permanent full time, 10 are permanent subject to furlough, and one position is seasonal. Staff adjustments are expected in the future due to organizational restructuring of fire management programs across the nation. The fire management officer is the overall program manager and leader of the senior fire management team. The fire and aviation management officer also assures coordination with other park supervisors and staff; park neighbors; and with local, statewide, and national cooperators and partners. The program manages all wildfire and prescribed fires throughout the park and is currently responsible for coordination and implementation of most aviation resources used throughout the park. Fire and aviation management is not responsible for structural fire management or suppression, and does not have structural fire apparatus or training.

Under the fire management officer, the fire and aviation management program is broken down into five major work units: wildfire operations; aviation; prescribed fire management; fire ecology and effects monitoring; and administration. While each unit is primarily responsible for program areas listed below, virtually all personnel participate and assist in all dimensions of fire management activities.

- The wildfire operations unit is the largest unit in the program and is organized to include supervision of the main fire cache station, the East Everglades Operations Center, and logistics and fire dispatch. The unit coordinates all wildfire and associated training and maintains the park-wide qualifications for firefighters, overhead personnel, and fire incident aviation users.
- The aviation management operational staff operates out of Homestead General Airport. Aviation use planning and scheduling of fixed wing or helicopter aircraft and flight following is performed by this unit. All non-fire related aviation user qualifications are maintained by this unit. Everglades National Park and Big Cypress National Preserve are currently working on a plan to manage aviation operations under the combined south Florida Aviation program. When this is implemented, aviation operations will remain tied to Everglades Fire Management but be managed under combined oversight from both NPS units.
- The prescribed fire unit plans and coordinates implementation of both prescribed fire activities and management of wildfires. This work unit is also responsible for remote sensing, sampling and reporting of fuels conditions, weather and soil conditions, maintaining two remote automated weather stations, maintaining fire reports and records, and for fire mapping and spatial displays and analysis.
- The fire ecology and effects monitoring unit is responsible for implementing the fire effects monitoring plan. This includes the installation, reading and re-monitoring, and data analysis of 84 fire effects monitoring plots located throughout the park. The unit also coordinates with researchers, resource managers, and other scientists to: recommend issues that need additional study; review research proposals; assists in fire related studies; and coordinate

resource management activities. This unit plays a key role in compliance issues for the fire and aviation management program.

- The administration unit of fire and aviation management is responsible for all budget and finance, timekeeping, travel management, personnel processing and record keeping, office administration, and fire support.

Fire and aviation management is divided into three operational facilities: the main fire cache operated out of the Dr. Bill Robertson Jr. building and the associated Iori building about 8 miles from park headquarters, the East Everglades Operations Center located east of Krome Ave. just north of 160th Street, and the aviation operations operated out of Homestead General Airport. The program provides emergency fire suppression and crash rescue equipment, and office space for the contracted pilots. Fire and aviation management also supports two fitness facilities, one at the Iori building and one at the East Everglades Operations Center.

Presently, fire and aviation management has a fleet of four wildland fire engines, multiple four-wheeled all terrain vehicles, seven leased support vehicles, and an extensive inventory of fire management equipment. They maintain a 50-person fire cache at its main facilities and a smaller cache at the East Everglades Operations Center. Inventory includes pumps, hose, water delivery appliances and hardware, portable water tanks, two aerial ignition machines, radio and telecommunications equipment, firefighter personal protection equipment, firefighter support equipment, hand ignition devices and hand and power tools. These facilities and equipment can support approximately 75"red carded" primary or collateral duty firefighters and overhead personnel.

Several fire and aviation management employees reside in park housing, either seasonally or full time, at Pine Island.

Other Divisions with Fire Management Responsibilities

Resource and Visitor Protection Division Operations. The resource and visitor protection division includes resource and visitor protection rangers (also called law enforcement rangers), telecommunications and fee collection, administrative and specialty staff, and field operations. There are five law enforcement districts, each with their own organizations of supervisory and field rangers and visitor use assistants (fee collectors). Law enforcement, search and rescue and emergency medical service operations are staged out of these five districts. One of these districts maintains their own structural fire engine and ambulance due to its remote nature.

Protection personnel are trained, qualified and equipped to respond to full range of emergency incidents and to conduct patrols, investigations and inspections. These activities provide for the protection, safety and security of park visitors, employees, concessionaires, and public and private property. Protection personnel are also entrusted to protect the natural and cultural resources in the park's care. Rangers conduct patrols by boat, airboat, aircraft, off road vehicles, four-wheel drive vehicles, and sedans. Rangers provide for the prevention of criminal activities through resource education, public safety efforts, and deterrence. Primary law enforcement duties include the detection and investigation of criminal activity and the apprehension and successful prosecution of criminal violators. Reasonable efforts are made to search for lost persons and to rescue sick, injured or stranded persons. Appropriate emergency medical services are provided for persons who become ill or injured, emergency pre-hospital care ranges from minor first aid to advanced life support in various environmental settings. Rapid response is made to structural fire and hazmat occurrences in a safe manner. A number of protection personnel are required to occupy park housing in all districts to aid their rapid response to any incident.

Some rangers have wildland fire "red card" credentials and have collateral duties to serve on fire events in various capacities. For example, during fire events when smoke may affect visibility, park law enforcement rangers provide traffic control, including setting up safety devices, guiding vehicles, directing traffic, or closing roads. Together with fire and aviation staff, rangers also investigate fires to determine their cause. For example, if the fire was caused by arson, the investigation would turn from a natural resources concern to a law enforcement investigation.

The communications center is equipped and staffed to ensure the safety of park visitors and employees. Dispatchers provide reliable and comprehensive radio, telephone, and electronic communications 24 hours a day, 365 days per year.

Maintenance Division Operations. The maintenance division is responsible for the maintenance and operation of facilities, utilities, grounds, roads, and the vehicle and marine fleet. Maintenance operations are staged out of four main areas in the park: Pine Island maintenance, Flamingo maintenance, Tamiami/Shark Valley maintenance, and gulf coast maintenance. The maintenance division consists of more than 60 personnel, five of whom occupy permitted or required housing.

Commercial Services

Commercial services are in the developed locations of the park and provide a variety of services to visitors. The following commercial services are summarized by location (NPS 2011c).

Flamingo. The Flamingo area has the most commercial visitor services of any area in the park. Commercial services here include, or have included, 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 a master plan for the area was recently completed.

Gulf Coast. Commercial services offered at gulf coast include commercial boat tours, canoe rentals, food service, and a gift shop.

Shark Valley. Most commercial services offered at Shark Valley are provided by Shark Valley Tram Tours. This company provides tram tours along the 15-mile tram loop and rents bicycles. They sell food and beverages from vending machines and run a gift shop and a book store.

Ernest F. Coe Visitor Center. A bookstore adjoining the visitor center sells books, film, postcards, insect repellent, souvenir clothing, and other souvenirs.

Commercial Airboating in the East Everglades Addition. Currently, commercial airboat operators in this area operate largely independently, with no real oversight or guidance from the National Park Service. However, commercial airboat operations must be brought under concessions contracts, consistent with the 1989 Expansion Act provisions related to commercial airboating and other applicable laws and policies.

Climate Change Effects on Park Operations

Increasing frequency and intensity of severe storms and floods may pose threats to trails, roads, administrative facilities, archeological sites, and historic structures, as well as other park resources and infrastructure (Loehman and Anderson 2009). As predicted storm frequency increases, more

fires may result from lightning caused fires, thus requiring more time spent by NPS staff as part of management and clean up/reconstruction efforts. Current projections for sea level rise during the next 20 to 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. Park managers carefully considered, in the context of climate change, how to (and whether to) construct or upgrade visitor and operational facilities in flood-prone zones. Due to the uncertainty and variability of outcomes associated with climate change and the limited five-year planning horizon of this environmental assessment, specific effects to park operations cannot be determined at this time.

ENVIRONMENTAL CONSEQUENCES

Impact Analysis Methods

Impacts on park operations were evaluated using the process described in "Methods for Analyzing Impacts." Impact threshold definitions are as follows. The area analyzed for possible effects on park operations and includes the entire park.

The major assumptions used in the analysis of effects on park operations are: (1) under Alternative A, the existing management direction for management of fire within the park would be extended into the future; (2) larger fires and their management would require response from other local, state, and federal agencies thus supplementing staffing needs at that time; (3) reduction of hazardous fuels through fire management efforts by the National Park Service would reduce the threat of potentially catastrophic fires; and (4) mitigation measures described in the park's Fire Management Plan would be implemented under Alternative B therefore limiting potential impacts to park operations.

Thresholds

Threshold	Definition
Negligible	Management actions would be at or below levels of detection and would not have an appreciable effect on park operations.
Minor:	Management actions would affect operations in a way that would be difficult to measure. Impacts on staff workload would be short term, with little material effect on other on-going national historic site programs. The change would be noticeable to staff but not to the public.
Moderate:	Changes in park operations would be readily apparent and would have appreciable effects on park operations that are noticeable to the staff and the public.
Major:	Changes in park operations would be readily apparent and would result in substantial changes in park operations that are noticeable to the staff and public and are markedly different from existing operations.
Short-term:	Occurs only during the management action.
Long-term:	Occurs after the management action.
Imperceptible	The incremental effect contributed by the alternative to the overall cumulative impact is such a small increment that it is impossible or extremely difficult to discern.
Noticeable	The incremental effect contributed by the alternative, while evident and observable, is still relatively small in proportion to the overall cumulative impact.
Appreciable	The incremental effect contributed by the alternative constitutes a large portion of the overall cumulative impact.

ALTERNATIVE A: NO ACTION / CONTINUE CURRENT MANAGEMENT

Impact Analysis

Fire has the potential to disrupt all aspects of park operations, dependent on the size, location, and intensity of the fire. Under Alternative A, suppression of some wildfires and management of prescribed fire would be necessary, requiring fire and aviation staff to meet existing fire management objectives throughout the park.

Impacts to park operations under Alternative A would continue to be primarily associated with disruption of daily work schedules associated with smoke and fire exposure. Closures of administrative areas due to health/safety considerations may disrupt some park staff daily operations. However, in most situations, staff can be reassigned to other tasks in other areas of the park. Displacement of NPS staff in offices may occur as outside staff members are brought in to manage fire. Implementation of Alternative A would continue to result in short-term, negligible to minor adverse effects on park operations due to administrative area closures and dispersed staff.

Smoke and particulate matter in office spaces and at work sites may disrupt employee ability to accomplish tasks dependent on individual sensitivity. Employee reactions to smoke exposure can range from mild discomfort to greater levels of distress. It is assumed the duration of their exposure would be a few hours to the full workday, and possibly for several days. In the past, employees were sent home for health and safety reasons associated with nearby fire management activities. For employees living on-site, the exposure could last for several days, with varying levels of intensity throughout its duration. Smoke exposure from implementation of Alternative A would continue to have short-term, negligible to moderate adverse effects on park operations, specifically staff abilities to accomplish tasks.

Park staff with fire credentials (red card) may be pulled off normal duties to participate in fire operations. For example, rangers may fill a variety of needs from traffic control to constructing fire lines (red carded staff only). This can result in staff shortages, which are usually ameliorated by rescheduling remaining staff and/or assigning overtime. Implementation of Alternative A would continue to result in short-term, negligible to minor adverse impacts on park operations.

Some NPS staff (interpretive and maintenance) work daily schedules that are determined by posted service hours or activities scheduled with the public; therefore the ability to travel from offices to work sites is important. For example, individual interpretive staff members may need to travel to appointments two to three times daily. Implementation of Alternative A could continue to result in road closures or areas put off-limits due to smoke, thus hampering staff ability to travel to work locations. This could potentially disrupt visitor services, or staff ability to accomplish projects. However, it is assumed these disruptions would be temporary (a few minutes to several hours). Implementation of Alternative A would continue to have short-term, negligible to minor adverse impacts on NPS staff.

Should fire events result in temporary road closures, concession staff members and incidental business permit holders may not be able to access work or important visitor use areas. Traffic impacts, especially on the Main Park Road, may potentially delay incidental business permit holders, deliveries, and visitors wishing to enter/leave the park. However, Flamingo restaurant and lodge concession employees would not be impacted because most reside in Flamingo. The park would continue to notify and coordinate with incidental business permit holders when feasible regarding planned fire management activities.

Gulf coast concessions are not impacted by fire operations. Shark Valley and Flamingo have never experienced closures due to fire. Although a closure could occur as a worst-case scenario,

implementation of Alternative A is expected to have no effect on concessions and Incidental Business Permit holders.

Overall, implementation of Alternative A would continue to have short-term negligible to moderate adverse effects on park operations.

Cumulative Impacts

Other past, present and reasonably foreseeable actions or plans that may affect park operations would include fire management collaborative processes, road improvements, and other park improvements (see the "Relationship to Other Plans and Policies" section in chapter 1 for more information on these actions).

The park participates in numerous national and regional collaborative processes to improve the use of physical resources and knowledge in fire management. Continued coordination with national and regional organizations would provide long-term beneficial effects to fire management in the park and in the surrounding region/state.

Resurfacing and other improvements to the Main Park Road from the main entrance to Flamingo would provide park staff and visitors with better access and safety. These improvements would improve shoulders and add turning lanes providing improved traffic safety if firefighting equipment is present on the Main Park Road. Resurfacing the physical road structure would reduce potential impacts as heavy equipment is used for fire management activities, and reducing maintenance efforts. Park road improvements would have long-term beneficial effects on park operations.

Implementation of the *Flamingo Commercial Services Plan* as well as the *Flamingo Master Plan and Design Program* would result in structural improvements in the Flamingo area that would have long-term beneficial impacts on park operations by reducing maintenance workloads.

Other natural resource management and associated activities in the park, including the restoration of the Everglades and its hydrology, would continue to have short-term, minor adverse effects on park operations as restoration projects would require varying levels of staff involvement throughout the implementation of the plan.

When the short-term, minor adverse and long-term beneficial effects of other past, on-going, and future plans, projects, and activities affecting park operations are combined with the effects of Alternative A, the resulting cumulative effects would be considered short- and long-term, minor to moderate, and adverse as well as long-term and beneficial. The effects of Alternative A would contribute an appreciable amount to the overall beneficial and adverse cumulative impacts.

Conclusions

Overall, implementation of Alternative A would continue to have short-term, negligible to moderate adverse effects on park operations. When the effects of other past, on-going, and future plans, projects, and activities affecting park operations are combined with the effects of Alternative A, the resulting cumulative effects would be considered short- and long-term, minor to moderate, and adverse as well as long-term and beneficial. The effects of Alternative A would contribute an appreciable amount to the overall beneficial and adverse cumulative impacts on park operations.

ALTERNATIVE B: NATIONAL PARK SERVICE PREFERRED ALTERNATIVE

Impact Analysis

Implementation of Alternative B would have impacts on park operations similar to those described for Alternative A, but the increased use of prescribed fire would have incrementally greater short-term, negligible to moderate adverse impacts on park operations under Alternative B.

Additionally, fire management actions under Alternative B would result in long-term beneficial effects to park operations as potential for catastrophic fire is reduced; however, as noted above, the limited increase in acreage under fire management may slightly increase fire management staff workloads. A reduction of fire suppression activities under Alternative B would reduce workloads on park staff, creating spillover effects onto visitor use and experience as less staff activity occurs and potential for disruption from helicopters and other machinery would be reduced. Additional park staff proposed under Alternative B would provide long-term beneficial effects to fire management activities within the park.

The National Park Service would coordinate with concessions and incidental business permit holders to limit impacts on operations to minimize adverse effects; these potential impacts would be short-term, negligible to minor, and adverse due to disruption of operations and the ability to provide their services to visitors.

Overall, implementation of Alternative B would continue to have short-term, negligible to moderate adverse impacts and long-term beneficial effects on park operations.

Cumulative Impacts

Impacts associated with other past, present and reasonably foreseeable actions are similar to those described under Alternative A. There would be short-term, minor adverse impacts as well as long-term beneficial effects. When the effects of other past, on-going, and future plans, projects, and activities affecting park operations are combined with the effects of Alternative B, the resulting cumulative effects would be considered long-term and beneficial. The beneficial effects of Alternative B would contribute an appreciable amount to the overall beneficial cumulative impact.

Conclusions

Overall, Alternative B would have short-term, negligible to moderate adverse impacts, as well as short- and long-term beneficial effects on park operations. When the effects of other past, on-going, and future plans, projects, and activities affecting park operations are combined with the effects of Alternative B, the resulting cumulative effects would be considered long-term and beneficial. The beneficial effects of Alternative B would contribute an appreciable amount to the overall beneficial cumulative impacts.