PURPOSE OF AND NEED FOR ACTION

INTRODUCTION

Invasive plant and animal species cost the world billions of dollars. In the United States alone, invasive species are responsible for environmental damage and losses estimated at $138 billion annually (Pimentel et al. 2000). Invasive nonnative species are sometimes referred to as exotic, nuisance, noxious, or nonindigenous species. They are defined as species that are “nonnative to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health” (*Executive Order 13112*). For the purpose of this draft *Exotic Plant Management Plan / Environmental Impact Statement* (EPMP/EIS), invasive nonnative plants are referred to as exotic plants.

Exotic Plants—Plant species that are nonnative, invasive plants.

Approximately 5,000 exotic plant species introduced to the United States have escaped cultivation and established themselves in natural areas (Morse et al. 1995). Approximately 1,200 exotic plant species in Florida have become established in natural areas, and as much as 4% of those exotic plants have displaced native species (Wunderlin 1998). The spread of invasive plants in Florida was exacerbated by the commercial importance of many exotic plants that were introduced for agricultural purposes (Stocker 2001). For the introduced invasive plant species for which records exist, approximately 90% were introduced deliberately (Gordon and Thomas 1997), and 46% of these were brought in for ornamental horticulture use. Federal, state, and local agencies spend more than $75 million annually in Florida to control exotic plants.

The U.S. Virgin Islands are experiencing similar impacts, although on a smaller scale. About 25% of plant species in the Caribbean national parks are exotic. A recent survey found that 19 of the 228 plant species growing on the 176-acre Buck Island Reef National Monument were exotic, including 8 previously undocumented exotic plant species (Ray 2002).

Exotic plants compete aggressively with native plants and are often at an advantage because they have no predators in newly invaded areas. When exotic plants displace native species (Morse et al. 1995), they alter native species proportion (Callaway and Aschehoug 2000; Gould and Gorchov 2000), nutrients (Evans et al. 2001; Mack et al. 2001; Scott et al. 2001), fire patterns, geomorphology, hydrology, and biogeochemistry (Scott et al. 2001). Exotic plants also reduce recreational opportunities (OTA 1993). When exotic plants clog waterways, they can impede boating, water skiing, swimming, and other water sports. The aggressive growth of Brazilian pepper encroaches upon wilderness areas, trails, and campgrounds, reducing access and degrading the aesthetics (Taylor 2003). Birding opportunities are reduced in infested areas because of the habitat degradation often associated with the invasion of exotic plants.

More than 2.5 million acres of National Park Service (NPS) lands are infested with exotic plants (NPS 2004a), including about 400,000 acres of NPS lands in Florida. In response to this growing problem, the NPS made the decision to integrate exotic plant management into every aspect of planning by developing exotic plant management partnership plans and programs that coordinate resources, funding, and scientific expertise (NPS 1996). This programmatic approach increases efficiency and consistency in managing exotic plants.

In 2003, the NPS Florida Partnership Exotic Plant Management Team (EPMT) was expanded to include the four Caribbean parks in conformance with the geographic boundaries of the NPS South Florida and Caribbean Inventory and Monitoring Network. The Florida/Caribbean EPMT and nine national parks in south Florida and the Caribbean have joined together to develop this draft EPMP/EIS to more effectively address the exotic plant threat to park resources. The nine national parks include five in Florida—Big Cypress National Preserve, Biscayne National Park, Canaveral National Seashore, Dry Tortugas National Park, and Everglades National Park; and four in the U.S. Virgin Islands—Buck Island Reef National Monument, Christiansted National Historic Site, Salt River Bay National Historic Park and Ecological Preserve, and Virgin Islands National Park.

PURPOSE OF AND NEED FOR ACTION

PURPOSE OF THE PLAN

The Council on Environmental Quality (CEQ) recommends that, where appropriate, agencies prepare programmatic environmental impact statements from which narrower site-specific documents can be tiered (40 *Code of Federal Regulations* [CFR] 1500.4). This allows an analysis of program components in a single document; otherwise, analyzing each component separately in site-specific environmental impact statements would require repetitive planning, analysis, or discussion of the same issues. Moreover, programmatic environmental impact statements tend to foster increased coordination among agencies, programs, and the public.

This draft EPMP/EIS proposes a range of strategies to manage and control exotic plants and establish a framework for future implementation of site-specific actions in the nine parks. The parks also have similar goals to preserve and protect park resources, face similar issues related to the presence and spread of exotic plants, and use similar techniques to manage exotic plants. In addition, this programmatic approach is intended to increase efficiency by combining the resources and expertise available from the nine participating parks. Based on these factors, the NPS determined that a programmatic environmental impact statement covering all nine parks is appropriate.

This collaborative draft EPMP/EIS approach would provide consistency in planning for exotic plant management among the nine parks and serve as a template for other national parks that may be candidates for this type of collaborative exotic plant planning effort. This draft EPMP/EIS addresses broad policies and approaches, including evaluation of the effects and effectiveness of various management measures that are used (or could be used) to address issues associated with exotic plants in the nine parks in south Florida and the Caribbean.

The purpose of this draft EPMP/EIS is to

- Provide a programmatic plan to manage and control exotic plants in nine parks in south Florida and the Caribbean.

- Promote restoration of native species and habitat conditions in ecosystems that have been invaded by exotic plants.

- Protect park resources and values from adverse effects resulting from exotic plant presence and control activities.

This draft EPMP/EIS evaluates a range of reasonable alternatives for managing exotic plants in nine parks in south Florida and the Caribbean. At the end of the EIS planning process, the record of decision announces which alternative has been chosen to guide future management of exotic plants in the nine parks.

This draft EPMP/EIS has been prepared in compliance with the *National Environmental Policy Act of 1969* (NEPA) and CEQ regulations (40 CFR 1508.9), NPS *Director's Order 12: Conservation Planning, Environmental Impact Analysis, and Decision Making* (NPS 2001a), and all other applicable requirements.

NEED FOR ACTION

The mild, humid climate of south Florida and the Caribbean makes the national parks in these areas especially susceptible to exotic plant infestations that threaten a park's natural and cultural resources. There is a need to manage exotic plants because:

- They often cause irreparable damage to natural resources by destroying the ecological balance among plants, animals, soil, and water achieved over many thousands of years.

- They are aggressive and competitive and, in newly invaded areas, lack sufficient predators from their native range, or local-occurring natural predators, to effectively control them.

- They displace native plants by robbing moisture, nutrients, and sunlight from them, which results in declines in habitat and food sources for animal populations, including critical habitat for threatened and endangered species.

- They can interbreed with native plant species thereby diluting native gene pools.

- They can alter cultural landscapes, and their excessive growth can threaten the integrity of historic and cultural sites and structures.

Activities to control exotic plants can also affect natural and cultural resources. Mechanized equipment, chemical herbicides, and prescribed fire to control remove and control exotic plants can disturb native habitats; harm nontarget species; damage archeological, ethnographic, landscape, and historic resources; and alter natural communities.

The NPS spends millions of dollars each year controlling the spread of exotic plants in parks and protecting and preserving park resources. These activities can be expensive: Canaveral National Seashore spent over $500,000 for treatment since 2000; Big Cypress National Preserve reported spending approximately $388,000 annually; and funding at Everglades National Park has increased from approximately $100,000 in 2001 to over 1.2 million dollars in 2004.

Currently, each of the nine national parks manages exotic plants on a project-by-project basis. In planning for this draft EPMP/EIS, the NPS recognized that it needed to adopt a collaborative approach among parks to more effectively manage and control the spread of exotic plants. This comprehensive plan improves the ability to respond to the threat of exotic plants in an effective, efficient, and timely manner that meets NPS mandates and individual park missions to protect park resources and values.

This draft EPMP/EIS provides for the broad-scale management of exotic plants in the nine parks over the next 10 years. This plan considers all treatment methods (biological, physical, mechanical, and chemical) that are currently being implemented by the nine parks, or that may be used in the foreseeable future. See the “Alternatives” chapter for a description of each treatment method. Individual treatments, or combinations of those treatments, would continue to be implemented, as appropriate, to control exotic plants.

The focus of this draft EPMP/EIS is on controlling terrestrial and freshwater aquatic (emergent and floating) exotic plants. Exotic marine algal species and their effects on marine resources are not analyzed although they are a growing concern to parks with marine environments. At this time, information is lacking about the level of threat, the extent of the problem in the parks, or the effective treatment methods that would support making decisions regarding the control of exotic marine algae. Because exotic plant treatment activities that take place on land can indirectly affect the marine environment, this draft EPMP/EIS does consider the effects of exotic plant management activities on important marine resources such as seagrasses, corals, and fish.

OBJECTIVES IN TAKING ACTION

Objectives are specific statements of purpose and describe what must be accomplished, to a large degree, for the plan to be considered a success. The objectives developed to guide preparation of this draft EPMP/EIS are organized under the following six categories.

PRESENCE OF EXOTIC PLANTS

- Establish priorities for exotic plants to be treated and treatment locations in parks.

- Reduce the number of individual targeted exotic plants to minimize the threat to natural resources (native habitat, plants, and wildlife).

- Reduce to the greatest extent possible the introduction of new exotic plants into parks.

- Ensure that park exotic plant management programs support, and are consistent with, south Florida ecosystem restoration goals.

CULTURAL RESOURCES

- Reconcile potential conflicts between preservation of significant cultural landscapes and removal of exotic plants.

- Preserve plants and sites valued by Native Americans and other traditional cultures while reducing the spread of exotic plant species.

- Protect archeological and historic resources while reducing the spread of exotic plant species.

OPERATIONS TO CONTROL EXOTIC PLANTS

- Conduct the exotic plant management plan so it is continually monitored and improved; environmentally safe; incorporates best management practices; and supports, and is supported by, science and research.

- Minimize unintended impacts of control measures on park resources, visitors, employees, and the public.

- Use federal resources with increased efficiency.

- Ensure that control measures are consistent with the *Wilderness Act* and *NPS Wilderness Policy*.

VISITORS AND THE PUBLIC

Increase visitor and public awareness of the impacts exotic plants have on native habitat and species and on cultural resources, building support for NPS management efforts.

GOVERNMENT PARTNERS / NEIGHBORING COMMUNITIES

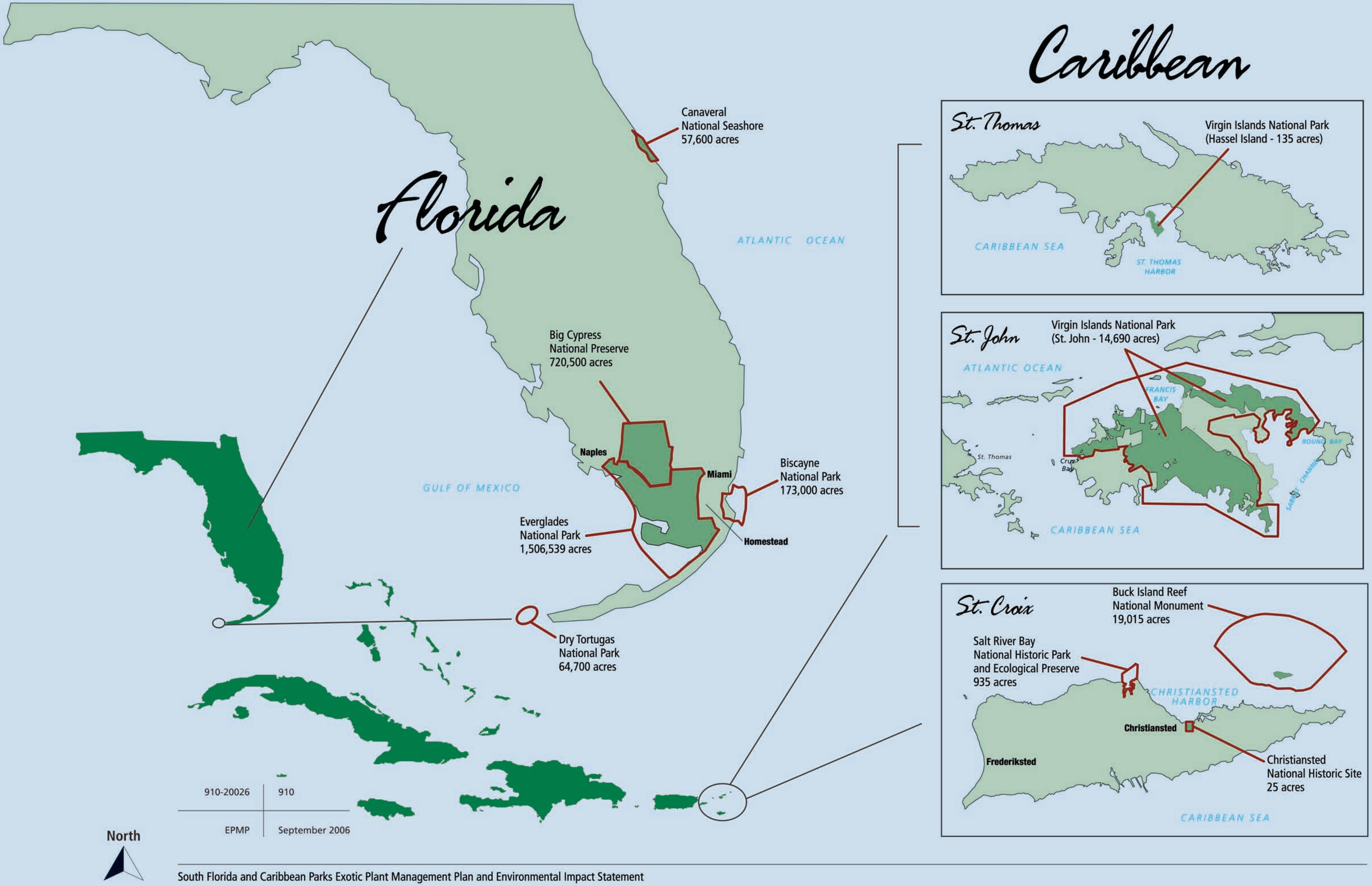
Coordinate efforts with partners and neighbors (nationally and internationally) to establish compatible goals and provide assistance to achieve them.

RESTORATION

Restore and protect native vegetation categories in ways that allow natural processes, function, cycles, and biota to be re-established and maintained in perpetuity.

PROJECT SITE LOCATIONS

All nine parks are located in a similar subtropical/tropical region (see “Figure 1: Vicinity Map”).


Florida
Canaveral
National Seashore
57,600 acres
ATLANTIC OCEAN
Big Cypress
National Preserve
720,500 acres
Naples
Miami
Biscayne
National Park
173,000 acres
GULF OF MEXICO
Everglades
National Park
1,506,539 acres
Homestead
Dry Tortugas
National Park
64,700 acres
910-20026
910
EPMP
September 2006
North
Caribbean
St. Thomas
Virgin Islands National Park
(Hassel Island - 135 acres)
CARIBBEAN SEA
ST. THOMAS HARBOR
St. John
Virgin Islands National Park
(St. John - 14,690 acres)
ATLANTIC OCEAN
FRANCIS BAY
St. Thomas
Cruz Bay
CARIBBEAN SEA
St. Croix
Buck Island Reef
National Monument
19,015 acres
Salt River Bay
National Historic Park
and Ecological Preserve
935 acres
CHRISTIANSTED HARBOR
Christiansted
Frederiksted
Christiansted
National Historic Site
25 acres
CARIBBEAN SEA

BACKGROUND

The following laws, policies, and planning documents are described to show the constraints under which this draft EPMP/EIS must operate and the goals and policies it must meet. These constraints, goals, and policies are described in depth in the following sections.

GUIDING LAWS AND POLICIES FOR ALL NATIONAL PARKS

NPS ORGANIC ACT OF 1916

In the NPS *Organic Act of 1916*, Congress directed the U.S. Department of the Interior and the NPS to manage parks "to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations" (16 United States Code [USC] § 1). Congress reiterated this mandate in the *Redwood National Park Expansion Act of 1978* by stating that the NPS must conduct its actions in a manner that ensures no "derogation of the values and purposes for which these various areas have been established, except as may have been or shall be directly and specifically provided by Congress" (16 USC § 1 a-1).

Despite these mandates, the *Organic Act* and its amendments afford the NPS latitude when making resource decisions that balance visitor recreation and resource preservation. By these acts, Congress "empowered [the NPS] with the authority to determine what uses of park resources are proper and what proportion of the park resources are available for each use" (*Bicycle Trails Council of Marin v. Babbitt*, 82 F.3d 1445, 1453 [9th Circuit, 1996]).

Courts consistently interpret the *Organic Act* and its amendments to elevate resource conservation above visitor recreation. *Michigan United Conservation Clubs v. Lujan*, 949 F.2d 202, 206 (6th Circuit, 1991) states, "Congress placed specific emphasis on conservation." The *National Rifle Association of America v. Potter*, 628 F. Supplement 903, 909 (District Court for the District of Columbia, 1986) states, "In the Organic Act Congress speaks of but a single purpose, namely, conservation." NPS *Management Policies 2001* also recognizes that resource conservation takes precedence over visitor recreation. The policy dictates that, "when there is a conflict between conserving resources and values and providing for enjoyment of them, conservation is to be predominant" (NPS 2001e, 1.4.3).

Because conservation remains predominant, the NPS seeks to avoid or minimize adverse impacts on park resources and values; yet, the NPS has discretion to allow negative impacts when necessary (NPS 2001e, 1.4.3). While some actions and activities cause impacts, the NPS cannot allow an adverse impact that constitutes resource impairment (NPS 2001e, 1.4.3). The *Organic Act* prohibits actions that impair park resources. The *General Authorities Act of 1970* (16 USC §§1a-1, et seq.) supplemented and clarified the NPS mandate with respect to the management of the national park system, and the *Redwoods Act of 1978* (16 USC §§1, 1a-1) reasserted the system-wide standard of protection established by Congress in the *Organic Act*. The *General Authorities Act* and *Redwoods Act* do not use the term "impairment" as does the *Organic Act*, but rather state, "…the protection, management, and administration of these areas …shall not be exercised in derogation of the values and purposes for which these various areas have been established, except as may have been or shall be directly and specifically provided by Congress."

> The impairment of park resources and values may not be allowed by the Service unless directly and specifically provided for by legislation or by the proclamation establishing the park. The relevant legislation or proclamation must provide explicitly (not by implication or inference) for the activity, in terms that keep the Service from having the authority to manage the activity so as to avoid the impairment (NPS 2001e, 1.4.4) The impairment that is prohibited by the *Organic Act* and the *General Authorities Act* is an impact that, in the professional judgment of the responsible NPS manager, would harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values. Whether an impact meets this definition depends on the particular resources and values that would be affected; the severity, duration, and timing of the impact; the direct and indirect effects of the impact; and the cumulative effects of the impact in question and other impacts (NPS 2001e, 1.4.5).

An action constitutes an impairment when its impacts "harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values" (NPS 2001e, 1.4.4). To determine impairment, the NPS must evaluate "the particular resources and values that would be affected; the severity, duration, and timing of the impact; the direct and indirect effects of the impact; and the cumulative effects of the impact in question and other impacts" (NPS 2001e, 1.4.4).

Parks vary in their enabling legislation, natural resources, cultural resources, and missions. The management activities in each park vary as well. An action that is appropriate in one park could impair resources in another park. Thus, this draft EPMP/EIS analyzes the context, duration, and intensity of impacts related to exotic plant management in the nine national parks, as well as the potential for resource impairment, as required by *Director's Order 12* (NPS 2001a).

NPS Management Policies (2001)

The NPS *Management Policies 2001* (NPS 2001e, 4.4.1.1) require that the NPS "adopt park resource preservation, development, and use management strategies that are intended to maintain the natural population fluctuation and processes that influence the dynamics of individual plant and animal populations, groups of plant and animal populations, and migratory animal populations in parks" (NPS 2001e). In addition, the NPS plans to work with other state, tribal, and federal land managers to encourage the conservation of the populations and habitats of these species outside parks, whenever possible.

NPS *Management Policies 2001* require the containment, control, and management of exotic plants to the greatest degree possible, particularly those with serious ecological threats (NPS 2001e). The sections of NPS *Management Policies 2001* that are relevant to exotic plants are presented below:

> **Management of Exotic Species (4.4.4)** — "Exotic species will not be allowed to displace native species if displacement can be prevented."
>
> **Introduction or Maintenance of Exotic Species (4.4.4.1)** — "In general, new exotic species will not be introduced into parks. In rare situations, an exotic species may be introduced or maintained to meet specific, identified management needs when all feasible and prudent measures to minimize the risk of harm have been taken," and the species meets at least one of seven listed criteria.
>
> **Removal of Exotic Species Already Present (4.4.4.2)** — "All exotic plant and animal species that are not maintained to meet an identified park purpose will be managed—up to and including eradication—if (1) control is prudent and feasible, and (2) the exotic species:
>
> a. Interferes with natural process and the perpetuation of natural features, native species or natural habitats; or
>
> b. Disrupts the genetic integrity of native species; or
>
> c. Disrupts the accurate presentation of a cultural landscape; or
>
> d. Damages cultural resources; or
>
> e. Significantly hampers the management of park or adjacent lands; or
>
> f. Poses a public health hazard as advised by the U.S. Public Health Service (which includes the Centers for Disease Control and the NPS Public Health Program); or
>
> g. Creates a hazard to public safety."
>
> This policy also states that high priority should be given to managing exotic species that have, or potentially could have, a substantial impact on park resources and that can reasonably be expected to be successfully controllable. Lower priority should be given to exotic species that have almost no impact on park resources or that probably cannot be successfully controlled.
>
> When exotic species are present and management appears to be feasible and effective, park superintendents should "(1) evaluate the species' current or potential impact on park resources; (2) develop and implement exotic species management plans according to established planning procedures; (3) consult, as appropriate, with federal and state agencies; and (4) invite public review and comment, where appropriate. Programs to manage exotic species will be designed to avoid causing significant

damage to native species, natural ecological communities, natural ecological processes, cultural resources, and human health and safety."

NPS Actions that Remove Plants and Animals (4.4.2.1) — When the NPS determines that there is a need to reduce the size of a park's plant or animal population, Section 4.4.2.1 of NPS *Management Policies 2001* must be followed. This section states, "such removals will not cause unacceptable impacts to native resources, natural processes, or other park resources." The NPS "will use scientifically valid resource information obtained through consultation with technical experts, literature review, inventory, monitoring, or research to evaluate the identified need for population management."

Restoration of Natural Systems (4.1.5) — The NPS is tasked to "re-establish natural functions and processes in human-disturbed components of natural systems in parks unless otherwise directed by Congress… Impacts to natural systems resulting from human disturbances include the introduction of exotic species; the contamination of air, water, and soil; changes to hydrologic patterns and sediment transport; the acceleration of erosion and sedimentation; and the disruption of natural processes. The Service will seek to return human-disturbed areas to the natural conditions and processes characteristic of the ecological zone in which the damaged resources are situated. …Efforts may include, for example: removal of exotic species… and restoration of native plants and animals."

Maintenance of Altered Vegetation Categories (4.4.2.5) — "In altered vegetation categories managed for a specified purpose, plantings will consist of species that are native to the park or that are historically appropriate for the period or event commemorated. …Use of exotic plants must conform to exotic species policy."

NPS *Management Policies 2001* also sets out guidance for the management of cultural resources, stating that: "The National Park Service will preserve and foster appreciation of the cultural resources in its custody, and will demonstrate its respect for the peoples traditionally associated with those resources, through appropriate programs of research, planning, and stewardship" (NPS 2001e). The sections of NPS *Management Policies 2001* that are relevant to management of cultural resources (archeological, historic, and ethnographic resources and cultural landscapes) are presented below:

National Park Service Research (5.5.1) — "The National Park Service will not take or allow any action that reduces the research potential of cultural resources without first performing an appropriate level of research, consultation, and documentation."

"Adequate research to support informed planning and compliance with legal requirements will precede any final decisions about …natural resource management activities that might affect cultural resources."

Planning (5.2) — "Planning for …natural resource management activities will integrate relevant concerns and program needs for identifying, evaluating, monitoring, protecting, preserving, and treating cultural resources."

Archeological Resources (5.3.5.1) — "Preservation treatments will include proactive measures that …maintain or improve their condition by limiting damage due to natural and human agents."

Cultural Landscapes (5.3.5.2) — "The treatment of a cultural landscape will preserve significant physical attributes, biotic systems, and uses when those uses contribute to historical significance. Treatment decisions will be based on a cultural landscape's historical significance over time, existing conditions, and use. Treatment decisions will consider both the natural and built characteristics and features of a landscape, the dynamics inherent in natural processes and continued use, and the concerns of traditionally associated peoples. The treatment implemented will be based on sound preservation practices to enable long-term preservation of a resource's historic features, qualities, and materials."

Biotic Cultural Resources (5.2.5.2.5) — "Biotic cultural resources, which include plant and animal communities associated with the significance of a cultural landscape, will be duly considered in treatment and management. The cultural resource and natural resource components of the park's resource management plan will jointly identify acceptable plans for the management and treatment of biotic cultural resources. The treatment and management of biotic cultural resources will anticipate and plan for the natural and human-induced processes of change. The degree to which change contributes to or compromises the historic character of a cultural landscape, and the way in which natural cycles influence the ecological processes within a landscape, will both be understood before any major treatment is undertaken. Treatment and management of a cultural landscape will establish acceptable parameters for change, and manage the biotic resources within those parameters."

Land Use and Ethnographic Value (5.3.5.2.6) — "Many cultural landscapes are significant because of their historic land use and practices. When land use is a primary reason for the significance of a landscape, the objective of treatment will be to balance the perpetuation of use with the retention of the tangible evidence that represents its history. The variety and arrangement of cultural and natural features in a landscape often have sacred or other continuing importance in the ethnic histories and cultural vigor of associated peoples. These features and their past and present-day uses will be identified, and the beliefs, attitudes, practices, traditions, and values of traditionally associated peoples will be considered in any treatment decisions."

Ethnographic Resources (5.3.5.3) — "Park ethnographic resources are the cultural and natural features of a park that are of traditional significance to traditionally associated peoples…. who typically assign significance to ethnographic resources—places closely linked with their own sense of purpose, existence as a community, and development as ethnically distinctive peoples. These places may… support ceremonial activities or represent birthplaces of significant individuals, group origin sites, migration routes, or harvesting or collecting places…. The National Park Service will adopt a comprehensive approach that considers parks and traditionally associated and other peoples as interrelated members of an ecosystem."

Sacred Sites (5.3.5.3.2) — "The National Park Service acknowledges that American Indian tribes…. treat specific places containing certain natural and cultural resources as sacred places having established religious meaning, and as locales of private ceremonial activities. Consistent with *Executive Order 13007*, the Service will, to the extent practicable… avoid adversely affecting the physical integrity of such sacred sites."

NPS *Management Policies 2001* also provides guidance related to various treatment methods of exotic plants. Before using pesticides in parks, pesticide requests must be submitted and then reviewed on a case-by-case basis, taking into account environmental effects, cost and staffing, and other relevant considerations (NPS 2001e, 4.4.5.3). Pesticide storage, transport, and disposal must comply with procedures established by (1) the Environmental Protection Agency (EPA); (2) the individual states in which parks are located; and (3) *Director's Order 30A: Solid and Hazardous Waste Management; Director's Order 77-1: Wetland Protection;* and *Director's Order 77-7: Integrated Pest Management* (in progress) (NPS 2001e, 4.4.5.5). The application or release of any biological control agents and bioengineered products must be reviewed by an integrated pest management specialist and conform to the exotic species policies in Section 4.4.4 described above (NPS 2001e, 4.4.5.4).

DIRECTOR'S ORDER 12: CONSERVATION PLANNING, ENVIRONMENTAL IMPACT ANALYSIS, AND DECISION-MAKING

Director's Order 12 and the accompanying handbook (NPS 2001a) lay the groundwork for how the NPS complies with NEPA. *Director's Order 12* and the handbook set forth a planning process for incorporating scientific and technical information and establishing a solid administrative record for NPS projects.

Director's Order 12 requires that impacts to park resources be analyzed in terms of their context, duration, and intensity. It is crucial for the public and decision makers to understand the implications of those impacts in the short and long term, cumulatively, and in context, based on an understanding and interpretation by resource professionals and specialists. *Director's Order 12* also requires that an analysis of impairment to park resources and values be made as part of the NEPA document.

DIRECTOR'S ORDER 77-7 (IN PROGRESS)

The current *NPS-77: Natural Resources Management Guideline*, and the in-progress *Director's Order 77-7,* requires that each park develop and implement an integrated pest management (IPM) program. The NPS IPM program was initiated in 1979 through a presidential memorandum. Since then, the program has worked toward the implementation of a science-based nationwide IPM program based on a decision-making process that coordinates knowledge of pest biology, the environment, and available technology. The program helps prevent unacceptable levels of pest damage and pest management-related activities by identifying cost-effective methods or strategies that pose the least possible risk to the public, employees, park resources, and the environment. Proper decision-making ensures that effective, low-risk management strategies are adopted and implemented to manage pests.

The IPM program addresses pest issues for all NPS management areas: natural and cultural resource management, maintenance, concessions, and public health. Each pest issue is investigated and reviewed on a case-by-case basis. IPM coordinators work cooperatively with other NPS employees and federal, state, local, and academic experts to ensure that the selected pest management approach is the most effective and presents the least risk. If a pesticide is proposed as part of an IPM program, the regional and servicewide IPM coordinators review the proposal; approve or deny it; provide additional technical guidance, if approved; and track pesticide use through the NPS Pesticide Use Proposal System. The decision to concur or deny use of a pesticide is based upon agency policy and guidelines, availability of nonchemical alternatives, and whether or not the proposed pesticide is registered by the EPA for its intended use.

An IPM program uses the least toxic, most effective management options. Because an integrated approach is often more effective than a single type of treatment, the approach employs multiple, integrated management practices when feasible. The IPM practices included in the management alternatives presented in this draft EPMP/EIS include:

- Treatment methods (mechanical, biological, chemical, or physical)
- Monitoring and data collection
- Education programs
- Collaboration measures
- Planning

Exotic plant management in the nine parks involves individual treatment applications or combinations of treatment methods for specific plants.

GUIDING LAWS, POLICIES, AND PLANNING DOCUMENTS FOR NATIONAL PARKS IN FLORIDA

National parks are established by Congress to fulfill specific purposes, based on each park’s unique and “significant” resources. A park’s purpose, as established by Congress, is the foundation on which later management decisions are based to conserve resources while providing “for the enjoyment of future generations.”

BIG CYPRESS NATIONAL PRESERVE

Project Site Location

Big Cypress National Preserve encompasses approximately 720,500 acres. It is located in southwest Florida and lies in Collier, Monroe, and Miami-Dade counties (see the "Big Cypress National Preserve" map in appendix A).

Park Enabling Legislation and Purpose

Big Cypress National Preserve was established in 1974 by Public Law (PL) 93-440 to "assure the preservation, conservation, and protection of natural, scenic, hydrologic, floral and faunal, and recreational values of the Big Cypress watershed in the state of Florida and to provide for the enhancement and public enjoyment thereof." The park's enabling legislation also states that as a unit of the national park system it is to be managed in a manner that ensures its "natural and ecological integrity in perpetuity." In April 1988, PL 93-440 was amended by PL 100-301—the *Big Cypress National Preserve Addition Act*. The addition totaled 146,000 acres and was designated the "Big Cypress National Preserve Addition."

The enabling legislation (16 USC 6, Section 698j) also mandates that "members of the Miccosukee Tribe of Indians of Florida and members of the Seminole Tribe of Florida shall be permitted, subject to reasonable regulations established by the Secretary, to continue their usual and customary use and occupancy of Federal or federally acquired lands and waters within the preserve and the Addition, including hunting, fishing, and trapping on a subsistence basis and traditional tribal ceremonials."

Park Significance

Big Cypress National Preserve is key to the survival of Everglades National Park and the integrity of the entire south Florida ecosystem. This meeting place of temperate and tropical species is a hotbed of biological diversity. The preserve contains a mixture of pines, hardwoods, prairies, mangrove forests, cypress strands, and domes; vast remnants of vegetation types found only in the preserve's mix of upland and wetland environments; and the largest known stands of dwarf cypress. White-tailed deer, bear, and Florida panther can be found in the preserve, along with the more tropical tree snail (*Liguus*), royal palm, and cigar orchid. Big Cypress provides habitat for 34 animal and plant species receiving special protection or recognition by the state of Florida, the United States, or the Convention on International Trade in Endangered Species.

Hydrologically, the preserve serves as a supply of fresh, clean water for the vital estuaries of the Ten Thousand Islands area near Everglades City. Big Cypress National Preserve is also significant because it remains largely accessible to the public for the pursuit of resource-based recreation; possesses significant prehistoric, historic, and contemporary cultural sites and landscapes; and is home to the Miccosukee and Seminole Indians, sustaining resources important to their culture.

Planning Documents for Big Cypress National Preserve

General Management Plan. The *Big Cypress National Preserve General Management Plan* (NPS 1991a) was completed in 1991. The *General Management Plan* provides guidance on visitor use, natural and cultural resource management, and general development in the original boundary of Big Cypress National Preserve.

The *General Management Plan* identifies melaleuca as the highest priority species that must be controlled, followed by Australian pine and Brazilian pepper. The *General Management Plan* states that the elimination of melaleuca would be accomplished by treating areas that contribute to the expansion of melaleuca, areas where important resources are threatened by melaleuca, areas where stands of melaleuca conflict with visitor use, and remaining areas that contribute seed sources for reinvasion. The *General Management Plan* also identifies any strong potential to eliminate Australian pine in the preserve because populations were fairly isolated and expansion was slow. Priority areas for treatment are similar to those described above for melaleuca. Brazilian pepper is characterized as impossible to eliminate from the preserve because of how widespread the problem is in south Florida. The control of exotic plants would be a continuous process, and areas that have important resource values or areas where infestation would conflict with visitor use would be given priority for treatment (NPS 1991a).

The park is developing a general management plan to guide management of the 146,000-acre Big Cypress National Preserve Addition over the next 15 to 20 years.

Strategic Plan. The *Strategic Plan for Big Cypress National Preserve* (NPS 2000c) was developed for 2001 to 2005 to fulfill the preserve's mission to safeguard and enhance the ecological processes and the natural, scenic, cultural, recreational, and educational values of the Big Cypress watershed. The *Strategic Plan* follows the NPS long-term mission goal (I1a) mandating that the "Big Cypress National Preserve natural and cultural resources and associated values are protected, restored and maintained in good condition and managed in their broader ecosystem and cultural context." Specific goals relating to this overarching long-term goal applicable to exotic plant management include the following:

> By September 30, 2005, 4,015 (10%) of the acres of Big Cypress National Preserve's targeted lands disturbed by prior development, off-road vehicle use, and agricultural use identified in fiscal year 1999, are restored (Ia1a).
>
> By September 30, 2005, 37,500 (50%) of the 75,000 acres of Big Cypress National Preserve lands impacted by exotic plants targeted by September 30, 1999, are contained (Ia1b).

BISCAYNE NATIONAL PARK

Project Site Location

Biscayne National Park is located in southeast Florida, in Biscayne Bay and the offshore waters along the Atlantic coast. The park is located in Miami-Dade

County, south of the city of Miami, and encompasses almost 173,000 acres, of which nearly 165,000 acres are water (see the “Biscayne National Park” map in appendix B).

Park Enabling Legislation and Purpose

Biscayne National Park was established by Congress in 1968 as Biscayne National Monument (PL 90-606). The boundaries were expanded in 1974 “to add approximately 8,738 acres of land and water, including all of Swan Key and Gold Key” (PL 93-477). In 1980, the boundaries were again expanded to create its current size of 173,000 acres, and Biscayne National Monument was designated Biscayne National Park “to preserve and protect for the education, inspiration, recreation, and enjoyment of present and future generations a rare combination of terrestrial, marine, and amphibious life in a tropical setting of great natural beauty” (PL 96-287). Congress also directed the NPS to “manage this area in a positive and scientific way in order to protect the area’s natural resource integrity.”

Park Significance

Biscayne National Park is the largest marine park in the national park system, with 95% of its 173,000 acres covered by water. The park’s waters contain unique marine habitats and nursery environments capable of sustaining diverse and abundant native fisheries. The park marks the northernmost extent of fragile and dynamic Florida coral reefs and coastal systems characterized by transitions in the physical and biological environment. In addition to the coral reefs, the park contains keys, estuarine bays, and mangrove coastal areas that are integral parts of the south Florida ecosystem, providing a place where diverse temperate and tropical species mingle, including largely undisturbed populations of tropical and subtropical plants.

The diversity and complexity of natural and cultural resources in the park provide a dynamic laboratory for education and scientific research. The park’s cultural history is linked to the natural environment, and the submerged and terrestrial resources represent a rich history of diverse cultures from prehistoric times to the present. Park visitors are offered opportunities to observe an abundance of resources, experience a multitude of recreational activities, or simply enjoy the park for the tranquility and solitude it offers.

Planning Documents for Biscayne National Park

General Management Plan. The *Biscayne National Park General Management Plan* was developed in 1983; a new plan is being developed by the park. The 1983 *General Management Plan* recognized one of the park’s major threats as the “continued spread of exotic plant and animal species, which displace native vegetation and wildlife,” and identified Australian pine as a high-priority species (NPS 1983b). Proposed management actions in the *General Management Plan* included the control of exotic plant species through “cutting, limited application of EPA- and NPS-approved herbicides and other approved methods” (NPS 1983b).

Strategic Plan. The *Strategic Plan for Biscayne National Park* (NPS 1997b) was developed for fiscal years 1997 to 2002 to help meet the park's purpose. An overarching mission goal (Ia) developed in the *Strategic Plan* was to preserve park resources, specifically to ensure that "park natural and cultural resources and associated values are preserved, protected, restored, and maintained in good condition and managed in a manner within their broader ecosystem and cultural context." A more specific long-term goal (Ia1) was to have been achieved by September 30, 2002, in which "5% of the targeted disturbed park lands, identified as of 1997, are restored, and 5% of priority targeted disturbances are contained" (NPS 1997b).

CANAVERAL NATIONAL SEASHORE

Project Site Location

Canaveral National Seashore is made up of nearly 60,000 acres located on a barrier island along Florida's central Atlantic coast. The park consists of the North and South Districts and the Seminole Rest Site. The North District and Seminole Rest Site lie in Volusia County, while the South District lies in Brevard County, near Titusville (see the "Canaveral National Seashore" map in appendix C).

Park Enabling Legislation and Purpose

Canaveral National Seashore was established by PL 93-626 on January 3, 1975, "to preserve and protect the outstanding natural, scenic, scientific, ecologic, and historic values of certain lands, shoreline, and waters of the State of Florida, and to provide for public outdoor recreation use and enjoyment of the same."

Park Significance

Canaveral National Seashore is on a barrier island that includes ocean, beach, dune, hammock, lagoon, salt marsh, scrubland, and pine flatwood habitats. The barrier island and adjacent waterways offer a blend of plant and animal life. Records show that 1,045 species of plants and 310 species of birds can be found in the park. The national seashore is home to 15 federally listed threatened or endangered wildlife species including loggerhead, green, and leatherback sea turtles (over 4,000 sea turtles nest in the park each year); West Indian manatee; bald eagle; wood stork; eastern indigo snake; and Florida scrub jay. Canaveral National Seashore has 98 known cultural sites; some may prove to be of tremendous historical significance, such as sites from the period of the conflict between Spain and France for the control of colonial Florida.

Mosquito Lagoon is part of the larger Indian River Lagoon, which contains one of the highest diversities of species of any estuary in North America and is listed as an Estuary of National Significance under the Environmental Protection Agency's National Estuary Program. In addition, Mosquito Lagoon provides a critical habitat for the West Indian manatee, juvenile sea turtles, and Atlantic salt marsh snake. Mosquito Lagoon also supports a nationally recognized commercial and recreational fishery that includes finfish and shellfish.

Planning Documents for Canaveral National Seashore

General Management Plan. The *Canaveral National Seashore General Management Plan* was completed in 1981. The park is developing a new general management plan that incorporates exotic plant management into the conceptual framework. The 1981 exotic plant management objectives were “to plan and manage the Seashore, to the extent possible, in ways that enhance natural ecological and geological processes and mitigate human impact on these processes … [and] to identify, inventory, and monitor the condition of the several park resources (natural, historic, prehistoric) and to provide appropriately for their protection and use” (NPS 1981).

Strategic Plan. Canaveral National Seashore developed long-term goals for its *Strategic Plan* in 2000 for fiscal years 2000 to 2005 (NPS 2000d). One overarching mission goal (Ia) is to ensure “seashore natural and cultural resources and associated values are protected, restored and maintained in good condition and managed in their broader ecosystem and cultural context.” More specific goals to be achieved under this overarching mission goal include the following: “By September 30, 2005, 15 acres of targeted disturbed lands, as of 1997, and including new disturbances in 1999, are restored” (Ia1a), and “By September 30, 2005, 973 acres of exotic plants, as identified in 1997, are restored to native vegetation” (Ia1b) (NPS 2000d). The park is seeking to restore vegetative cover in dune areas in the “15 acres of targeted disturbed lands” that has been damaged by storm surges during hurricanes.

Resource Management Plan. In 1997 Canaveral National Seashore developed a *Resource Management Plan* (NPS 1997a) to implement activities consistent with the park’s enabling legislation and *General Management Plan*. A central element of the resource management plan is the removal of Brazilian pepper, Australian pine, and century plant (*Agave sisalana*). The resource management plan describes treatments for Brazilian pepper and Australian pine, as well as the need for additional and follow-up treatments, baseline documentation of changes in species distribution and density, and identification of cultural landscapes that could be affected (NPS 1997a).

Park Resource Management

The southern two-thirds (about 40,000 acres) of the 58,000 acres in Canaveral National Seashore is owned by National Atmospheric and Space Association (NASA), Kennedy Space Center (KSC) (see the “Canaveral National Seashore Land Management” map in appendix C). The majority of this area is jointly managed with the United States Fish and Wildlife Service through a cooperative agreement. The adjacent Merritt Island National Wildlife Refuge (MINWR) manages natural resources in the joint area, while the NPS is responsible for interpretation and protection of archeological and historic sites (Interagency Agreement between NPS and USFWS 1990). The remaining one-third of Canaveral National Seashore is owned and managed by the NPS.

Canaveral National Seashore and MINWR work closely together to manage the contiguous and overlapping ecosystems. While the missions of the NPS and U.S. Fish and Wildlife Service are not identical, they are compatible. MINWR was established in 1963 “for use as an inviolate sanctuary, or for any other management purpose, for migratory birds" as stated in the *Migratory Bird Conservation Act of 1929* (16 USC 715 d). The mission statement provides more detail and adds threatened and endangered species, public use, and environmental education. It reads: "to protect, enhance, and manage wetlands and uplands for biodiversity and for the benefit of all species native to Merritt Island National Wildlife Refuge; provide feeding, resting, and wintering habitat for waterfowl and other migratory birds; protect and manage threatened and endangered species and their habitats; and provide opportunities for compatible public recreation and environmental education."

Exotic plant management activities that would affect natural resources within Canaveral National Seashore within a jointly managed area would need to be conducted with the collaboration and cooperation of the U.S. Fish and Wildlife Service.

DRY TORTUGAS NATIONAL PARK

Project Site Location

Dry Tortugas National park is a cluster of seven coral reef and sand islands surrounded by shoals and reef waters. The park encompasses 64,701 acres and is located approximately 70 miles west of Key West, Florida, in Monroe County (see the "Dry Tortugas National Park" map in appendix D).

Park Enabling Legislation and Purpose

In 1935, President Franklin Roosevelt set aside Fort Jefferson and the surrounding waters as a national monument. Congress redesignated the area as Dry Tortugas National Park in 1992 "to (a) protect and interpret a pristine subtropical marine ecosystem, including an *intact* coral reef community; (b) to protect fish and wildlife, including (but not limited to) loggerhead and green sea turtles, sooty terns, frigate birds, numerous migratory bird species; (c) to protect the pristine natural environment of the Dry Tortugas group of islands; (d) to preserve and protect submerged cultural resources; and (e) in a manner consistent with the above, provide opportunities for scientific research" (PL 102-525).

Park Significance

Dry Tortugas National Park is a unique area of the national park system and the least disturbed portion of the Florida Keys coral reef ecosystem. The tropical coral reef of the Dry Tortugas is one of the best developed on the continent and possesses a full range of Caribbean coral species, some of which are rare elsewhere.

The national park provides outstanding opportunities to understand and experience a rare combination of near-pristine natural resources and historic, scientific, and exceptional marine resources, in addition to quiet remoteness and peace in a vast expanse of sea and sky.

The park is an important resting spot for migrating birds, providing unique opportunities to see tropical birds. It has the only significant sooty and noddy tern nesting colonies in the country (Bush Key) and the only frigate bird nesting colonies in the continental United States (Long Key). The park is also one of the most isolated and least-disturbed habitats for endangered and threatened sea turtles in the United States.

Fort Jefferson, on Garden Key, is the park's central cultural feature and the largest 19th-century American coastal fort of military and architectural significance. The ruins of the first marine biological laboratory in the Western Hemisphere (the Carnegie Institution of Washington, D.C., Marine Biological Laboratory) are also on this key. The historic Loggerhead Key lighthouse and Garden Key harbor light are also located in the park.

Planning Documents for Dry Tortugas National Park

General Management Plan. The *Dry Tortugas National Park General Management Plan* was developed in 2001 to guide the future management of the park. The plan identifies resource protection as a long-term goal, so that "all natural resources and associated values are protected, restored, and maintained in near-pristine condition." Specifically, habitats impacted by humans should be restored so that the natural environment is suitable for use by wildlife, and native plants and animals should not be impaired by exotic plants (NPS 2001b).

Strategic Plan. The *Strategic Plan for Dry Tortugas National Park* for fiscal years 2001 to 2005 identified as a key natural resource long-term goal under Section Ia1, "the protection, restoration, and maintenance in near pristine condition of all natural resources and associated values." A more specific goal relating to exotic plants (Ia1a) is that "by September 30, 2005, 40 acres of disturbed park land is restored" (NPS 2001g).

EVERGLADES NATIONAL PARK

Project Site Location

Everglades National Park is located in south Florida, spanning the southern tip of the Florida Peninsula and most of Florida Bay. The 1,509,000-acre park lies in portions of three counties: Miami-Dade, Monroe, and Collier (see the "Everglades National Park" map in appendix E).

Park Enabling Legislation and Purpose

Everglades National Park was established in 1947 to be "wilderness where no development . . . or plan for entertainment of visitors shall be undertaken which would interfere with the preservation of the unique flora and fauna of the essential primitive natural conditions now prevailing in the area." An additional 109,506 acres were added to the East Everglades portion of the park under the *Everglades National Park Protection and Expansion Act of 1989* (PL 101-229). Title 16, Chapter 1, of the U.S. Code outlines rights of the Seminole Indian Tribe by stating: "…nothing in Sections 410 to 410c of this title shall be construed to lessen any existing rights of the Seminole Indians which are not in conflict with the purposes for which the Everglades National Park is created."

*The Miccosukee Reserved Area Act (*Public Law 105-313 of October 30, 1998) declared the activities of the Miccosukee Tribe on the Miccosukee Reserved

Area of Everglades National Park, situated along the northern edge of the park, to be consistent with the purposes of the park. Among other provisions, the act replaces past special use permits with a legal framework and affirms the intergovernmental effort among the United States, the state of Florida, the Miccosukee Tribe, and the Seminole Tribe of Florida to restore the South Florida ecosystem, including prevention of "significant propagation of exotic plants and animals" and significant cumulative adverse environmental impacts.

Park Significance

Everglades National Park is the largest designated subtropical wilderness reserve on the North American continent. The park contains both temperate and tropical vegetation categories and marine and estuarine environments. Its vast subtropical upland and marine ecosystems include freshwater marshes, tropical hardwood hammocks, rock pinelands, sawgrass prairies, extensive mangrove forests and cypress swamps, and seagrass ecosystems that support world-class fisheries. The park is known for its rich bird life, particularly large wading birds, such as the roseate spoonbill, wood stork, great blue heron, and a variety of egrets. It is also the only place in the world where alligators and crocodiles exist side by side.

The park is the only place in the United States designated as a World Heritage Site, an International Biosphere Reserve, and a Wetland of International Importance. The park provides sanctuary for more than 20 federally listed and 70 state-listed rare, threatened, and endangered species, and foraging and breeding habitat for over 400 species of birds. It is home to world-renowned wading bird populations and a major corridor for migratory bird populations.

Everglades National Park contains important natural and cultural resources of a number of Native American tribes and nations: Miccosukee Tribe of Indians of Florida, Independent Traditional Seminole Nation of Florida, Seminole Tribe of Florida, and the Seminole Nation of Oklahoma. The park's archeological and historical resources span 3,000 years of human culture. Its prehistoric sites reveal a fishing-hunting-gathering adaptation to a tropical environment (unique in the continental United States). The park still retains structures from a Nike missile installation constructed in the early 1960s as a part of south Florida's Cold War defenses.

Planning Documents for Everglades National Park

General Management Plan. Everglades National Park is developing a general management plan to replace its 1979 *Master Plan*. The new general management plan provides a broad conceptual framework to guide decisions for long-term park management and resource protection over the next 20 years, including exotic plant management. The 1979 plan identified the need to research and evaluate conditions that prevent the invasion of Brazilian pepper, and to study the effects exotic plant species have on the Everglades ecosystem (NPS 1979).

Strategic Plan. The *Strategic Plan for Everglades National Park* for fiscal years 2001 to 2005 includes a key natural resource long-term goal (Ia) to ensure that "natural and cultural resources and associated values are protected, restored, and maintained in good condition and managed within their broader ecosystem and cultural context." In addition, the park developed a specific mission goal for "Everglades National Park to be restored and protected in ways that allow natural processes, functions, cycles, and biota to be reestablished and maintained in perpetuity, and that allow archeological and historical resources to be appropriately preserved" (Ia1). More specific long-term goals for the park relating to exotic plants are, "by September 30, 2005, 1,220 acres in the Hole-in-the-Donut are restored (Ia1A)," and "by September 30, 2005, exotic plants on 6.3% of targeted acres of parkland is contained" (Ia1B) (NPS 2001h).

Resource Management Plan. Everglades National Park developed a *Resource Management Plan* in 1994 that specifically addresses exotic plants and their threats to native ecosystems. The NPS considers the following exotic plant species as serious threats because of the large areas they have invaded in the park: melaleuca, Brazilian pepper, Australian pine, and lather leaf. The *Resource Management Plan* suggests that long-term, and often regional, commitments with consistent monitoring and follow up are essential to successful exotic plant control (NPS 1994b).

GUIDING LAWS, POLICIES, AND PLANNING DOCUMENTS FOR CARIBBEAN NATIONAL PARKS

BUCK ISLAND REEF NATIONAL MONUMENT

Project Site Location

Buck Island Reef National Monument consists of approximately 19,015 land and water acres north of the island of St. Croix in the U.S. Virgin Islands (see the "Buck Island Reef National Monument" map in appendix F).

Park Enabling Legislation and Purpose

Buck Island Reef National Monument originally consisted of approximately 180 acres of land and 700 acres of water. It was established by presidential proclamation as a national monument in 1961 for the purpose of "protecting Buck Island and its adjoining shoals, rocks, and undersea coral reef formations" and to preserve "one of the finest marine gardens in the Caribbean Sea" for the benefit and enjoyment of the people and to protect it from "despoliation and commercial exploitation." Under the U.S. Coral Reef Initiative, the monument was expanded in 2001 to include submerged lands totaling 19,015 acres, to bring into the monument "additional objects of scientific and historic interest, and provide necessary further protection for the resources of the existing monument."

Park Significance

The park is one of only a few fully protected marine areas in the national park system. The island and surrounding coral reef ecosystem support a large variety of native plants and animals. Buck Island provides nesting habitat for three endangered and one threatened species: the hawksbill and leatherback turtles, the brown pelican, and the green turtle, and potential habitat for the endangered St. Croix ground lizard. The elkhorn coral barrier reef that surrounds two-thirds of the island has extraordinary coral formations, deep grottoes, abundant reef fishes and sea fans, as well as the famous underwater trail at the eastern-most point of the reef. The island contains terrestrial plants and animals and cultural artifacts.

Planning Documents for Buck Island Reef National Monument

General Management Plan. The park is developing a general management plan that provides a conceptual framework to guide the direction of the park over the next several years. Exotic plant management shall be incorporated into the plan as the park develops goals for natural and cultural resource protection.

CHRISTIANSTED NATIONAL HISTORIC SITE

Project Site Location

Christiansted National Historic Site is located on the island of St. Croix in the U.S. Virgin Islands and consists of 7 acres on the Christiansted waterfront/wharf area (see the “Christiansted National Historic Site” map in appendix G). The entire park may be considered a historic landscape whose orderly design and development reflect its 18th century traditions. This historic landscape is dominated by colorful colonial buildings, set on 2 acres of green open space that are planted with a mixture of plant species, including banyan, fan and date palms, flamboyant tree, mango, mahogany, tamarind, hogplum, lignum vitae, bougainvillea, shrubs, and grass. The size, scale, and design of the buildings, their organization, and the planned landscape, are all representative of Danish cultural moors at this time and place in history.

Park Enabling Legislation and Purpose

Christiansted National Historic Site was established through the initiative of concerned local citizens and through a series of agreements between the government of the Virgin Islands and the NPS “to preserve the historic integrity of the structures and ground as an excellent example of the Danish economy and way of life in the Virgin Islands for the enjoyment of present and future generations.” On March 4, 1952, the Department of the Interior and the government of the Virgin Islands entered into a memorandum of agreement that established the Virgin Islands National Historic Site to preserve the wharf area and related buildings as fine examples of the town’s economy and way of life in Danish times. The name of the park was changed in 1961 to Christiansted National Historic Site under a new memorandum of agreement.

Park Significance

Christiansted National Historic Site, consisting of 7 acres centered on the Christiansted waterfront/wharf area, offers a glimpse at a unique part of America’s heritage. The park’s significance centers on its five historic structures that provide excellent examples of Danish economy and way of life in the Virgin Islands: Fort Christiansvaern (1738), the Danish West India & Guinea Company Warehouse (1749), the Steeple Building (1753), the Danish Custom House (1844), and the Scale House (1856). The site contains the oldest and largest former slave-trading complex under the U.S. flag.

The NPS uses these resources to interpret the drama and diversity of the human experience at Christiansted during Danish sovereignty—colonial administration, the military and naval establishment, international trade (including the slave trade), religious diversity, architecture, trades, and crime and punishment.

Planning Documents for Christiansted National Historic Site

General Management Plan. The *Christiansted National Historic Site General Management Plan* was developed in 1986 to provide guidance on the overall management of the park and on ways to meet stated management objectives. The *General Management Plan* does not specifically address exotic plant management, but it does address the need to preserve the site and its landscape in its historic condition and to protect cultural resources (NPS 1986).

SALT RIVER BAY NATIONAL HISTORIC PARK AND ECOLOGICAL PRESERVE

Project Site Location

The park totals 1,015 acres and is located on the island of St. Croix in the U.S. Virgin Islands (see the “Salt River Bay National Historic Park and Ecological Preserve” map in appendix H).

Park Enabling Legislation and Purpose

Salt River Bay National Historic Park and Ecological Preserve was established by Congress in 1992 “to preserve, protect, and interpret for the benefit of present and future generations certain nationally significant historical, cultural, and natural sites and resources in the Virgin Islands” (PL 102-247).

Park Significance

Salt River Bay National Historic Park and Ecological Preserve has been a National Natural Landmark since February 1980. Salt River Bay contains nationally significant wildlife habitat that supports threatened and endangered species. The area’s blend of sea and land holds some of the largest remaining mangrove forests in the Virgin Islands, as well as estuary, coral reefs, and a submarine canyon.

Possibly inhabited as far back as 2000 B.C., Salt River Bay encompasses all major cultural periods of human habitation in the Virgin Islands. The park contains prehistoric and colonial-era archeological sites and ruins, plus village middens and burial grounds that provide evidence of Caribbean life before Columbus. It is the only known site where members of the Columbus expeditions set foot on what is now U.S. territory.

The park not only provides outstanding opportunities to interpret Caribbean history and culture, but it reveals the impact of European exploration and settlement. It was the focal point of various European attempts to colonize the area during the post-Columbian period. The park contains sites of Spanish, French, Dutch, English, and Danish settlements, including Fort Sale, one of the few remaining mudwork fortifications in the Western Hemisphere. The park also has the only ceremonial ball court ever discovered in the Lesser Antilles.

VIRGIN ISLANDS NATIONAL PARK

Project Site Location

Virgin Islands National Park covers approximately 14,690 acres in the U.S. Virgin Islands—approximately 60% of the island of St. John, nearly all of 135-acre Hassel Island in the Charlotte Amalie harbor off the island of St. Thomas, 6 acres in the Red Hook area, and 4 acres at the Wintberg estate on St. Thomas (see the "Virgin Islands National Park" map in appendix I).

Park Enabling Legislation and Purpose

Virgin Islands National Park was established in 1956 so its outstanding scenic values and features of national significance would be "be administered and preserved …in their natural condition for public benefit and inspiration." (70 U.S. Statutes [Stat.] 746). The park was expanded in 1962 (76 Stat. 746) to include an additional 5,650 acres of adjoining submerged lands to preserve "significant coral gardens, marine life and seascapes."

Park Significance

Virgin Islands National Park is renowned throughout the world for its breathtaking beauty and outstanding scenery. The park is an undeveloped sample of a tropical environment where the processes of nature can be observed, studied, and used as a basis for comparing the development of natural ecosystems in similar areas. The park is composed of protected bays of crystal, blue-green waters teeming with coral-reef life, white sandy beaches shaded by sea grape (*Coccoloba uvifera*) trees, and tropical forests providing habitat for over 800 species of plants.

The park has a rich cultural history. It contains relics from the pre-Colombian Amerindian civilization, as well as cultural sites that are significant in the settlement and colonial development of the New World and in its maritime history and commerce. The park contains the remains of Danish colonial sugar plantations and its reminders of African slavery and the subsistence culture that followed it for the 100 years after Emancipation.

Planning Documents for Virgin Islands National Park

General Management Plan. The *General Management Plan for Virgin Islands National Park* was developed in 1983 to perpetuate and enhance the park's nationally significant natural and cultural resources and to continue the variety of resource-based activities enjoyed by visitors. The General Management Plan's strategy is to deal with exotic plants, inventory terrestrial vegetation, and conduct research to improve the management of natural resources. Virgin Islands National Park is now developing a general management plan to replace its 1983 plan.

Resource Management Plan. The park's *Resource Management Plan*, developed in 1994, describes the threat exotic plants pose to native species and ecosystems and the ways exotic plants are introduced into the park. The plan identifies the need to inventory exotic species and determine the level of threat they pose to park resources. The plan also identifies conditions when further management actions need to be evaluated and implemented. A condition could be when “the species interferes with park objectives, has the ability to alter ecosystems, can spread to natural communities, can out-compete native species, or is allelopathic” (has the ability to produce secondary chemical compounds that can leach from leaves, seeds, or roots into the soil and suppress the germination or growth of native plant species) (NPS 1994a).

SUMMARY OF RESEARCH ON EXOTIC PLANTS

Exotic plant species can displace or hybridize with native species. They can also change the structure of the vegetation category, the competitive regimes, or the function of the ecosystem they invade. These species have one or more characteristics that enable them to displace native plant species and sometimes entire vegetation categories. Exotic species have:

- Effective reproduction and dispersal mechanisms
- A competitive ability superior to that of native plants in the original or modified system
- Few or no herbivores or pathogens, especially in herbivore-controlled communities
- The ability to occupy a “vacant niche”
- The ability to alter a site by significantly changing resource availability or disturbance regimes or both (Gordon 1998)

A subtropical climate, abundant freshwater, and the influx of cultures and commodities that enter Florida, make the state susceptible to exotic plant invasions. The Port of Miami receives at least 85% of the live nonnative plant shipments that arrive each year in the United States (ISWG 2002). Of the 31 exotic plant species in Florida considered by the Florida Exotic Pest Plant Council to be the most invasive, 12 to 20 (39% to 64%) potentially alter the ecosystem properties of geomorphology, hydrology, biogeochemistry, and disturbance (Gordon 1998).

The four Virgin Islands national parks also have problems with nonnative species. European settlers destroyed most of the native plants in the early 1700s while converting the land into plantations. On St. John, for example, the destruction of native plants continued until over 90% of them were destroyed and eventually replaced by dense thickets or grasslands of the introduced nonnative species (Acevedo-Rodriguez 1996).

Exotic species also affect the human environment, with some individuals affected by allergies and skin irritations caused by certain plant species. Citing Lloyd et al. (1977); Morton (1978); and Olmsted and Yates (1984), the exotic weeds discussion on the NPS Nature and Science website reports that Brazilian pepper can produce effects similar to those of its close relative, poison ivy, and may have caused massive bird kills in Florida (NPS 2003e). Melaleuca can cause severe respiratory disorders and headaches among some people, although Geary and Woodall (1990) note no reports of such effects in Australia or Hawaii. In fact, the Australian Northern Territory Centre for Disease Control recommends burning melaleuca bark to repel biting midges (Whelan 2003).

EXOTIC PLANT TREATMENT METHODS

The NPS currently uses a variety of treatment methods to control exotic plants. The methods include mechanical, physical, biological, and chemical treatments, as well as prescribed fire.

Mechanical Treatment Methods

Mechanical treatment consists of methods that physically destroy, disrupt growth, or interfere with the reproduction of noxious and exotic plants. These methods can be accomplished by hand, hand tool, power tool, or heavy equipment, such as bulldozers, and may include manual pulling, digging, hoeing, tilling, cutting, mowing, and mulching exotic plants. Remote locations and marshy conditions make it difficult or impossible to perform mechanical treatment in some areas of the parks.

Manual pulling of exotic plants is very labor intensive and often leaves root fragments in the ground. If sufficient root mass is removed, the individual plant can be destroyed. This can be done successfully with shallow-rooted plants. However, some exotic plant species respond to mechanical treatment by aggressively resprouting, even if only small root fragments are left in the soil. This type of treatment is much less effective on rhizomatous plants (for example, guinea grass [*Urochloa maxima*]) than non-rhizomatous exotic plant species because of their well-developed root system and carbohydrate reserves. Mechanical treatments must be repeated several times a year for many years to eradicate exotic plant species that are prolific seed producers and have built up a residual seed bank in the soil. To be most effective, mechanical treatment must occur before seed production starts. Plants that have already flowered must be removed from the treatment area and destroyed. Mechanical treatment methods are most effective when used in combination with other controls, such as chemical treatments. The basal bark herbicide application method is an example of a successful combination of mechanical and chemical control.

Prescribed Fire

Prescribed fires change some element of a system's ecology. Prescribed fire has been used to alter fire regimes in order to control exotic plants.

Prescribed fire is not used in the Virgin Islands parks because the ecosystem is not based on a fire regimen. Florida, with numerous ecosystems that depend on occasional fires, has been among the leading states to use of prescribed fire, passing the *Prescribed Burning Act* into law in 1990. This legislation and its associated administrative rules authorize and protect prescribed fire for ecological, silvicultural, and wildfire management purposes (Brenner and Wade 2003). Cultural sites, such as historic structures, cultural landscapes, and exposed or partially exposed archeological sites, are especially vulnerable to fire.

Therefore, before a prescribed fire is initiated, these resources would be identified and protective measures would be established.

The use of prescribed fires for controlling exotic species in parks has been both necessary and effective. Exotic plants can compromise human safety in and near the parks. Old World climbing fern (also known as "lygodium") provides fire ladders that give flames access to forest canopies, intensifying fires and allowing them to spread more quickly. Stands of exotic plants near residential areas can increase the threat to homes posed by fire. Overgrowth of exotic plants near roadways can interfere with a driver's line of sight, blocking views of road signs or of traffic at intersections and, generally, complicating navigation. It has been observed that fire alone, without the assistance of herbicide application, is not successful in eradicating Old World climbing fern, though fire treatment does result in reduced biomass, requiring the use of less herbicide (Ferriter 2001).

Melaleuca is a fire-adapted species and is capable of colonizing Florida's fire-adapted habitats. Burning melaleuca facilitates the spread of the species by causing the release of vast numbers of stored seeds, and it rarely results in the death of mature trees. However, because melaleuca invades fire-adapted systems, the lack of burning in these areas results in undesirable successional changes in the vegetation (Myers et al. 2001). Managers, therefore, had to define ways in which to use prescribed fire in fire-adapted communities to promote appropriate successional changes in native vegetation without enhancing the spread of melaleuca. It was discovered that the use of fire is successful in killing seedlings of melaleuca after an initial treatment with herbicides. Field studies have shown that most seedlings less than 50 centimeters tall are killed by prescribed fire (Myers et al. 2001).

Big Cypress has successfully employed this approach in the past in managing stands of melaleuca. The preserve used a combination of herbicide treatment and mechanical removal, followed by burning within 2 to 12 months of initial treatment. The approach has proven successful in that there are no longer any sizable stands of melaleuca remaining within the preserve (Myers et al. 2001).

Prescribed fire is being conducted under carefully designed fire management plans in Big Cypress National Preserve, Everglades National Park, and Canaveral National Seashore to enhance and protect native vegetation communities and to benefit wildlife, such as the red-cockaded woodpecker. The benefits from this activity include:

1. restoring and maintaining fire-dependant communities
2. reducing the chances of destructive wildfires
3. reducing invasion by hardwood species
4. perpetuating fire-adapted flora and fauna
5. cycling nutrients
6. controlling tree disease
7. and opening vistas (USFWS 2004).

Periodic fires also protect private property near the park's boundaries. Prescribed fires in the park are small, controlled, and spread slowly. Prescribed fires are only used for the goals of reducing fuel loads that have the potential to become wildfires, or of improving habitat for wildlife.

In 2001, implementation of the *Integrated Pest Management Plan* enabled prescribed fires to be used for the control of exotic plants in the Arthur R. Marshall Loxahatchee National Wildlife Refuge. Using federal and state funding, prescribed fire has been performed on thousands of acres infested with melaleuca, Old World climbing fern, and other exotic species.

A recent survey found that while 7% of Florida homeowners approve of herbicide use for vegetation management, 85% support prescribed fires, if properly managed. Primary concerns expressed about such fires are containment of the fire and the effects of smoke (Nelson et al. 2003).

Florida's *Prescribed Burning Act of 1990* requires a written burn plan or prescription, including a site description and map, personnel and equipment, desirable weather conditions, and desired fire behavior factors (Brenner and Wade 2003). In addition, plans should emphasize protection of adjacent land, including identification of potential ways the fire may escape containment and the planned responses to such fire escapes, including who would be in charge of suppression, what equipment would be available, and the names and phone numbers of local and state fire-protection officers and other officials to notify before starting the burn (USFS 1989).

Preparation to ensure that prescribed fires stay contained can take up to a year. Field surveys ascertain whether the terrain is suitable for controlled burns. Firebreaks, sometimes prepared weeks or months in advance, limit the treated area. Large areas are broken into smaller blocks that can be burned in one working day (SFWMD 2004); each of the smaller blocks should have a detailed map in the burn plan (USFS 1989).

When the fuel load is dangerously large, mechanical grinding can reduce loads to a safe level for later burning. The fire is begun only if weather conditions fit the prescription, and close monitoring of weather during the burn alerts managers to conditions that could require fire suppression (SFWMD 2004). Computer programs, such as BEHAVE and VSMOKE GIS, can predict fire and smoke behavior using data such as fuels, weather conditions, and topography. Some programs can run on hand-held calculators to enable instantaneous decisions in the field (USFS 1989; Goodrick and Brenner 1999). Firefighters stationed along the perimeter make sure that the burn stays within the designated area (SFWMD 2004).

Precautions to prevent fire from escaping also include:

- Carrying burn plans and maps on the job
- Checking all control lines (fire barriers) and cleaning or reinforcing, as necessary, before starting

- Performing a small test burn and starting the prescribed fire only if fire and smoke behavior are acceptable
- Having all crew members carry radios for communication
- Patrolling perimeters constantly during, and after, the burn until there is no further danger of fire escape
- Having a backup plan and backup forces available (USFS 1989)

The U.S. Forest Service also recommends further analysis before burning if "red flag situations" exist. These situations include heavy fuel loads, dry duff and soil, extended drought, inadequate control lines, large burn areas, and relative humidity below 30% (USFS 1989).

Heavy smoke that lasted for weeks from wildfires in Florida in 1988 closed down major transportation routes and caused health problems across the state (Seminole County 2003). Fortunately, fire management can result in less smoke from a prescribed fire than from a wildfire burning the same area (Monroe 1999). To minimize smoke effects from prescribed fires, national parks address smoke issues before and during burns (NPS 2003a; 2003e).

Five toxins of greatest concern—Carbon monoxide, respirable particulates, formaldehyde, acrolein, and benzene.

Smoke consists of ash particles, partly consumed fuel, and liquid droplets. Invisible gases, such as carbon monoxide, carbon dioxide, hydrocarbons, and small quantities of nitrogen oxides accompany smoke (USFS 1989). Most toxins in smoke are produced during the smoldering phase (Nature Conservancy 2000). The five toxins of greatest concern are carbon monoxide, respirable particulates, formaldehyde, acrolein, and benzene. Exposure levels for workers to the other four correlate closely with exposure to carbon monoxide, which is easily and inexpensively monitored (USFS 1996; Nature Conservancy 2000).

Glyphosate—An herbicide that inhibits a specific enzyme that plants need to grow. Roundup® is one herbicide based on glyphosate.

The warnings on herbicide labels to avoid smoke if the herbicide is burned apply to concentrated forms as found in containers, not to the diluted form applied to forest sites, in which only a few kilograms or even grams of herbicide are applied to several thousand kilograms of vegetation and forest litter (McMahon and Bush 1992). Moreover, many herbicides break down quickly after use, and field measurements as well as theoretical calculations indicate that prescribed fires burn hot enough to break down herbicides, so that any residues in smoke are well within currently accepted standards (USFS 1989; McMahon and Bush 1986). A study in Oregon found no residues in smoke from prescribed fires in areas previously treated with glyphosate (National Council for Air and Stream Improvement [NCASI] 1987). Samples collected using personal monitors on forest workers and portable monitors set in areas of high smoke concentration at 14 brown-and-burn fires in Georgia were analyzed using gas chromatography No airborne herbicide residues were detected. Herbicides used to prepare the areas for burning included imazapyr and triclopyr (McMahon and Bush 1992).

Despite fears expressed by some members of the public about herbicide residues in smoke, "the principal inhalation hazard to workers in prescribed fire operations continues to be from smoke constituents derived from the natural or untreated forest vegetation" (McMahon and Bush 1992). While particulates can present a safety hazard by reducing visibility (USFS 1989), these same particulates can penetrate deep into the lungs, posing a health risk. Seventy percent of these particles are less than 2.5 microns in diameter, a size that appears to be closely associated with lung damage, respiratory illness, cardiovascular disease, and premature death (Monroe 1999). Short-term health effects of smoke exposure include eye and respiratory system irritation (USFS 1989). Long-term effects for those subject to repeated, lengthy exposure to relatively low concentrations include respiratory problems and an increased cancer risk of approximately one in 1 million (USFS 1989).

The compounds in smoke when burning noxious plants, such as poison ivy, carry additional risk. Smoke containing these residues can cause widespread skin rashes and serious respiratory system irritation (USFS 1989). Among the exotic plants invading the parks, Brazilian pepper is known to cause such reactions. Smoke from burning this plant can cause severe sinus, lung, and eye irritation (Brevard County n.d.; University of Florida 2004).

While occasional brief exposure to low-concentration smoke is more a temporary inconvenience than a major health risk (EPA 2004), high concentrations of smoke can adversely impact health, especially for those with respiratory illnesses (USFS 1989). However, carbon monoxide from cigarette smoking may involve more risk than from burning vegetation (Nature Conservancy 2000). Although as many as 10% of firefighters can be exposed to potentially hazardous smoke levels during prescribed fires, when properly dispersed, such smoke does not threaten human health (USFS 1996).

Short-term overexposure to smoke most often results from high winds or unexpected fire behavior, and it usually affects workers maintaining the fire within its prescribed boundaries (Reinhardt et al. 2000). Smoke-exposure risk for fire crews can be minimized by providing awareness training for crews, rotating crew members in high-exposure assignments, monitoring exposure using carbon monoxide dosimeters, having crew members use respirators, only burning when fuels contain moderate moisture, and avoiding burning during inversions or when wind speeds are too low or too high (Nature Conservancy 2000). In addition, smoke management should include careful pre-burn planning, strategic water application, and a health surveillance program to identify individuals susceptible to adverse risks from smoke exposure (Reinhardt et al. 2000).

Prescribed fire managers must also protect populations other than those working the burn. Susceptible populations, such as those with asthma, are more susceptible to adverse effects from forest-fire smoke than are firefighters (Slaughter et al. 2004). In addition, managers must consider smoke-sensitive areas, such as populated areas, highways, and airports, and burn only on days when the wind blows away from such sensitive areas (USFS 1989).

Although prescribed fires, unlike wildfires, do not degrade air quality on a regional scale, they can cause air-quality issues at a local level (USFS 1989). Mitigation to minimize impact on smoke-sensitive areas and populations includes a wide range of measures. Prescribed fires should be postponed during regional air quality alerts or stagnant conditions (USFS 1989).

Burning should only occur under wind conditions that favor rapid dispersion of the smoke and that carries smoke away from sensitive areas as far as several miles downwind. Good smoke dispersion conditions exist when the layer of air within which smoke and other pollutants mix with the air extends at least 1,700 feet above the ground, and wind speeds within that layer are more than 9 miles per hour (USFS 1989). In contrast, stable air conditions (including temperature inversions) allow smoke to accumulate near the ground (USFS 1989).

Atmospheric conditions for dispersion of smoke are most favorable during the middle of the day, because by then, dew has usually evaporated, while there is yet time enough for a thorough mop-up before nightfall. Smoke drift and visibility are very difficult to predict at night, because the wind may lessen or stop completely, keeping smoke concentrations high in the vicinity of the burn. When relative humidity rises above 80%, the formation of fog becomes increasingly likely as moisture condenses on smoke particles. On coastal plains, nighttime air drainage, and therefore smoke, often follows waterways, so extra caution should be taken to protect smoke-sensitive areas or populations along drainages (USFS 1989).

Burning should be done when the wind can carry smoke away from public roads, airports, and populated areas. If a smoke-sensitive area is within a half-mile downwind of the proposed burn, the burn should be delayed until the wind changes. The burn team should post smoke-warning signs on roads and be ready to direct traffic if needed (USFS 1989). Mop-up along roads should begin as soon as possible and focus on extinguishing stumps, snags, and logs to reduce the impact on visibility, as well as on sensitive populations. If, despite such efforts, smoke becomes a problem, mitigation strategies could include advising residents to close windows and doors, improving heating, ventilating, and air conditioning (HVAC) system particle-filtration, and providing portable air cleaners (Miller and Milford 2001). The agency conducting the burn could also offer to evacuate anyone with respiratory problems during the burn, putting them up in a local motel if necessary (USFS 1989).

Biological Treatment Methods

Biological controls use a plant's natural predators to limit its population. The U.S. Department of Agriculture has used biological controls for 110 years. The term was originally used in 1919 by H.S. Smith of the University of California, when he referred to "the action of parasites, predators, and other pathogens in maintaining another organism's density at a lower average than would occur in their absence" (USDA 2000). Though this approach is not as quick or dramatic as other treatment options, it is often used as a less expensive and less invasive alternative to the use of chemical or mechanical control of exotic plant species. Biological controls are less dangerous to air, soil, and water resources than chemical treatment, and less disturbing to human activities. The insects used are usually specific to a particular pest, whereas some herbicides are non-specific and can kill many nontarget organisms. The use of biological controls, however, requires a thorough understanding of the ecosystem in which the insect would be released.

There are three approaches to biological control: classical, augmentation, and conservation.

> *Classical* – biological control involves the use of insects from within the pest's own region. Typically, this means traveling to the country of an exotic species' origin and bringing back a natural enemy of the exotic species. There must be a great deal of research done prior to this to ensure that the natural enemy cannot feed on or affect other nontarget species in addition to the intended exotic.
>
> *Augmentation* – is an increase in the population of the natural enemy of a particular pest. This can include mass breeding (rearing) and release, or developing better, more efficient enemies who can find and then attack their prey more effectively. This method is very management-intensive and should be considered a short-term solution to be later replaced with a more sustainable approach.
>
> *Conservation* – is the identification and alteration of factors limiting the effectiveness of the natural enemy in order to enhance the success of their attacks. This involves activities that either reduce factors interfering with their survival or successful hunting, or increasing factors that are beneficial to their survival and efficiency in attacking (Orr et al. 1997).

Biological control is a feasible approach for Old World climbing fern in the south Florida Parks, since it is taxonomically isolated from all but one other U.S. plant, and it grows intertwined into other natural vegetation categories that might be damaged or killed by most control methods because of their proximity (Ferriter 2001). This is also a good technique for the control of Brazilian pepper and melaleuca, since both plants have numerous host-specific herbivorous insects known to feed on them in their native regions (Laroche 1999).

Biological controls continue to be used successfully to treat melaleuca in south Florida, specifically in Big Cypress National Preserve. Two insect biological control agents, the leaf weevil (*Oxyops vitiosa*) and the sap-sucking psyllid (*Boreioglycaspis melaleucae*) have been released in south Florida to help control melaleuca. Another insect, a gall-forming fly, (*Fegusonina* sp.), may be released in the near future. (It is currently waiting petition for release.) In 1997, approximately 8,000 weevils were released at 13 melaleuca-infested locations in south Florida. Currently there are millions of weevils feeding on the leaves of melaleuca trees (Pratt et al. 2004). Both adults and larvae damage melaleuca by disrupting the plants' normal growth processes. Large larvae can destroy most of the leaves on several shoots of an individual plant, and this feeding by the weevil decreases the ability of the tree to reproduce. Mostly young leaves are eaten, and, eventually, the trees are defoliated, because the old leaves fall off when dead, and there are no new leaves to replace them. The damaged melaleuca foliage can be seen at several sites in south Florida where high populations of the larvae have been observed. Where the weevil has been established, it has been demonstrated that flowering of the plant has been reduced up to 90%. This type of feeding damage helps to reduce seed production and prevent further spread of this highly invasive plant (Cuda et al. 2005).

The psyllid was released in 2002, and to date, some 350,000 have been released at a variety of south Florida locations. The psyllid immature stage (nymph) kills the leaves and stems of the plant. These insects have established large populations at most release sites, and the estimated numbers per acre are in the multimillions (Pratt et al. 2004).

The gall-forming fly, which is awaiting approval for release, galls the buds of melaleuca where multiple fly larvae feed and develop. The damage to the bud stunts the growth of melaleuca and should reduce seed production (Buckingham 2004). The overall goal of biological controls is to reduce seed production and, thus, the invasive spread of melaleuca. A reduction in seed production through the use of these biological controls will complement other treatment methods, such as chemical and mechanical treatments, and enhance the efficacy of the overall management program in south Florida and in the parks (Laroche 1999). The unexpected effects of biological control can include, among other things, damage to or decimation of nontarget species populations (plant of animal) and the unintended removal of a keystone species in the ecosystem. Some argue that every fish introduction for biological control that has been thoroughly studied has had major detrimental effects on nontarget organisms, despite its impact on the target species (Simberloff and Stiling 1996). The effects of a species introduction, especially when an exotic is brought in to an ecosystem to control another exotic, can have disastrous effects to the entire ecosystem. This can occur as a result of direct predation, competition for food, destruction or alteration of habitat, or myriad other effects to the many resources the nontarget native species relies upon. A cogent example of this is the case of the introduction of the Myxoma virus to control the population of rabbits in Great Britain. The rabbits were the main means of maintaining the open habitat in a time of changing land uses, but with its population reduced, the appropriate habitat available for the nesting ant (*Myrmica sabuleti*) was also reduced. This ant's nests, in turn, provided a necessary and specialized habitat for the caterpillars of the large blue butterfly (*Maculina arion*). This ant does not nest in developed areas, so that with less undisturbed land available because of the rabbit's maintenance of it, less ant nests were created. The reduced number of ant nests so affected the habitat needs of the butterfly that it ultimately led to the butterfly's extinction (Ratcliffe 1979 as cited in Simberloff and Stiling 1996).

Additional problems with biological control are the development of safeguards against nontarget predation, dispersal, and evolution. Developing safeguards prior to release of a new species into the ecosystem can be extremely expensive. Living organisms tend to disperse, and, when the introduced organism disperses beyond the intended region, it becomes very difficult to safety test for host-specificity (Simberloff and Stiling 1996). Evolution can cause unexpected problems in that every gene mutation that occurs in the introduced predator can change host-specificity, leading to unpredictable nontarget species predation.

Others argue that the data are not strong enough to support generalized assumptions about nontarget predation and ecosystem damage by introduced species used for biological control. There are few documented instances of damage to nontarget organisms or the environment from the release of nonindigenous species for biological pest control, relative to the number of such releases. Funaski et al. found that of 679 species deliberately introduced between

1890 and 1985, 243 established populations, and 20 of these are recorded as having attacked nontarget native species. Additionally, of the 533 introduced insect species, 15 are known to attack nontarget hosts (Funasaki et al. 1988). This information should be considered in the argument that modern protocols in biological control have greatly advanced in minimizing the already-low probability of unforeseen effects (Funasaki et al. 1988). However, this information from this study alone is not evidence that biological control is safe, because monitoring of nontarget species is minimal, particularly in sites and habitats far from the point of release (Simberloff and Stiling 1996).

Under the *Plant Protection Act of 2000*, the U.S. Department of Agriculture Animal and Plant Health Inspection Service (APHIS) has the authority to regulate "any enemy, antagonist or competitor used to control a plant pest or noxious species." Cooperation among APHIS, the Technical Advisory Group, and scientists working to get a recommendation for the introduction of biological agents, begins early and continues throughout the approval process. Scientists submit a petition to Technical Advisory Group with a proposed host specificity test plant list. A potential threat that any biological control agent might hold for any threatened or endangered species is also assessed. Scientists must then request a permit from the APHIS Plant Protection Quarantine Unit for importing any biological agent. It takes four to six weeks to receive the permit. Once the approved biological control agent arrives in the United States, it must be held in a high-security containment facility where tests of the biological control agent are conducted. For example, insects are placed in "eat or starve" conditions with a variety of plant species to determine their host-specificity.

Release of a biological agent requires compliance with both the *National Environmental Policy Act* and the *Endangered Species Act*, which require, at a minimum, an environmental assessment and a biological assessment, respectively. Next a petition is submitted to the Technical Advisory Group for the release of the biological control agent. Once this approval is received, the scientist must submit the draft environmental assessment and biological assessment to the Plant Protection Quarantine Unit and apply for release. At this point, the applicant must consult with the Fish and Wildlife Service (FWS). The response of FWS is then incorporated into the environmental assessment. The U.S. Department of Agriculture Office of General Counsel then reviews the environmental assessment. If approved, the environmental assessment is then made available for comment, after which the Plant Protection Quarantine Unit either issues a permit, advises the preparation of an EIS, or advises discontinuation of the project.

More details of the APHIS biological control approval process can be found on their website at http://www.aphis.usda.gov/ppq/permits/biological/weedbio.html. Only APHIS-approved biological controls would be used in the parks and would be released according to APHIS requirements and NPS policy.

Despite the potential risks, the science and practice of biological control continues to be developed and used, because the cost of not doing the project may be greater than the potential ecological or financial costs of introducing an insect or other organism.

Chemical Treatment Methods

Chemical treatment methods involve the use of herbicides to destroy a target plant species, usually an exotic plant. Herbicides have been commonly used throughout recent decades as an inexpensive, low-impact method of controlling exotic plants and allowing the reestablishment of native species. Herbicides can selectively treat individual plants with minimal soil disturbance, which is especially important in cases where even disturbance of the litter layer could spur a reinfestation (Kline and Duquesnel 1996). When infestations of exotic species are contained within a mixed species community, single-stem herbicide treatment (cut-surface or basal-bark treatment, or foliar-spray application) is the best option for avoiding non-target mortalities. When infestations have created a monoculture, broadcast herbicide application is the most efficient method of treatment.

All herbicides used in the United States are regulated and licensed through the EPA. Herbicides cannot be released to market until they have been thoroughly evaluated for potential long- and short-term effects on humans and the environment. This evaluation includes examination of the herbicide's ingredients; the particular site or crop on which it is to be used; the amount, frequency, and timing of its use; and storage and disposal practices. The producer of the herbicide provides the EPA with all data from tests done in order to assess the potential to cause adverse effects on humans, wildlife, fish, and plants, in addition to the possibility of surface or groundwater contamination from leaching, runoff, or spray drift. The pesticide registration process is as follows:

1. The manufacturer submits the herbicide registration application, including background test data (chemistry, assessment for food safety, tolerance information, and proof of reliability) and labeling information (occupational data, directions for use, and warnings).

2. The EPA processes the application and conducts an evaluation by reviewing the data on aggregate risks and cumulative risks to humans, and environmental risks to water, endangered species, and endocrine system functioning.

3. The EPA makes the decision on the herbicide's regulation (EPA 2004).

The review process for registration can take several years to complete. Applications for approved active ingredients (such as Glyphosate, Metsulfuron methyl, Triclopyr, and Imazapyr) can often complete the process faster, for example, in as little as a year.

A summary of available scientific information about the characteristics and effects of the herbicides that would potentially be used for treatment of exotic plants under this management plan is provided in appendix J.

EXOTIC PLANT TREATMENT PRIORITIES

Although numerous exotic plant species have invaded the nine NPS units participating in this coordinated effort, to keep this draft EPMP/EIS to a manageable size, this summary of research focuses on seven high-priority species for which information exists concerning the exotic species' effects on other resources. The priority exotic plant species (lime berry and genip) that are infesting parks in the Caribbean have not been included in the summary of research. Although research is currently being conducted in the Caribbean, there is no published research available on the effects that these plants are having on other resources that could be supplied in this summary.

The species were selected using the following four criteria:

- Immediacy of threat to park resources
- Prevalence in the parks
- Responsiveness to treatment
- Available research on effects

Seven exotic plant species meet more than one of the above criteria and are receiving the highest priority for treatment:

1. Australian pine
2. Brazilian pepper
3. guinea grass
4. lather leaf
5. melaleuca
6. Old World climbing fern
7. tan tan

The following is a summary of the characteristics of each of these plant species and the effects they have on some of the park resources. A full discussion of the effects of these plants and treatment methods is in the "Environmental Consequences" chapter.

Australian pine in a beach area

AUSTRALIAN PINE

Australian pine (*Casuarina* spp.) is an evergreen tree with tiny, cone-like fruit, and soft, multijointed branchlets that resemble pine needles. It can grow 5 to 10 feet per year, reaching heights greater than 100 feet. Native to the South Pacific and southern Asia, it has spread to Hawaii, Florida, many islands in the Caribbean and the Bahamas (Gilman and Watson 1993). Its dense thickets replace native vegetation categories along dunes and beaches, as well as in disturbed areas, such as road shoulders, filled wetlands, and undeveloped lots (Maxwell 1984). Australian pine was widely planted in populated coastal areas during the 1950s, because it tolerates salt and drought, provides a windbreak and shade, and was erroneously believed to prevent erosion. Unfortunately, it reproduces prolifically, with as many as 300,000 seeds to the pound, which are easily dispersed by wind, water, and birds (Morton 1980).

Currently, Australian pine is found in Everglades National Park, Big Cypress National Preserve, Canaveral National Seashore, Dry Tortugas National Park, Salt River Bay National Historic Park and Ecological Preserve, and Virgin Islands National Park (Pernas 2003). It was first reported in Everglades National Park in the 1960s, and it currently infests over 75,000 acres of Everglades wetland areas (NPS n.d.b).

Effects on Native Vegetation

Australian pines drop a substantial amount of litter that forms a dense layer and prevents native plants from germinating. The shade produced by the evergreen foliage may cause native plant species in the understory to decline because of light deprivation. There is some speculation that the litter releases toxins that suppress the growth of other plants (Morton 1980). The shallow roots form a thick mat that prevents deeper-rooted plants from becoming established by intercepting water and nutrients. In addition, Australian pines on coastal areas are more likely than native species to be blown over during strong winds.

Effects on Threatened and Endangered Species

The thick root systems of Australian pine can prevent federally threatened and endangered sea turtles from digging their nests on coastal beaches and have occasionally trapped turtles while they were trying to dig nests. The trees also interfere with American crocodile nesting. The thick mats of litter and roots prevent development of native beach and dune plants, some of which are listed as endangered or threatened species in Florida (FLEPPC 2004).

Infestations of Australian pine into the wet (marl) prairies in Everglades National Park and Big Cypress National Preserve are seriously harming the habitat for the federally endangered Cape Sable seaside sparrow, which needs an open habitat for breeding and foraging (Pimm 2004).

Effects on Wildlife

Australian pine out-competes native vegetation by creating dense shade, a thick layer of litter, and a dense mat of roots. Australian pine provides inferior wildlife habitat (Binggeli 1997), because it replaces a species-rich habitat with one that is biologically less diverse. Even common species such as the cotton rat and marsh rabbit are unable to find sustenance in the sterile habitat of Australian pine stands (Morton 1980).

Effects on Soils

Australian pine has the ability to fix nitrogen (convert nitrogen to a stable, biologically available form) in the soil, altering soil chemistry, which also gives it a competitive edge over native species (Swearingen 1997).

BRAZILIAN PEPPER

This evergreen shrub native to South America grows to 40 feet tall. Multistemmed trunks and branches form tangled thickets. Leaflets are 1 to 2 inches long, with dark upper surfaces and lighter lower surfaces. Clusters of small, white flowers produce red spherical fruits.

Brazilian pepper (*Schinus terebinthifolius*) was first described as a potential problem plant in south Florida in the early 1960s and identified as an invasive species in Everglades National Park in 1969. Frugivorous (fruit-eating) birds that eat and disperse the Brazilian pepper's bright red berries provide the primary means of dispersal. Brazilian pepper can successfully colonize not only disturbed sites but also natural communities, where it aggressively crowds out native plants.

Habitats invaded by Brazilian pepper include fallow farmlands, pinelands, hardwood hammocks, roadsides, and mangrove forests (Laroche 1994). By 1997, it was estimated to occupy over 700,000 acres in central and south Florida (Ferriter 1997). The shrub is currently found in Everglades National Park, Big Cypress National Preserve, Biscayne National Park, Virgin Islands National Park, and Canaveral National Seashore. It was first reported in Everglades National Park in 1947 and is concentrated in the Hole-in-the-Donut area, where 5,928 acres of Brazilian pepper can be found (NPS n.d.b).

Effects on Native Vegetation

Brazilian pepper displaces native species (DeCoster et al. 1999). It thrives in pine rocklands in south Florida, including Everglades National Park's Long Pine Key, the largest remaining example of a pine rockland ecosystem in the United States. Stands dominated by Brazilian pepper contained about half of the species richness of uninvaded sites (Gordon 1998). There is evidence that the aqueous leaf extract of Brazilian pepper has inhibitory effects on seed germination and aboveground biomass accumulation of two native species, *Bidens alba* (L.) D.C. and *Rivina humilis* L. (Morgan n.d.). Brazilian pepper can also displace other species, such as buttonwood (*Conocarpus erectus*), that are commonly found just above the high-tide elevation.

Effects on Threatened and Endangered Species

In Everglades National Park, anecdotal evidence suggests that the spread of Brazilian pepper is threatening the nesting habitat of the gopher tortoise (*Gopherus polyphemus*), a threatened species in Florida that is found in pine flatwoods, dry prairies, and coastal dunes (Ferriter 1997). Brazilian pepper root systems may prevent the tortoise from burrowing in preferred habitats, and it displaces plants like grasses, gopher apple (*Licania michauxii*), and *Opuntia* cactus that the tortoise uses for forage.

Brazilian pepper is invading the potential habitat of the federally endangered red-cockaded woodpecker in Big Cypress National Preserve. The presence of Brazilian pepper in the naturally open understory could alter the natural fire cycle and result in a catastrophic fire that could damage the old-growth pines upon which the woodpeckers depend for nesting (Taylor 2004a).

Effects on Wetlands

Detritus—Dead or decaying plant material.

Hydrophytic—Growing wholly or partially in water. Hydrophytic plants can thrive in waterlogged conditions.

Brazilian pepper appears to cause soil development and elevation increases that leave native ecosystems nonviable in the shallow, wetland soil systems it colonizes (Gordon 1998). The native wetland communities are graminoid (grassy) systems that do not accumulate a substantial amount of detritus. Brazilian pepper, however, deposits a large amount of litter, and detritus buildup causes the soil to accumulate to a point that it no longer supports wetland hydrophytic plants.

Effects on Wildlife

Brazilian pepper stands provide relatively poor wildlife habitat. Numerous studies have shown that infestations of exotic plants in natural areas result in the degradation of wildlife habitat (Gordon 1998). Not only do the exotic plants displace the native species, they can alter the habitat so that the ecosystem processes that support native wildlife are lost or degraded (Gordon 1998). In a study on the use of a mature Brazilian pepper stand by native birds, it was found that species diversity and total population density of native bird species declined in a mature Brazilian pepper stand when compared to native pinelands and forest-edge habitats (Ferriter 1997).

Some exotic plant species have direct effects on wildlife. For example, a chemical that occurs in the fruit of Brazilian pepper has been noted to have a “paralyzing effect” on birds. The red berries of Brazilian pepper attract robins, cedar waxwings, and mocking birds, which become intoxicated and have been reported to collide with buildings or become paralyzed and die (Ferriter 1997).

Herptofauna—A collective term for reptiles and amphibians.

Herpetological research in Everglades National Park has indicated that Brazilian pepper has little effect on reptiles and amphibians. In studies conducted in Brazilian pepper monocultures in the Long Key-Paradise Key region of Everglades National Park, Dalrymple collected scattered examples of a few native amphibians and reptile species and an abundance of two nonindigenous species, Cuban tree frogs (*Osteopilus septentrionalis*) and brown anole lizards (*Anolis sagrei*). Because the herptofauna of Brazilian pepper forests are similar in species numbers and foraging guilds (foraging guilds are groupings based on the techniques that reptiles use to obtain food) to those of southern Florida’s hammock communities, Dalrymple believes that most amphibians and reptiles respond to basic microhabitat (the immediate localized environment of organisms) requirements and not the species composition or structure of the vegetation. Therefore, it was assumed that the infestation of Brazilian pepper in south Florida’s hardwood hammocks has little effect on native and introduced herptofauna (Ferriter 1997).

Effects on Soils

Brazilian pepper appears to cause soil buildup and elevation increases in the shallow soil systems it colonizes (Gordon 1998); these changes can alter the hydrologic regime.

GUINEA GRASS

Native to Africa, *Urochloa maxima* (formerly known as *Panicum maximum*) was introduced to virtually all tropical countries as a source of high-protein fodder for livestock. The plant grows about 6 feet tall, has long narrow leaves, and a seed head that resembles rice. Habitats include open grasslands, woodland brush thickets, roadsides, and abandoned cultivated fields. The plant prefers well-drained soils and sunny areas but also tolerates a variety of other conditions, including shade, wet areas, and drought. Guinea grass spreads aggressively and can build up extensive fuel loads that could increase the intensity of naturally occurring fires. Guinea grass develops broad underground root systems that allow it to survive fires that many native species cannot, further allowing it to dominate post-fire landscapes (IPIF 2003).

Guinea grass is found in Virgin Islands National Park, Salt River Bay National Historic Park and Ecological Preserve, Big Cypress National Preserve, Canaveral National Seashore, Everglades National Park, Dry Tortugas National Park, and throughout Buck Island Reef National Monument (NPS 2004c).

Guinea grass can harm native vegetation in two ways. It forms dense stands of herbaceous material with extensive root systems that out-compete native plants for water and nutrients. It also forms large amounts of biomass that burns readily and at high temperatures. The guinea grass is able to recover from fires because of its extensive root systems but the native species are often not fire adapted and do not recover.

Effects on Native Vegetation

Guinea grass is considered a threat to local native plants, primarily because its resistance to drought allows it to accumulate a dangerous amount of plant material that burns hot enough in wildfires to destroy native plants, which have lower fire-tolerance. For example in the native thorny scrub forest plants of the Virgin Islands, during periods of drought guinea grass forms extensive biomass, unlike the native thorny scrub and cactus plants. Occasional wildfires would normally burn quickly through the scrub at low temperatures and cause little damage, but the large amount of biomass produced by the guinea grass fuels hotter fires that destroy the native vegetation. Guinea grass, which is fire-adapted with underground rhizomes, sprouts new growth after fires and spreads into those areas where fire destroyed the native plants (IPIF 2003).

Guinea grass, like tan tan, forms dense thickets that would out-compete native species such as organ cactus (*Pilosocereus royenii*) and frangipani (*Plumeria alba*) (NPS 2004c).

LATHER LEAF (*COLUBRINA ASIATICA*)

Lather leaf, named for its ability to produce lather in water, is a low shrub/vine with long branches, shiny oval leaves, and clusters of small, greenish flowers. The stems can grow 32 feet in a year and form adventitious roots (roots that grow downward from a branch) wherever they touch the ground. Plants can mature to produce seeds within 1 year of germination, especially if growing in the sun.

Lather leaf is present along the eastern and western coastlines of central and southern Florida (essentially frost-free areas), including the Florida Keys. It occurs in tropical hardwood hammocks in Biscayne National Park and Everglades National Park, where it covered an estimated 1,000 acres in the mid-1990s and is reportedly doubling in area every 10 years. It was casually noted as occurring in Everglades National Park until the 1970s when large monotypic stands up to 2.5 acres in area were observed along Florida Bay (NPS n.d.b). Because lather leaf is widespread throughout the Caribbean Basin, there is a likelihood that it may also occur in the U.S. possessions of Puerto Rico and the U.S. Virgin Islands. However, it is not known to occur in the four Caribbean national parks at this time. The lather leaf seeds are buoyant and salt-tolerant and can disperse using ocean currents (Jones 1999).

Effects on Native Vegetation

Lather leaf produces a thick mat of tangled stems several feet thick that can overgrow underlying plants or shade them out (Schultz 1992). Impacts to natural areas include alterations of community composition and structure, diminishment of natural habitats for native wildlife, disruption of species relationships and interactions, and interference with ecological and geological processes, such as water and nutrient cycling.

Effects on Threatened and Endangered Species

The occurrence of lather leaf in Florida's coastal tropical hardwood forests is of special concern because of the uniqueness of this habitat and the rarity of some of its constituent plant species, including a number of Florida state-listed threatened and endangered species, such as West Indian mahogany (*Swietenia mahagoni*), Florida thatch palm (*Thrinax radiata*), wild cinnamon (*Canella winterana*), manchineel (*Hippomane mancinella*), prickly-pear (*Opuntia* spp.), and dildo cacti (*Cereus pentagonus*), and a number of bromeliads and orchids. Sites infested by lather leaf experience a great reduction in biological diversity, because very few plants (including seedlings of lather leaf itself) can persist after lather leaf has engulfed the plants, cutting off sunlight, air, and moisture (Jones 1999).

Effects on Wildlife

Sites infested by lather leaf experience a great reduction in biological diversity, because very few plants (including seedlings of Asiatic lather leaf itself) can persist under these conditions. Impacts to natural areas include alterations of community composition and structure, diminishment of natural habitats for native wildlife, disruption of species relationships and interactions, and interference with ecological and geological processes, such as water and nutrient cycling (Jones 1996).

MELALEUCA

Melaleuca (*Melaleuca quinquenervia*) are evergreen trees native to Australia and several surrounding islands in the southwest Pacific Ocean. The bark is soft, light-colored, and multilayered; its leaves smell of camphor when crushed; the white flowers resemble bottle brushes about 16 inches long; and fruits occur in clusters of capsules along the stems, with each capsule holding 200 to 300 seeds (Langeland and Burks 2000). Although melaleuca prefers seasonally wet sites, it also flourishes in standing water and well-drained wetlands (Laroche 1994). Melaleuca invades pine flatwoods, sawgrass marshes, and cypress swamps (Nelson 1994).

Melaleuca reproduces at an early age (as early as 2 years from seed) and has a highly successful dispersal mechanism for spreading its seeds. The plant grows rapidly, reaching up to 100 feet tall (Langeland and Burks 2000). Melaleuca can withstand a wide variety of ecological conditions, and, unfortunately, stresses such as cutting, burning, herbicide application, and drought can trigger the release of as many as 20 million tiny seeds per tree (Bodle et al. 1994). As a result, treatment efforts to control the plant can, instead, increase its population.

Invading melaleuca is mainly found in the southern half of Florida, infesting 500,000 to 1.5 million acres. An expansion model predicts that, if left unchecked, the tree could take over most of the region's remaining natural landscape within 30 years (Bodle et al. 1994). The tree is among the worst of the nuisance species in the south Florida national parks, infesting more than 490,000 acres in south Florida by 1994 (Laroche 1994), including approximately 50,000 to 60,000 acres in Everglades National Park and an undetermined area in Big Cypress National Preserve (Pernas 2003). It was first reported in Everglades National Park in 1967 and is primarily concentrated in the East Everglades Acquisition Area (EEAA) (NPS n.d.c).

Effects on Native Vegetation

Melaleuca generally grows well under nutrient-deficient conditions, allowing it to displace native plants growing under borderline conditions. Melaleuca easily establishes itself in human-disturbed habitats and also adapts well to flooding. Additionally, the plant has few herbivores or competitors to keep it under control outside its native range. This combination of characteristics makes melaleuca a potent and continuing threat to native plants in the parks in southern Florida (Kaufman et al. 2001). Melaleuca trees produce allelopathic chemicals, which may enhance their ability to displace native flora (Rayamajhi et al. 2002). Allelopathy refers to the beneficial or harmful effects of one plant on another plant by the release of chemicals from plant parts by leaching, root exudation, volatilization, residue decomposition and other processes. Commonly cited effects of allelopathy on native plants include reduced seed germination and seedling growth (Ferguson 2003). Melaleuca readily invades canal banks, pine flatwoods, cypress swamps, and undisturbed sawgrass prairies. In south Florida,

Allelopathy—A plant's ability to produce secondary chemical compounds that can leach from leaves, seeds, or roots into the soil and suppress the germination or growth of native plant species.

it is a threat to native sawgrass, mixed marshes and prairies, and tree island vegetation categories.

Effects on Threatened and Endangered Species

Melaleuca infestations into the wet (marl) prairies are seriously harming the habitat for the Cape Sable seaside sparrow, a federally endangered species, which requires open habitat for breeding and foraging (Pimm 2004).

Effects on Water Quality and Hydrology

Melaleuca, which invades herbaceous communities, has been demonstrated to modify rainfall interception, surface flow, evapotranspiration rates, and, possibly, water table elevations. A higher net evapotranspiration, along with increases in substrate elevation associated with this species, may change the distance to the water table and the direction and rate of surface water flow (Gordon 1998).

Effects on Wetlands

Melaleuca was originally planted in Florida for its swamp-drying ability, because it absorbs and transpires much more water than the native plants it replaces. Litter deposition of 2 inches or more under melaleuca decomposes and becomes soil, raising the ground elevation and topography in the flat, shallow wetlands. The result is that the elevated infested areas are now above the water level needed to sustain native wetland habitat, which means the infested areas are no longer wetlands. Plant-species richness in wet prairies is reduced by 60% to 80% when melaleuca is present (Gordon 1998), and the diversity of wildlife inhabiting the area drops significantly.

Effects on Wildlife

Melaleuca was introduced into southern Florida in the early 1900s as an ornamental plant and a possible source of lumber. An aggressive plant, it has spread throughout the region, replacing native plants with dense, monotypic (same species) forests that provide little value to wildlife (Pernas and Snyder 1998).

Aerial photo of Old World climbing fern

Effects on Soils

Litter deposition of 2 inches or more under melaleuca decomposes and becomes soil, raising the ground elevation and changing topography in the flat, shallow wetlands of south Florida (Gordon 1998).

OLD WORLD CLIMBING FERN

This native of Asia, Africa, Australia, and the Pacific Islands has become a serious problem in south Florida. Old World climbing fern (*Lygodium microphyllum*, also known as “lygodium”) grows over trees and shrubs, forming dense mats that other plants cannot penetrate, and which can quickly engulf cypress stands, wet prairies, saw-grass marshes, mangroves, and Everglades tree islands. The fern propagates by spores that can remain airborne for months and easily spread into adjacent habitats (Ferriter 2001). It often establishes itself at the transitional zone between wetlands and pinelands (Langeland and Burks 2000). It alters fire behavior by engulfing trees with skirts of old fronds, serving as ladder fuel to the canopy (NPS n.d.d).

Old World climbing fern is currently found in the vegetative cover of Everglades National Park and Big Cypress National Preserve. In the south Florida region, 43,302 acres were reported infested in 1999, a 400% increase over the 10,117 acres reported in 1993. In Loxahatchee National Wildlife Refuge during a similar time period, the fern had spread from a few acres to virtually every tree island in the refuge.

Effects on Native Vegetation

Once established, Old World climbing fern climbs and blankets other vegetation, ultimately causing mortality to mature canopy and subcanopy trees. Old World climbing fern is also believed to increase the potential for trees to be toppled during hurricanes (Saddle 2005). Sometimes the fern covers other vegetation so completely that it is impossible to see the plants underneath. Near the ground, a thick mat of fronds ultimately smothers native plants, including herbs and tree seedlings that would ordinarily maintain the forest canopy if allowed to mature (Ferriter 2001). Research has shown that Old World climbing fern reduces native plant cover. Infestations of the fern also alter fire regimes by providing “fire ladders” into canopy trees, with devastating results. Trees that would normally survive ground fires are killed when fire is carried into the canopy. Fires that would normally terminate at the margins of cypress sloughs are able to burn into and through areas infested with the exotic plant (Clark 2002).

Old World climbing fern is particularly devastating in forested areas. It is common in cypress stands, where the fern can form mats so dense and heavy that it would literally pull down a cypress tree, but it also infests pine flatwoods, wet prairies, saw-grass marshes, mangrove communities, tree islands, and agricultural areas.

Effects on Threatened and Endangered Species

Rare plant species, such as the tropical curlygrass fern (*Actinostachys pennula*), which is a state-listed endangered species, are severely imperiled by the spread of Old World climbing fern into their last remaining habitats, such as the northern Everglades tree islands (Ferriter 2001).

Effects on Wetlands

The dry stems of Old World climbing fern form extensive mats that often extend into wetlands. Wildfires that would normally stop at the wetland edge are able to invade the wetlands because of the “bridges” created by the dry materials. Fires that spread into wetlands can damage plants that are not fire adapted or can cause peat fires that burn away the soil (Pernas 2003).

TAN TAN

Tan tan (*Leucaena leucocephala*), or wild tamarind as this tree is known on the Virgin Islands, grows to about 10 to 15 feet tall. It is characterized by fern-like, light-green foliage, with globular, fragrant, greenish-white flowers, and flat, brown, legume-like seed pods. Tan tan was introduced extensively throughout the tropics as a reforestation species and as a source of food for human consumption, livestock fodder, and fuel. Over time, the tree has escaped cultivation and is now a widespread problem. The plant favors limestone soils and disturbed areas (Smith 1985). It tolerates a variety of growing conditions and has few pests (Francis 2001).

Tan tan is found in Virgin Islands National Park, Buck Island Reef National Monument, Salt River Ecological Preserve, Christiansted National Historic Site, and, to a lesser degree, in Big Cypress National Preserve, Biscayne National Park, and Everglades National Park, (Pernas 2003).

Effects on Native Vegetation

Tan tan is a very opportunistic tree that invades any available niche caused by disturbance. It forms thickets in Virgin Islands National Park that prevent native species, whether canopy or understory, from developing. On Buck Island Reef National Monument, it displaces the native organ cactus and frangipani (NPS 2004c).

CURRENT RESTORATION EFFORTS

A goal of the treatment of exotic plant species is the restoration of native ecosystems. As Gordon (1998) notes, “Where ecosystem processes have been altered, site restoration likely will require both control of the invader(s) and recovery of processes.” The focus of restoration efforts can range from a particular species to an entire ecosystem, watershed, or landscape (Ehrenfeld 2000). Within a given focus, the degree of restoration efforts can be either passive or active (see the “Active Restoration Approach” section in this chapter).

FOCUS OF RESTORATION EFFORTS

Restoration efforts vary in scale from those that restore an individual species to projects that reestablish functioning ecosystems. Scientists planning such restoration should define the kind of ecosystem to be restored and should emphasize the standard of restoration success, for example, whether to restore a damaged ecosystem to a historic or pre-existing condition, or to replace an ecosystem when the altered environment can no longer support any previously occurring type of regional ecosystem.

Species-oriented restoration projects center on an individual species (usually an endangered or threatened species, such as the red-cockaded woodpecker or Florida panther) or on the restoration of certain rare assemblages of vegetation, such as pine rockland or sand pine scrub. Ecosystem-scale restoration projects generally have a broader scope with long-term goals, such as “Hole-in-the-Donut” in Everglades National Park. This ecosystem-scale restoration seeks to establish a functioning native ecosystem different from the original system, since reestablishing the original system is impossible or impractical. At "Hole-in-the-Donut," extreme measures (including complete soil removal) were necessary to prevent Brazilian pepper from reestablishing itself after eradication. The goal of the "Hole-in-the-Donut" project is to establish a longer hydroperiod (the number of days in a year there is standing water at a location) wetland habitat, as opposed to the short hydroperiod, graminoid (grassy) wetlands and mesic (moderately moist) pine savannah that existed before the system was altered by agricultural activities and the subsequent take-over of the Brazilian pepper monoculture (the sole species). The "Hole-in-the-Donut" project is discussed in greater detail in this chapter in the section "Active Restoration Approach."

Restoration measures discussed in this draft EPMP/EIS focus on both species-oriented restoration and ecosystem-scale restoration because of the broad range of potential projects and site constraints.

APPROACH TO RESTORATION EFFORTS

Active restoration and passive restoration are the two approaches considered in this draft EPMP/EIS. Both approaches are defined and explained in detail in the "Alternatives" chapter. For some areas, particularly those with a mild infestation of invasive exotic plants or those in inaccessible locations, a passive approach may be the best alternative, as currently practiced in much of the target areas described in this draft EPMP/EIS.

Passive Restoration Approach

The passive approach involves treating exotic species and allowing the treated areas to regenerate native vegetation naturally. Follow-up treatment of seedlings that reemerge is usually necessary with herbicides or mechanical methods, such as hand pulling, and, in some cases, the treated vegetation is removed. No other alterations to the existing conditions take place (Pernas 2004a).

Some examples of successful passive restoration include the guinea grass treatment on Buck Island Reef National Monument in the U.S. Virgin Islands, where the guinea grass was treated with herbicides in January 2004 and continues to be re-treated to in order to exhaust the persistent seed bank that exists and to keep the species from reinvading the site. Restoration of native plants has also begun. After the mats of grass decayed and disintegrated, previously overlooked native plant species, such as Turk's cap cactus (*Melocactus intortus*), were observed under the treated mats of grass (Clark 2004b). Additional native species have generated in the relatively short time since the treatment.

Passive restoration has also been successful in areas of Everglades National Park and Big Cypress National Preserve. Melaleuca that had become established in some remote areas in the transitional areas between pine flatwoods and cypress domes was treated periodically with aerial applications of herbicide. Over 5 or 6 years, the melaleuca colonies have declined, and sawgrass and other native plants have recruited into the impacted areas. Surviving melaleuca saplings are periodically pulled out by hand, and future follow-up treatments will completely restore the sites (Pernas 2003).

Active Restoration Approach

When restoration needs a "jump start" or is proposed for severely altered areas, an active approach to habitat restoration may be needed. This could involve treating the invasive plants and then carrying out additional restoration activities such as altering the hydrology, removing soil layers, or planting native species. Active restoration efforts have several advantages over passive efforts. They usually result in faster recovery of native habitat, ensure that the targeted goals are met sooner, and often help prevent the recolonization of exotic plants. For example, removal of the litter accumulated under Brazilian pepper and melaleuca colonies may be necessary if restoration to the original habitat is desired (Gordon 1998).

An active approach would be appropriate when an infestation is highly visible to the public or potential erosion or water quality issues exist. Not restoring the native community can result in erosion, flooding and inundation, and changes in the dynamics of carbon fixation, which can contribute to further modifications of the site (Gordon 1998). Species-oriented restoration could also benefit from active restoration because the habitat would become available sooner to the recovering native species.

The NPS acknowledges that few documented active restoration efforts have been undertaken in the national parks of south Florida and the Caribbean (Pernas et al. 2004). However, some examples do exist within the region. For example, the U.S. Environmental Protection Agency issued a Five Star Restoration Grant for the restoration of a portion of the Indian River Lagoon in Brevard County. This successful program involved removing Brazilian pepper and planting mangroves and other coastal species on 100 acres of shoreline (DeVivo 2004).

The Hole-in-the-Donut, probably the best-known and documented active restoration project to date, includes the restoration of a 9,880-acre area of some of the most highly disturbed lands in Everglades National Park. This area was farmed extensively, and the soil was altered significantly to support the crops. After farming stopped in 1975, the area quickly became infested with Brazilian pepper. When the land was transferred to the NPS, NPS efforts to control the exotic infestation, including prescribed fires, herbicide treatments, and mowing, were unsuccessful. In 1989, two test plots were established for an experiment in the effectiveness of soil removal. The plot that underwent only partial removal of the altered soils was quickly recolonized by Brazilian pepper and other exotic plants. In contrast, the plot that underwent complete removal of the altered soils experienced successful germination of native hydrophytes (plants that grow in water or damp environments) and no recolonization of Brazilian pepper.

The Hole-in-the-Donut project is now in its second decade, and about 1,225 acres (approximately 21% of the site) now support native plants and animals. Although no planting is occurring, native species are recruiting at an impressive rate (Norland 2004). Administered by the south Florida Natural Resources Center at Everglades National Park, the restoration effort is widely considered a success and will serve as a model for future large projects (Darymple et al. 2003). The cost to actively restore an acre of the land in this manner is approximately $13,000.

Bill Baggs State Recreation Area in Florida is the site of another large, active restoration project. Prior to Hurricane Andrew in 1992, the recreation area was a popular beach destination, with a canopy dominated by Australian pines and an open understory. After the hurricane toppled the Australian pines, the tangled mass was bulldozed and taken to a landfill. The bulldozers also took a significant amount of topsoil, which prevented a massive resprouting of the Australian pines but also prevented native species from sprouting. For the next 6 to 8 years, volunteers hand-pulled Australian pines that sprouted, eventually exhausting what was left in the seed bank. This area has since been replanted with sea grape, sea oats, and other native plant species, however, exotic species are still being controlled as over 100 exotic plant species have germinated from seeds brought in by migratory birds and coastal currents. The restoration effort has cost over $7 million to date, despite the large volunteer force. Because few written records have been kept, no monitoring or documentation of the effort is available (Golden 2004).

Other active habitat restoration projects in south Florida include projects that have been accomplished under the Florida Audubon Society's Florida Keys Environmental Restoration Trust Fund. The trust fund has completed over 24 projects and has approximately 18 more underway (Audubon 2004). The projects are predominantly species-oriented, active-restoration projects that involve removing fill from historic wetlands, filling artificial ditches and channels, removing and managing exotic plants, and replanting restored areas. The projects have resulted in the establishment of natural benthic communities, transitional wetlands, and mangrove wetlands through eradication of exotic plants, replanting, and return of the natural topography.

RELATED LAWS, POLICIES, PLANS, AND CONSTRAINTS

RELATED FEDERAL LAWS, POLICIES, PLANS, AND CONSTRAINTS

Many federal laws, authorities, and programs, as well as international agreements and treaties, have been established to support efforts to prevent, control, and manage different types of invasive species, including exotic plants, and their impacts. Federal programs and responsibilities involving exotic plant management include prevention; early detection and rapid response; control, management, and restoration; research and monitoring; international measures; public outreach and partnership efforts; and interagency efforts. Federal laws, policies, plans, and constraints related to this document are included in appendix K.

RELATED FLORIDA STATE LAWS AND POLICIES

Florida State laws and policies related to this document are included in appendix K.

SUMMARY OF STATE AND LOCAL PROGRAMS FOR THE MANAGEMENT OF EXOTIC PLANTS

Partnerships that integrate planning are crucial to the success of managing exotic plants. The NPS recognizes the importance of cooperation with existing working groups of scientists, academics, municipalities, and environmentalists to ensure that the most appropriate management actions are being applied in the most effective manner. In south Florida, many programs involving the cooperation of multiple agencies, some including the NPS, have been established to manage exotic plants. Details are included in appendix L.

SCOPING PROCESS AND PUBLIC PARTICIPATION

In December 2003, the NPS met with various federal, territorial, state, and local government agencies to discuss the scope of issues and a range of alternatives to be analyzed. Representatives of four agencies attended two meetings in the Virgin Islands: one on St. John and one on St. Croix. In Florida, 26 agency representatives attended a meeting in West Palm Beach. The public scoping process began on January 22, 2004, with the publication in the *Federal Register* (Federal Register [FR], Vol. 69, No. 14) of a Notice of Intent to prepare an EIS. Six public scoping open houses were held in March 2004 in the following communities: Cruz Bay on St. John; two in Christiansted on St. Croix; one in Frederiksted on St. Croix; one in Naples, Florida; and one in Homestead, Florida. A summary of the agency and public scoping activities is presented in the "Consultation and Coordination" chapter.

Open house participants were encouraged to submit comments at the meetings or to email or mail their comments to the NPS before the close of the scoping comment period on April 1, 2004. Public comment (received at either the open houses or by mail or email) expressed concerns, raised issues, or commented on the preliminary alternatives to manage exotic plants in the nine parks. Approximately 28 people attended the open houses and 40 pieces of correspondence (letters, emails) were received, many containing more than one comment, with a total number of 144 individual comments. In response to public comment, the interdisciplinary planning team refined the issues to be addressed in this draft EPMP/EIS.

ISSUES AND IMPACT TOPICS

Issues are problems, opportunities, and concerns regarding the current and potential future management of exotic plants in the nine national parks. Issues were identified by NPS, other federal agencies, state and territorial agencies, and the public throughout the scoping process.

Impact topics are derived from issues, and in the "Environmental Consequences" chapter of this draft EPMP/EIS, are used to examine the extent to which the exotic plant problem would be made better or worse by the actions of a particular alternative. Impact topics focus the planning process and the assessment of potential consequences of the alternatives. *Director's Order 12* and handbook (NPS 2001a) lists impact topics that must be considered, based on requirements in such sources as federal legislation, executive orders, and CEQ guidelines for implementing the *National Environmental Policy Act* (NEPA). Other impact topics are identified based on regional or park-specific concerns, or as a result of scoping.

The issues addressed in each impact topic were identified during internal scoping meetings with NPS staff, through consultation with other federal and state agencies, and as a result of public scoping comments. The relevant current conditions of impact topics are discussed in detail in the "Affected Environment" chapter. Impacts associated with each of the exotic plant management alternatives are described in the "Environmental Consequences" chapter. Table 1 includes a summary of the issues considered by technical experts on the interagency team that were further analyzed in this draft EPMP/EIS.

GENERAL ISSUES

Native plants and animals may be directly affected by exposure to herbicides or by the creation of access trails required to reach infested areas. Native plants and animals and their habitats may also be affected or lost by prescribed fire and mechanical treatment methods.

Exotic plants may be further spread by the activity associated with the treatment effort. For example, exotic plants seeds often have barbs or stickers that can adhere to clothing, hair, or tire treads and can then be distributed to undisturbed areas by workers or equipment. Some species, like melaleuca, are able to release their seeds rapidly when stressed by fire or physical damage, which can compound the treatment problem.

Some exotic plants increase fuel loads and produce chemicals that alter the fire regime of a system. Excessive fuel loads can raise the temperature of a fire beyond that which native species can survive. Some plants, like melaleuca, contain oil in their leaves that makes them more flammable, thereby facilitating the spread of fire. Other plants, such as Old World climbing fern, create "fire ladders" into canopies of native species that otherwise would be able to survive seasonal ground-level brush fires.

Mechanical treatments and treatment site access involving large machinery may result in soil compaction and rutting (which may alter the flow of water across the landscape) and in trampling or loss of native plants. Severe soil compaction in hydric (wet) soils may result in tree mortality and a shift in species composition. Rutting in wetlands may result in erosion, surface water impoundment, and the introduction of additional exotic plants.

Removal of exotic plants by any treatment method may alter the viewshed (scenery), with resultant impacts on wilderness value, visitor use and experience, or cultural landscapes. Because exotic plants typically form monocultures (single-species environments), removing or treating exotic plants may result in large vacant areas or vast expanses of dead plants.

Controlling exotic plants in parks presents a positive environmental education opportunity. Educating the public about the threats posed by exotic plants and the different ways the plants are spread can aid control and management efforts.

Removal of exotic plants by any treatment method exposes areas to invasion by other exotic plants. This draft EPMP/EIS emphasizes the fact that the treatment of exotic plants is an ongoing, and likely, never-ending effort.

The following section discusses exotic plant issues with respect to the ecological effects of infestation and the effects various treatment methods may have on specific park natural, cultural, and socioeconomic resources.

TABLE 1: ENVIRONMENTAL ISSUES AND CORRESPONDING IMPACT TOPICS

Description of Environmental or Other Issues	Corresponding Topics in Chapter 4: "Environmental Consequences" Where Impact Is Discussed
Exotic plant species displace native plants by shading, allelopathy, and altering soil properties.	Impacts on Native Plants / Vegetation Categories section
Exotic plant species change the composition, structure, and processes of native vegetation categories.	Impacts on Native Plants / Vegetation Categories section
Exotic plant species alter the natural fire regime and resultant catastrophic wildfires adversely impact native plants.	Impacts on Native Plants / Vegetation Categories section
The removal of exotic plants by mechanical methods (including the use of heavy equipment) may lead to soil erosion, with consequential effects, such as discharges of sediments and particulate matter into adjacent waters, and increases in turbidity levels in aquatic environments during heavy rain or storm events.	Impacts on Water Quality and Hydrology, Soils, and Essential Fish Habitat sections
The introduction of herbicide compounds into the water from terrestrial treatment of exotic plants may affect water quality, and decaying herbicide-treated plant material can cause water quality impacts by adding nitrogen and phosphorous to aquatic systems. Some herbicides contain surfactants or other compounds that poison aquatic organisms and degrade water quality.	Impacts on Water Quality and Hydrology, Wildlife and Wildlife Habitats, and Essential Fish Habitat sections
The equipment and vehicles needed to access sites for treatment can cause physical damage to native plants and to substrate, such as the fragile Karst formations, through uprooting, crushing, or cutting of plants.	Impacts on Native Plants / Vegetation Categories, Soils, Essential Fish Habitat, and Water Quality and Hydrology sections
Exotic plants can alter habitat, food availability, and behavior of wildlife, including threatened and endangered species.	Wildlife and Wildlife Habitats, Special Status Species, and Native Plants / Vegetation Categories sections
Treatment methods to remove exotic plants, and the presence of humans and machinery to implement treatments, may interfere with the nesting and foraging behavior of wildlife, including threatened and endangered species, or may remove or alter habitat.	Impacts on Wildlife and Wildlife Habitats, Special Status Species, and Native Plants / Vegetation Categories sections
The removal of some exotic plants may directly reduce the food source for many birds. Indirect effects to wildlife may occur from the accidental over-spray of herbicides on native habitat, use of untrained field labor, or incorrect use of prescribed fires.	Impacts on Wildlife and Wildlife Habitats and Special Status Species sections
Prescribed fire and mechanical treatments of exotic plants may remove wildlife habitat used for nesting or cover for roosting.	Impacts on Wildlife and Wildlife Habitats and Special Status Species sections
The use of fire to treat areas infested with Old World climbing fern may result in impacts to wildlife. Because of Old World climbing fern, habitats that under normal environmental conditions could tolerate or even benefit from fires are now being destroyed by fires.	Impacts on Wildlife and Wildlife Habitats and Special Status Species sections
Noise associated with exotic plant treatments may impact wildlife nesting, feeding, or roosting. The presence of humans and use of machinery for treating exotic plants may alter wildlife behavior, disrupt mating activities, and damage nests or eggs.	Impacts on Wildlife and Wildlife Habitats and Special Status Species sections
There is potential for wildlife to be directly exposed to chemicals during preparation and application of herbicides.	Impacts on Wildlife and Wildlife Habitats and Special Status Species sections
Treatment of exotic plants by fire may add nutrients and particulates to seagrass habitat through surface water runoff and atmospheric deposition.	Impacts on Native Plants / Vegetation Categories and Water Quality and Hydrology sections
Seagrasses may be affected by degraded water quality resulting from machinery fluids and fuels entering the water.	Impacts on Native Plants / Vegetation Categories section
Seagrasses may be affected by degraded water quality resulting from the application of herbicides to treat exotic plants.	Impacts on Native Plants / Vegetation Categories section
Accessing treatment sites and treatments of exotic plants on adjacent lands could result in soil erosion that may increase sedimentation and turbidity, thus affecting light availability and altering seagrass habitat. Accessing treatment sites through shallow seagrass beds can cause permanent damage by rutting, scarring, and seagrass removal.	Impacts on Native Plants / Vegetation Categories section
Exotic plant treatments can create unnatural features that alter the visual landscape in wilderness areas.	Impacts on Wilderness section

TABLE 1: ENVIRONMENTAL ISSUES AND CORRESPONDING IMPACT TOPICS (CONTINUED)

Description of Environmental or Other Issues	Corresponding Topics in Chapter 4: "Environmental Consequences" Where Impact Is Discussed
Noise and visual intrusion during treatments may reduce wilderness character.	Impacts on Wilderness section
The use of fire to control exotic plants would restore natural processes that occur in wilderness.	Impacts on Wilderness section
Exotic plants can affect soil integrity or quality through erosion and changes to soil chemistry.	Impacts on Soils section
Excessive use of fire can rapidly oxidize soils, and rapid oxidation reduces the nutrients and organic materials in the soils, thereby lowering soil productivity.	Impacts on Soils section
Mechanical treatment of exotic plants may cause erosion, compaction, or other soil disturbance that could promote the establishment of additional exotic plants.	Impacts on Soils section
Some herbicides used to treat exotic plants can remain in soil, which degrades soil quality.	Impacts on Soils section
Exotic plant treatments can degrade air quality from the exhaust from mechanized equipment used to access treatment sites and to treat the sites, from prescribed fires used for exotic plant removal, and from aerial application of herbicides.	Impacts on Air Quality section
Exotic plant treatment activities can adversely affect soundscapes by noise from workers, equipment, or machinery used to implement treatment methods and to access sites.	Impacts on Soundscapes and Wilderness sections
The displacement of native plants by exotic plants may alter the cultural landscape by crowding out plants linked to prehistoric or historic use of an area.	Impacts on Cultural Resources and Cultural Landscapes sections
Exotic plants may be a contributing element of a historic landscape, and their removal would diminish the significance of that landscape through the loss of historic planting patterns, landscape designs, and heirloom species, and by the changes in the visual appearance of the landscape.	Impacts on Cultural Resources and Cultural Landscapes sections
The physical destruction of historic structures can be accelerated if the roots of exotic plants penetrate foundations and walls. Sometimes, though, exotic plants may aid in the stabilization of historic structures by reducing soil erosion in the area or by supporting unstable ruins.	Impacts on Cultural Resources; Historic Structures, Buildings, and Districts sections
Exotic plants in south Florida and the Caribbean national parks may have cultural significance to traditionally oriented peoples. Treatment methods to control exotic plants could result in the removal of plant species of traditional or cultural value.	Impacts on Cultural Resources and Ethnographic Resources sections
Management techniques to remove exotic plants may negatively alter the cultural landscape by associated physical damage to other plantings and landscape structures.	Impacts on Cultural Resources and Cultural Landscape sections
Artifacts and archeological site features can also be damaged by creating access to sites and by equipment used to implement management activities.	Impacts on Cultural Resources and Archeological Resources sections
Exotic plants may be "markers" for buried historic sites. Removal of exotic plants without documentation of the sites diminishes the potential for future site identification and protection.	Impacts on Cultural Resources and Archeological Resources sections
The contamination of soil, charcoal deposits, and artifacts by chemical compounds, especially hydrocarbons, could alter results of expensive scientific analysis, such as Carbon 14 testing.	Impacts on Cultural Resources and Archeological Resources sections
Exotic plants alter the natural landscape and may impact the viewshed and visitor experience of the park.	Impacts on Visitor Use and Experience section
Public access to some areas of a park could be blocked by the presence of exotic plants.	Impacts on Visitor use and Experience section
Some visitors may be opposed to the use of chemical treatments on exotic plants.	Impacts on Visitor use and Experience section
Exotic plant treatments can result in numerous standing dead plants, which could detract from the natural landscape and affect the visitor experience.	Impacts on Visitor use and Experience section
The presence of exotic plants may pose a health risk to park visitors, staff, or area residents. Many people are allergic to exotic plants.	Impacts on Public Health and Safety section

TABLE 1: ENVIRONMENTAL ISSUES AND CORRESPONDING IMPACT TOPICS (CONTINUED)

Description of Environmental or Other Issues	Corresponding Topics in Chapter 4: "Environmental Consequences" Where Impact Is Discussed
Stands of exotic plants near residential areas increase the risk of fire and threat to public health and safety. An overgrowth of exotic plants close to roadways can potentially interfere with travelers' ability to navigate or view road signs.	Impacts on Public Health and Safety section
The treatment of exotic plants may also present health and safety risks to workers, park visitors, and area residents.	Impacts on Public Health and Safety section
Chemicals used to control exotic plants may enter the groundwater and have adverse effects on public health and safety.	Impacts on Public Health and Safety and Water Quality and Hydrology sections
People in or near exotic plant treatment areas may be accidentally exposed to herbicides.	Impacts on Public Health and Safety section
The burden on NPS staff and resources to control exotic plants has grown with the increasing presence of the plants and need to treat these species.	Impacts on Management and Operations section
Treatment activities, especially fire, may prohibit access to areas of the park, which may disrupt or hinder other park activities, while heavy machinery used for mechanical control of exotic plants can damage park roads and infrastructure.	Impacts on Management and Operations section

ISSUES SPECIFIC TO EACH IMPACT TOPIC

Native Plants / Vegetation Categories

Many species of exotic plants often have faster growth rates than native plants, enabling them to out-compete native species for essential resources. Exotic plants also displace native plants by shading, altering soil properties, and allelopathy. Allelopathy gives some plants the ability to reduce competition from other plants for nutrients, water, and light, and is believed to be present in some species of exotic plants, such as melaleuca, Brazilian pepper, and Australian pine.

Exotic plants change the composition, structure, and processes of native vegetation categories. Exotic plant infestations typically lead to dense monotypic stands (stands of the same species), which could be shrub thickets of Brazilian pepper, savannahs of African guinea grass, or dense forests of Australian pines, tan tan, genip, and melaleuca. These areas are destined to lack the biodiversity and varied structure of native vegetation categories. For instance, a typical pristine cypress forest has a canopy of mature cypress trees, a subcanopy of cypress or other tree saplings, shrubs such as buttonbush, and an understory of ferns and herbaceous plants. The biodiversity and structure of these native communities are necessary for the survival of native plants and wildlife.

Sea grape is a native plant with very dense, intertwined root systems that are important in stabilizing sandy beaches and preventing erosion caused by waves. The replacement of native coastal plant species by exotic plants (such as Australian pine) can jeopardize beach stability and significantly alter beach forest values.

Exotic aquatic plants were not analyzed within this draft EPMP/EIS. Although water hyacinth (*Eichhornia crassipes*), water lettuce, and Hydrilla (*Hydrilla verticillata*) are a problem in south Florida, infestations within Big Cypress National Preserve and Everglades National Park are confined to canals and water-control structures and are not a high priority for treatment (Burch and Pernas 2005). Water hyacinth and water lettuce are mostly a water conveyance issue and are only a priority species for the U.S. Fish and Wildlife Service and the south Florida Water Management District (Ferriter et al. 2001). While these plants can be found downstream of S-12 structures within Everglades National Park, they have not expanded their range. Similarly, exotic aquatics within Big Cypress are restricted to mostly disturbed areas, and, in both parks, the encroachment into the parks is held in check because of salinity fluctuations, low nutrients, and short hydroperiods (Taylor 2005). In addition, these exotic plants within the canals are being treated and controlled by the south Florida Water Management District, which further prevents their establishment within the parks.

Prescribed Fire. The use of fire to control exotic plants may facilitate return of the natural fire regime. However, the use of fire in stands of melaleuca could exacerbate issues related to this exotic species. Fire can facilitate the spread of melaleuca by causing the release of vast numbers of stored seed, and fire rarely results in the killing of mature trees, although a combination of herbicide and fire is effective in killing seedlings. As such, treatments of this exotic species with fire are conducted within the parks under carefully designed fire management plans so that infestations are controlled and not spread.

In addition, in areas infested with Old World climbing fern, the fires may cause more damage to the native plants than to the exotic plants. Old World climbing fern forms flammable mats that allow the fire to spread over the lower levels of plants and climb into the crowns of trees. Habitats that under normal environmental conditions could tolerate or even benefit from fires are now being destroyed by fires because of the presence of this species (Ferriter et al. 2003). This is also true with exotic grass species. If these grasses, such as the noxious cogon grass or guinea grass, infest a site otherwise dominated by woody species, the effects of a fire can be catastrophic. Although the unusually hot fire eliminates the woody species, the grasses flourish as a result of their strong underground root system. Similarly, frequency and severity of wildfires in exotic, grass-infested habitats in the Caribbean can be increased in non-fire-dependant vegetation categories. These wildfires have eliminated native plant species and increased the infestation of exotic grasses that are fire-tolerant in burned areas.

Evapotranspiration—The return of moisture to the air both through evaporation from the soil and transpiration—loss of water vapor from a plant's surface.

Water Quality and Hydrology

The presence of exotic plants in aquatic systems may reduce or deplete water levels or alter runoff patterns and increase soil erosion, thus diminishing water quality.

Current efforts to control exotic plants are not sufficient to protect wetlands from infestation. Exotic plants, such as melaleuca and Brazilian pepper, can aggressively displace native plants and alter wetland function. Melaleuca's high evapotranspiration rate changes hydrology and vegetative structure in wetlands if not controlled (Bodie et al. 2003).

Mechanical Treatment and Access. The removal of exotic plants by mechanical methods (including the use of heavy equipment) may lead to soil erosion, with consequential effects, such as discharges of sediments and particulate matter into adjacent waters and increases in turbidity levels in aquatic environments during heavy rain or storm events.

Chemical Treatment. The introduction of herbicide compounds into the water from terrestrial treatment of exotic plants may affect water quality, and decaying herbicide-treated plant material can cause water quality impacts by adding nitrogen and phosphorous to aquatic systems. Some herbicides contain surfactants or other compounds that poison aquatic organisms and degrade water quality.

Access. The equipment and vehicles needed to access sites for treatment can cause physical damage to native wetland plants through uprooting, crushing, or cutting of plants and can result in the creation of flow-altering channels.

Special Status Species

Exotic plants can alter habitat, food availability, and behavior of threatened and endangered species. Brazilian pepper’s weak, brittle wood makes it difficult for some species to nest, and the bark on melaleuca has evolved a continuous peeling or sloughing characteristic to prohibit the colonization of epiphytic plants (plants that grow on top of, or are supported by, other plants). If melaleuca displaces the native trees, then locally, many endangered epiphytic orchids and bromeliads might be extirpated, and, on a regional level, the range of these epiphytes could be reduced.

Epiphytic—A plant that naturally grows on another plant but does not derive nourishment from it.

Exotic plants compete with native threatened and endangered plants by altering habitat. The changes that may occur to habitat include shading, allelopathy, or alteration of nutrient composition and moisture availability in soils (Levine 2002). For example, melaleuca has a very high transpiration rate and can alter the character of a habitat by reducing groundwater availability or altering community structure. Melaleuca changes the environmental condition in wet prairies to a drier state, which prevents native species from becoming established. These native species provide habitat for the Cape Sable seaside sparrow. Habitat alteration caused by exotic plants replacing native coastal plants may affect hawksbill sea turtle nesting areas.

Treatment methods to remove exotic plants, and the presence of humans and machinery to implement treatments, may interfere with threatened and endangered species’ nesting and foraging behavior or may remove or alter critical habitat.

Other listed species in the Caribbean (such as brown pelicans and roseate terns) may be affected by the habitat alteration resulting from the presence of exotic plants along beaches. Exotic species, such as Guinea grass and tan tan, are known to be present in brown pelican nesting sites on Buck Island within Buck Island Reef National Monument.

Wildlife and Wildlife Habitats

The presence of exotic plants could change foraging patterns, change predator and prey interactions, displace native wildlife species, and alter wildlife habitat, including breeding areas. For example, large monocultures of melaleuca and Australian pine typically do not contain a lower level of smaller trees and shrubs (understory) that some small mammal species require for foraging and refuge from predation. Melaleuca monocultures displace native pine and cypress and are not suitable for rookery development.

The removal of some exotic plants (such as Brazilian pepper) may directly reduce the nonnative food source for many birds. Indirect effects to wildlife may occur from the accidental overspray of herbicides on native habitat, use of untrained field labor, or incorrect use of prescribed fires.

Prescribed Fire and Mechanical Treatments. Prescribed fire and mechanical treatments of exotic plants may remove wildlife habitat used for nesting or cover for roosting. For this reason, many of the parks leave the dead trees and shrubs in place after treatment to provide nesting and roosting areas and to allow the trees and shrubs to decay, which create additional forage opportunities.

The use of fire to treat areas infested with Old World climbing fern may result in impacts to wildlife. Fires normally stop at flooded cypress swamps, which become refuges for wildlife during wildfires. Old World climbing fern, however, forms flammable mats that allow the fire to spread over the lower levels of plants and climb into the crowns of trees. Because of Old World climbing fern, habitats that under normal environmental conditions could tolerate (or even benefit from) ferns are now being destroyed by fires (Ferriter et al. 2003).

Noise associated with exotic plant treatments may impact wildlife nesting, feeding, or roosting.

Chemical Treatment. There is potential for wildlife to be directly exposed to chemicals during preparation and application of herbicides. Treatment of exotic plants with chemicals potentially may affect fish and aquatic invertebrates. The combined domestic application of pesticides, including herbicides, totals about 2 billion pounds of active ingredients annually (Lyon 1996), and a significant amount of these pesticides enter the water bodies through runoff and groundwater infiltration. Although the herbicides may not impact fish directly, they may impact the food source or habitat of a species. Chemical treatments may also increase the amount of dead plant material entering adjacent water bodies, and the decaying plant material can result in lower oxygen levels in the water.

Access. The presence of humans and use of machinery for treating exotic plants may alter wildlife behavior, disrupt mating activities, and damage nests or eggs.

Essential Fish Habitat

The presence of exotic plants adjacent to areas of essential fish habitat can indirectly alter the habitat. For example, dense stands of Brazilian pepper along canals and estuarine systems can alter flow patterns, crowd out native vegetation, and increase erosion. The shallow root systems of Brazilian pepper do not provide as much soil stabilization as native species, such as grasses and other forbs that are typically crowded or shaded out.

Mechanical Treatment. Mechanical treatments may result in increased turbidity, sedimentation, or nutrient levels, such as phosphorous or nitrogen, altering essential fish habitat. Occasionally, the most effective way to eradicate a dense monoculture of exotic plants is to remove the plants and topsoil. This removes the roots and seeds so that there is less likelihood of regeneration. Earthwork such as this increases the chances of erosion, which can result in a reduction in water clarity, increased sedimentation and turbidity, and elevated nutrient levels, adversely affecting essential fish habitat.

Chemical Treatment. Chemicals entering the water as a result of herbicide treatment of exotic plants may alter habitat suitability for fish. As described above, the improper use of herbicides could result in harmful effects to the environment (Lyon 1996). Herbicide treatments may indirectly affect fish habitat. Chemical treatment of terrestrial vegetation may result in an increase of decaying plant material in essential fish habitat affecting the oxygen availability in the water.

Access. Access to treatment areas may result in increased turbidity or result in direct physical damage, as from propellers, to essential fish habitat.

Delineated essential fish habitat is found in Biscayne National Park, Canaveral National Seashore, Dry Tortugas National Park, Everglades National Park, Buck Island Reef National Monument, Salt River Bay, and Virgin Islands National Park. Because of the extent of infestation and, thus, the size of the areas that require treatment within Canaveral National Seashore, Everglades National Park, Buck Island Reef National Monument, Salt River Bay, and Virgin Islands National Park, and the potential for movement of soils to the environment, particularly in the Caribbean parks because of the steep topography, essential fish habitats have the potential to be adversely affected by exotic plants and the management actions taken to treat them.

In Biscayne National Park and Dry Tortugas National Park, the management of exotic plants would be less extensive, as these parks nearly have reached a maintenance level of control, and, therefore, actions to treat the plants are highly targeted with minimal disturbance to soils. Because of the low topography, there is minimal movement of soils (if disturbed) to the water and, therefore, negligible impacts on water quality. As such, it is not expected that essential fish habitat would be disturbed beyond a negligible level under any alternative. Therefore, impacts to essential fish habitat will not be further analyzed for these parks.

Seagrasses

Prescribed Fire. Treatment of exotic plants by fire may add nutrients and particulates to seagrass habitat through surface-water runoff and atmospheric deposition.

Mechanical Treatment. Seagrasses may be affected by degraded water quality resulting from machinery fluids and fuels entering the water. Oil-based products have a tendency to cling to the surface of the seagrasses, preventing the exchange of oxygen, and severe contamination eventually kills the seagrasses. The seagrasses' ability to photosynthesize may be altered by a reduction in sunlight because of increased turbidity from the erosion of sediments at treated sites.

Chemical Treatment. Seagrasses may be affected by degraded water quality resulting from the application of herbicides to treat exotic plants. The chemicals may enter the water directly as a result of overspray, or indirectly as a result of stormwater runoff leaching contaminants from the soil and treated foliage. Herbicides that enter the water may directly affect seagrasses, much as they affect terrestrial plants.

Access. Accessing treatment sites and treatments of exotic plants on adjacent lands could result in soil erosion that may increase sedimentation and turbidity, thus affecting light availability and altering seagrass habitat. Accessing treatment sites through shallow seagrass beds can cause permanent damage by rutting, scarring, and seagrass removal.

Wilderness

Exotic plant treatments can create unnatural features (such as chain-sawed trunks or stands of dead plants) that alter the visual landscape in wilderness areas. Monotypic stands (stands of the same species) of exotic plants do not impart the same sense of wilderness as diverse natural habitat.

Mechanical Treatment. Noise and visual intrusion during treatments may reduce wilderness character. Although only lasting for a short period of time, the noise created by the equipment and crews is pervasive and would detract from the wilderness experience. Accessing treatment areas with heavy equipment can cause unintended trails and rutting and can provide substrate for the establishment of other exotic plants, further affecting wilderness resources and values. A comprehensive plan to control exotic plants in wilderness would lessen the frequency of return and disturbance in wilderness areas and reduce adverse effects on wilderness resources.

Soils

Exotic plants can affect soil integrity or quality through erosion and changes to soil chemistry. Allelopathic agents (secondary chemical compounds) can leach from leaves, seeds, or roots into the soil and suppress the germination or growth of native plant species. The dense leaf litter produced by some exotic plants cools the soils and slows decomposition, which can alter soil chemistry.

Prescribed Fire. Excessive use of fire can rapidly oxidize soils, and rapid oxidation reduces the nutrients and organic materials in the soils, thereby lowering soil productivity.

Mechanical Treatment. Mechanical treatment of exotic plants may cause erosion, compaction, or other soil disturbance that could promote the establishment of additional exotic plants.

Chemical Treatment. Some herbicides used to treat exotic plants can remain in soil, which degrades soil quality.

Air Quality

Some exotic plant treatments can degrade air quality; for example, the exhaust from mechanized equipment used to access treatment sites and to treat the sites (such as for soil removal) can cause local degradation of air quality, as can the prescribed fires used for exotic plant removal.

The effects of treatment activities have been addressed for parks where aerial treatment or treatment with fire would occur, or where large-scale restoration projects may involve using large-scale construction equipment that would result in impacts at a level greater than minor. These parks include Big Cypress National Preserve and Everglades National Park. Impacts to air quality were also addressed for Salt River Bay, because the continued presence of exotic plants, such as guinea grass, may result in wildfire.

Impacts to air quality in Biscayne National Park, Canaveral National Seashore, Dry Tortugas National Park, Buck Island Reef National Monument, Christiansted National Historic Park, and Virgin Islands National Park were dismissed from further analysis, because the exotic plant management actions that would be implemented under the no-action and action alternatives would not generate measurable air quality effects within each respective park. Treatment actions at Biscayne National Park, Canaveral National Seashore, and Dry Tortugas National Park would not involve aerial spraying or prescribed fire. Large-scale restoration projects requiring large-scale construction equipment would not be conducted. Impacts to air quality in these parks as a result of management actions would not be greater than negligible. These effects would be attributed to emissions from minimal use of mechanized hand tools or small-scale mechanized landscape equipment and chippers for short periods of time, or from vehicles and watercraft traveling to the site for access and monitoring. Buck Island Reef National Monument and Virgin Islands National Park would experience no more than short-term, negligible, adverse effects to air quality from emissions from mechanized equipment, vehicles or watercraft, and potential dust generation from management actions. Management actions in these parks would not include aerial spraying or large-scale restoration. In addition, these parks would not use prescribed fire as a management tool, because they do not have fire-adapted vegetation categories. Because Buck Island Reef National Monument staff currently treats infestations of guinea grass, there is very low potential that any infested area would ignite resulting in adverse effects to air quality. Therefore, impacts on air quality in each of these specific parks were not further evaluated.

Soundscapes

During exotic plant treatments, the natural soundscape can be adversely affected by noise from workers, equipment, or heavy machinery used to implement treatment methods; aircraft overflights associated with monitoring, surveillance, or aerial spraying of herbicides; or motorboats and vehicles used to access treatment sites.

Cultural Resources

The displacement of native plants by exotic plants may alter the cultural landscape by crowding out plants linked to prehistoric or historic use of an area.

Conversely, some exotic plants may be a contributing element of a historic landscape, and their removal would diminish the significance of that landscape through the loss of historic planting patterns, landscape designs, and heirloom species and by changes in visual appearance of the landscape.

The physical destruction of historic structures can be accelerated if the roots of exotic plants penetrate foundations and walls. Sometimes, though, exotic plants may aid in the stabilization of historic structures by reducing soil erosion in the area or by supporting unstable ruins.

Exotic plants in south Florida and the Caribbean national parks may have cultural significance to traditionally associated peoples. Treatment methods to control exotic plants could result in the removal of plant species of traditional or cultural value. Genip, for example, is a local exotic tree that grows in Virgin Islands National Park on St. John. Genip was planted because it was thought to bring good fortune. The fruits are eaten, and the seeds of the fruit are roasted for a popular snack.

Management techniques to remove exotic plants may negatively alter the cultural landscape by associated physical damage to other plantings and landscape structures. Management actions to remove exotic plants may uncover historic or archeological resources, which may result in damage or loss of artifacts and features due to erosion, exposure to the environment, and unauthorized collection. Artifacts and archeological site features can also be damaged by creating access to sites and by equipment used to implement management activities, resulting in loss of vital stratigraphic (layers of earth) information and physical damage to features and artifacts still remaining in their original location.

Exotic plants may be “markers” for buried historic sites because they were purposely planted on the site as part of its landscaping or use, or because the soil was disturbed and thus vulnerable for exotic infestation. Removal of exotic plants without documentation of the sites diminishes the potential for future site identification and protection. However, the systematic surveys required to identify and treat exotic plants, along with collection of global positioning system (GPS) coordinates, can aid cultural resource specialists in finding previously unidentified sites. The contamination of soil, charcoal deposits, and artifacts (such as bone and shell) by chemical compounds, especially hydrocarbons, could alter results of expensive scientific analysis such as Carbon 14 testing (Michaels and Fagan 2005). The resulting dates might be invalid, leaving park managers without one of their most valuable tools for site identification and treatment.

Visitor Use and Experience

The presence of exotic plants in the national parks may lead some park visitors to believe that the NPS is not fulfilling its mandate to protect and preserve park resources; yet, other visitors may not comprehend the difference between exotic and native plants, which leads to confusion about what the natural environment truly is.

Exotic plants alter the natural landscape and may impact the viewshed and visitor experience of the park. During exotic plant treatment activities, the presence of crews and equipment and area closures can also impact visitor use and experience. Until native plants reestablish following exotic plant treatment, some areas of the park could be visually unattractive, which may detract from visitor experience during the transition period.

Some visitors may be opposed to the use of chemical treatments on exotic plants. The smell of herbicides and compounds that enhance their effectiveness is offensive to many people, and although temporary, visitor and applicator experience can be affected by chemical smells.

Exotic plant treatments can result in numerous standing dead plants, which could detract from the natural landscape and affect the visitor experience.

Public Health and Safety

The presence of exotic plants may pose a health risk to park visitors, staff, or area residents. Many people are allergic to exotic plants. Melaleuca causes severe respiratory disorders in some people. Brazilian pepper is in the same family as poison ivy, and some people experience contact dermatitis after exposure to its leaves, berries, and sap.

As discussed earlier in the “Native Plants and Vegetation Categories” and “Wildlife and Wildlife Habitat” sections, exotic plants can alter the intensity and structure of wildfires because of an increase in fuel loads and flammable chemicals in leaves and can also facilitate the spread of fire into the forest canopy. Stands of exotic plants near residential areas increase the risk of fire and threat to public health and safety. An overgrowth of exotic plants close to roadways can potentially interfere with travelers’ ability to navigate or view road signs.

The treatment of exotic plants may also present health and safety risks to workers, park visitors, and area residents. The operation of equipment used to treat exotic plants may pose a danger to the operators or those in the vicinity of the treatment areas. There could be risks to workers during transport to treatment areas in boats, helicopters, and trucks, but these risks are minimized by strict equipment maintenance routines, implementation of health and safety plans, and use of trained, experienced workers.

Prescribed Fire. The use of fire to treat exotic plants may damage property and pose a safety risk to people. Exotic tree species (like Australian pine, which can grow up to 100 feet tall) left standing following chemical treatment may present a safety hazard when they decay and fall after treatment.

Chemical Treatment. Chemicals used to control exotic plants may enter the groundwater and have adverse effects on public health and safety. The use of EPA-approved herbicides and use-specific application methods as per labeling instructions reduces this risk significantly, because the EPA requires that before a pesticide may be sold in the United States, research must show that its use does not present unreasonable risks to people and the environment.

People in or near exotic plant-treatment areas may be accidentally exposed to herbicides. However, the herbicides typically used in the parks are rarely classified as “restricted” or potentially harmful to humans or the environment.

Management and Operations

The burden on NPS staff and resources to control exotic plants has grown with the increasing presence of the plants and the need to treat these species. The NPS also strives to prevent the introduction of exotic plants into the parks.

Treatment activities, especially fire may prohibit access to areas of the park, which may disrupt or hinder other park activities. In addition, heavy machinery used for mechanical control of exotic plants can damage park roads and infrastructure.

ISSUES DISMISSED FROM FURTHER CONSIDERATION

URBAN QUALITY AND DESIGN OF THE BUILT ENVIRONMENT

Urban quality and design of the built environment were eliminated from further consideration, because exotic plant management actions would have little or no affect on development.

SOCIOECONOMICS

Removing exotic plants harvested by local area residents for consumption may adversely affect individuals in local communities. For example, in Virgin Islands National Park, genip is collected and eaten by local people. However, potential economic gain from exotic plant harvest within the parks is assumed to be negligible, and management alternatives are unlikely to economically affect the local community. Therefore, this topic was eliminated from further consideration. Effects to traditionally associated peoples are analyzed under ethnographic resources within the “Cultural Resources” impact topic.

MINORITY AND LOW-INCOME POPULATIONS (ENVIRONMENTAL JUSTICE)

Executive Order 12898: Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, directs federal agencies to address environmental and human health conditions in minority and low-income communities to avoid the disproportionate placement of any adverse effects from federal policies and actions on these populations. This topic is dismissed from further consideration because communities in areas adjacent to the parks may include low-income populations, but these populations would not be disproportionately affected by any of the proposed alternatives.

CONFLICTS WITH OTHER LAND USE PLANS, POLICIES, OR CONTROLS

Park resource managers report that all alternatives are consistent with aspects of other park plans addressing management of vegetation communities. Where exotic plants may be identified as historically significant to the cultural landscape, limited populations of those plants would be retained to allow accurate understanding of their cultural significance. None of the alternatives would conflict with land use plans, policies, or controls for areas neighboring the nine parks. Goals and initiatives similar to those of other federal, state, and local agencies foster cooperation with such agencies. For example, the Bureau of Invasive Plant Management in the Florida Department of Environmental Protection has a mandate to reach a maintenance level for exotic plants on public land by the year 2010. This goal has spurred the bureau to partner with the five national parks in south Florida to control exotic plants in the parks and on neighboring public lands (Pernas 2004b). In the Virgin Islands, the territorial government turns to Buck Island Reef National Monument to learn about effective treatments for exotic plants (Hillis-Starr 2004).

FLOODPLAINS

The proposed management alternatives do not involve development that would change water surface elevations or cause flooding that would affect human safety, health, or welfare. Therefore, this topic is not addressed.

PRIME AND UNIQUE AGRICULTURAL LANDS

No prime or unique agricultural lands exist in the nine parks involved in this plan, and none would be affected outside the parks.

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

Delineated essential fish habitat, which include coral reefs that are found in Biscayne National Park, Canaveral National Seashore, Dry Tortugas National Park, Everglades National Park, Virgin Islands National Park, Salt River Bay National Historic Park, and Buck Island Reef National Monument, are ecologically critical habitats. Issues related to these habitats have been included in the analysis and can be found in the "Essential Fish Habitat" section of the document. Seagrass and mangroves are also considered essential fish habitat and are discussed in detail within the "Native Plants / Vegetation Categories" section of this draft EPMP/EIS.

INDIAN TRUST RESOURCES

The federal Indian trust responsibility is a legally enforceable fiduciary obligation on the part of the United States to protect tribal lands, assets, resources, and treaty rights. No Indian trust resources have been identified for any of the parks participating in this planning effort. Therefore, this impact topic is eliminated from further consideration. The Seminole Tribe of Florida and the Miccosukee Tribe of Indians of Florida have strong associations with Big Cypress National Preserve and Everglades National Park and their resources. Effects to these tribes are evaluated in the "Cultural Resources" section in the "Environmental Consequences" chapter.

ENERGY REQUIREMENTS AND CONSERVATION POTENTIAL

Refer to the section titled "Sustainability and Long-Term Management" for the rationale for dismissal.

NATURAL OR DEPLETABLE RESOURCE REQUIREMENTS AND CONSERVATION POTENTIAL

Refer to the section titled "Sustainability and Long-Term Management" for the rationale for dismissal.