



South Florida/Caribbean Network Early Detection Protocol for Exotic Plants

Corridors of Invasiveness

Natural Resource Report NPS/SFCN/NRR—2022/2420



ON THE COVER

Upper left: SFCN Botanist Robert B. Shamblin surveying the Rowdy Bend trail in Everglades National Park. Upper right: Using the “Mule” to survey Spite Highway on Elliott Key in Biscayne National Park. Lower left: Road survey near Chekika in Everglades National Park. Lower right: Airboat survey in Shark Slough within Everglades National Park.
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Change History

Protocol versions are tracked in the revision history log attached to the narrative and to each Standard Operating Procedure (SOP). Major changes results in an update by whole numbers (i.e., version 1.0, version 2.0, etc.) and minor changes by tenths (e.g., version 1.1, version 1.2, etc.).

Revision Date	Author	Changes Made	Reason for Change	New Version #
6/1/2020	Robert Shamblin	1) Updated site maps to include new sites and sites that were dropped. 2) Updated Table 2 – Five-year rotation. 3) Updated new SOP names throughout the Narrative	1) The status of some campground sites has changed and are no longer campground sites. The newly acquired Key Largo property sites were added. 2) Updated to reflect 5 years of sampling based on when protocol was published. 3) SOP's were modified and received new names (Ex. SOP A - Preparation for Field is now SOP CI01 – Preparation for Fieldwork)	1.1

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Executive Summary

Exotic plant populations can be potentially catastrophic to the natural communities of South Florida. Aggressive exotics such as Brazillian Pepper (*Schinus terebinthifolius*) and Melaleuca (*Melaleuca quinquinervia*) have displaced native habitats and formed monocultures of exotic stands (Dalrymple et al. 2003). Nearby plant nurseries, especially the ones outside the boundaries of Biscayne National Park (BISC) and Everglades National Park (EVER), are a continuous source of new exotic species that may become established within South Florida's national parks. Early detection and rapid response to these new species of exotic plants is important to maintaining the integrity of the parks' natural habitats and is a cost-effective approach to management. The South Florida/Caribbean Network (SFCN) developed the *South Florida/Caribbean Network Early Detection Protocol for Exotic Plants* to target early detection of these potential invaders.

Three national parks of South Florida are monitored for invasive, exotic plants using this protocol: Big Cypress National Preserve (BICY), Biscayne National Park (BISC), and Everglades National Park (EVER). These national parks include some 2,411,000 acres (3,767.2 square miles [mi^2]) that encompass a variety of habitat types. To monitor the entire area for new species would not be feasible; therefore the basic approach of this protocol is to scan major "corridors of invasiveness," e.g., paved and unpaved roads, trails, trail heads, off road vehicle (ORV) trails, boat ramps, canals, and campgrounds, for exotic plant species new to the national parks of South Florida. Sampling is optimized using a two- to three-person crew: a trained botanist, a certified herbicide applicator, and optionally a SFCN (or IPMT [Invasive Plant Management Team]) staff member or park staff to take photographs and help with data collection. If infestations are small, they are treated immediately by the herbicide applicator. If large, they are reported to park staff and the Invasive Plant Management Team.

The sampling domain is partitioned into five regions, with one region sampled per year. Regions include the terrestrial habitats of Biscayne National Park, the eastern region of Everglades National Park, the western region of Everglades National Park, the northern region of Big Cypress National Preserve, and the southern region of Big Cypress National Preserve.

Monitoring of roads, trails, and canals occurs while traveling into and through the parks (i.e., travel at 2–10 mph) using motorized vehicles, airboats, and/or hiking. Campgrounds, boat launches, trailheads, and similar areas, involve complete searches. When an exotic plant is observed, a GPS location is obtained, and coordinates are taken of the plant. Photographs are not taken for every exotic plant encountered, but photographs will be taken for new and unusual species (for example a coastal exotic found in inland habitats). Information recorded at each location includes the species name, size of infestation, abundance, cover class, any treatment/control action taken, and relevant notes. During the surveys, a GPS "track" is also recorded to document the areas surveyed and a field of view is estimated. Field notes, pictures, and GPS data are compiled, entered, and analyzed in a Microsoft Access database. Resource briefs (and optional data summary reports) and associated shapefiles and data are then produced and sent to contacts within the corresponding national parks.

The specifics of the methods used to accomplish the monitoring objectives are detailed in nine Standard Operating Procedures (SOP's):

- CI01—Preparation for Fieldwork,
- CI02—Survey Methods,
- CI03—Removing Exotic Plants,
- CI04—Post Field Data Activities,
- CI05—Downloading Waypoints and Tracklines from Handheld GPS Units,
- CI06—Geospatial Data Processing,
- CI07—Creating the Data Summary Report,
- CI08—Revising the Protocol, and
- CI09—Site Selection.

The IPMT herbicide treatment procedures are documented by the IPMT program separately.

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Background and Objectives

The South Florida/Caribbean Network is part of the National Park Service's Inventory and Monitoring program. The program's role is to inventory and monitor natural resources on National Park Service managed lands. National Park Service lands across the nation were divided into 32 networks based on physiographic similarity and administrative feasibility. The South Florida/Caribbean Network consists of seven parks including: Big Cypress National Preserve (BICY), Biscayne National Park (BISC), Buck Island Reef National Monument (BUI), Dry Tortugas National Park (DRTO), Everglades National Park (EVER), Salt River Bay National Historical Park and Ecological Preserve (SARI), and Virgin Islands National Park (VIIS; Figure 1). The information and understanding gathered from this science-based inventory and monitoring program is intended to improve resource management in national parks as well as inform public policy development to better protect the natural resources of this nation.

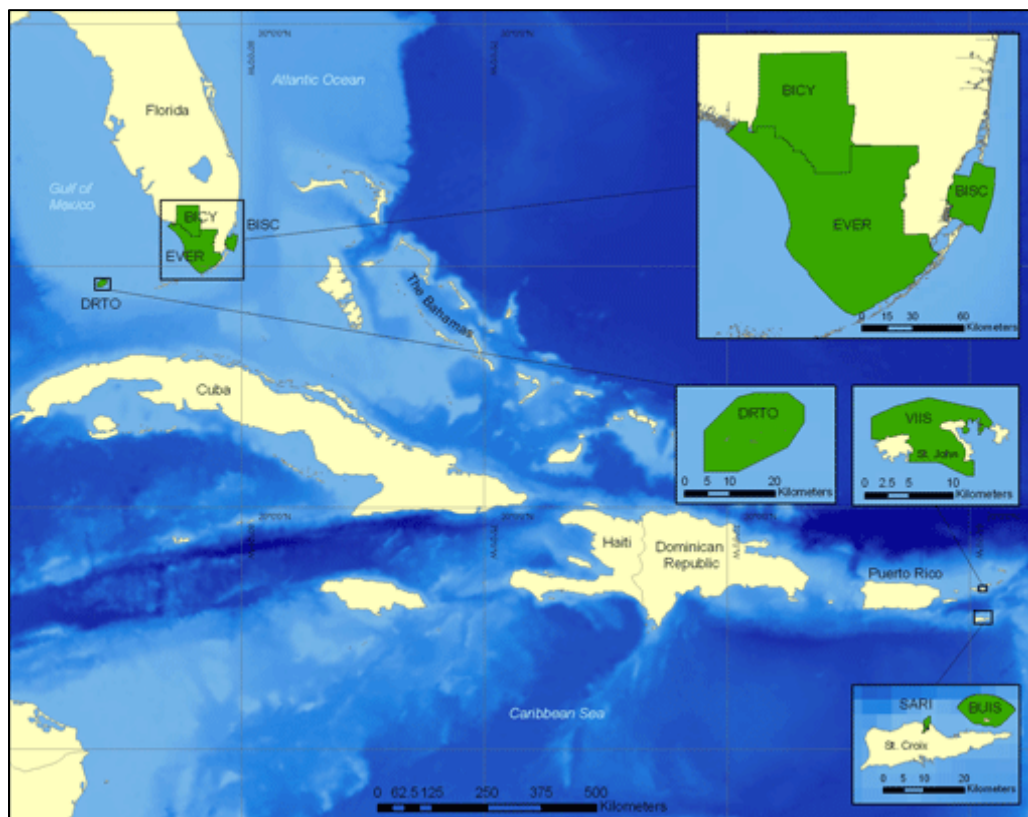


Figure 1. The seven national parks comprising the South Florida/Caribbean Network.

The National Park Service (NPS) South Florida/Caribbean Network (SFCN) and the Florida and Caribbean Invasive Plant Management Team (IPMT) collaborate closely on the implementation of this monitoring protocol to detect newly emerging and existing exotic plant species and infestations. The IPMT program was created in 2000 and is charged with assisting parks in preventing introductions of new species, reducing existing infestations, and restoring native plant communities

and ecosystem functions. The Florida and Caribbean IPMT covers the same parks as the South Florida/Caribbean Network plus several additional parks in north Florida.

Invasive exotic plants are one of the most serious threats to maintaining ecosystem integrity in the national parks of South Florida and were ranked fifth in priority out of 44 SFCN “vital signs” (indicators of park natural resource health) by over 100 area scientists, government staff, and non-government organizations. The process involved scoping of management issues, development of conceptual models, indicator identification workshops, online web ranking, and final review and approval by SFCN’s Board of Directors and Science and Technical Committee (Patterson et al. 2008).

Invasive exotic plant species can affect park natural resources and visitor satisfaction by altering the natural landscape, reducing habitat for native plants and animals, and increasing demand on park resources for trail maintenance and exotic plant eradication efforts. Early detection of exotic plants is a vital part of managing their presence in the SFCN national parks and preventing their establishment, thereby preserving the parks’ native flora and fauna.

Vulnerability of SFCN Parks to Invasive Species

Exotic plant species in South Florida and the Virgin Islands not only involve grasses and herbs, but also include shrubs (e.g. *Schinus terebinthifolius*) and trees (e.g. *Melaleuca quinquenervia*) which can radically alter vegetation structure and habitats for native flora and fauna. The national parks of the South Florida area, i.e., Everglades National Park, Biscayne National Park, and Big Cypress National Preserve (Figure 2), are floristically unique from the rest of the United States. These parks contain a flora consisting of both wetland and upland species which can be either temperate or tropical in origin, often found growing in close proximity to each other.

The “peninsula effect,” suggested in Simpson (1964), denotes a decrease in species diversity along the peninsula from base to tip, and may have an effect on South Florida ecosystems where temperate species are reaching their southern limit and tropical species are reaching their northern limit, allowing for niches that can be filled by exotic species. This vulnerability is coupled with proximity to a large metropolitan area which draws visitors from around the world to the parks plus a large landscaping nursery industry which can be a source of new exotics. Other parks within the South Florida/Caribbean Network are predominantly small island parks, i.e., Dry Tortugas National Park and Buck Island Reef National Monument, and large island parks, i.e., Salt River Bay National Historical Park and Ecological Reserve and Virgin Islands National Park.

The Florida Exotic Pest Plant Council (FLEPPC) compiles exotic species lists revised every two years. Professional botanists and others perform exhaustive studies to determine invasive exotic plants that should be placed on the lists. According to FLEPPC, invasive exotic plants are termed Category I invasive plants when they are altering native plant communities by displacing native species, changing community structures or ecological functions, or hybridizing with natives. This definition does not rely on the economic severity or geographic range of the problem, but on the documented ecological damage caused. Category II invasive exotic plants have increased in

abundance or frequency but have not yet altered Florida plant communities to the extent shown by Category I species. These species may become Category I if ecological damage is demonstrated.



Figure 2. Exotic plant surveys are conducted in the three National Parks of South Florida: Big Cypress National Preserve, Everglades National Park, and Biscayne National Park.

The Florida Exotic Pest Plant Council (FLEPPC) 2019 Invasive Plant Species List included 81 Category I invasive species and another 85 Category II species ([Florida Invasive Species Council](#)).

Existing Programs

The Florida and Caribbean Exotic Plant Management Team (now the Florida and Caribbean Invasive Plant Management Team) has used two methods for assessing the extent and distribution of invasive plant species in South Florida and U.S. Virgin Island parks: (1) Digital Aerial Sketch Mapping (DASM) and (2) complete surveys. These methods have been discontinued due to problems with sketch mapping software and changes in the Florida and Caribbean Invasive Plant Management Team program.

Digital Aerial Sketch Mapping was developed in the 1990s by the USDA Forest Service for the aerial detection and mapping of forest pests and pathogens. In 2005, the National Park Service (NPS) and the South Florida Water Management District (SFWMD) conducted a pilot project utilizing DASM technology. Using an aircraft, observers would sketch exotic plant distribution on touch-sensitive computer displays showing the aircraft's GPS position against a background of moving digital aerial photos and background data. Based on the success of the 2005 work the National Park Service is using the DASM software to track invasive exotics at a large landscape level.

Since this protocol was published in 2013, there have been changes within the IPMT program. One major change is the suspension of the annual seasonal field crews that would conduct complete surveys and treatment of islands and small parks (BISC, BUIS, DRTO, and SARI). With this change, SFCN parks conduct their own surveys and hire their own contractors in the treatment of exotic species.

While these existing programs are good at detecting large populations of known invasive exotic species (e.g., visible from a helicopter and/or identifiable by a contractor with a specific list of known exotic plants), in the larger parks these programs are less likely to detect newly established exotic plants with the potential to become invasive, but which are previously unknown in the park. Detecting new species with the potential to become invasive while they are still in small controllable populations is important because the probability of treatment success is high, and cost-effectiveness is maximized. However, detecting these newly emerging problem species requires personnel with an extensive knowledge of the native vegetation of a park such that they can rapidly spot the "odd" species against the background of myriad native species. In addition, as conducting complete searches of any but the smallest parks are not feasible the sampling strategy for detecting these species differs from the existing efforts.

The most successful and cost-effective strategy for preventing the establishment of exotic plant species is to implement an early detection plan for these species (Hobbs and Humphries 1995; Randall 1996; Rejmanek and Pitcairn 2002). The method of early detection through observation of pathways by which invasive exotics become introduced into an ecosystem is suggested in General Guidelines for the Establishment and Evaluation of Invasive Species Early Detection and Rapid Response Systems, published by the National Invasive Species Council in 2003. This report proposes the use of active detection networks along high-risk locations (corridors) to catch invasions early, before they develop into a larger problem, and respond adequately.

A study of prevention and control of invasive zebra mussels in Michigan lakes found that investing in prevention methods over control methods was a more effective form of invasive management (Leung et al. 2002). Prevention measures are currently employed by the U.S. Coast Guard in an effort to halt the transport of marine invasive species in ships' ballast water from port to port. Ships with ballast water are required to follow a series of rules regarding discharge and reporting of discharge. Consequently, this protocol focuses on monitoring areas suspected of being high risk for invasive-exotic plant introduction (termed "Corridors of Invasiveness") and quickly preventing their establishment and development into larger populations requiring more intensive management.

Defining “Corridors”

“Corridors of Invasiveness” are defined in this protocol as areas that allow or facilitate the introduction of exotic species due to intentional or non-intentional human activities. The corridors of invasiveness function as in-roads or access into natural areas allowing for a seed source for colonization, and ultimately an introduction site for founder populations to start from. The general assumption is that plant species with human assisted dispersal mechanisms can potentially be introduced via a corridor into natural habitats. Seeds or propagules can be moved by attaching themselves to clothing or equipment and by humans actively transporting them from site to site (i.e. hiking trails, ORV roads). The seeds or propagules can readily invade areas where there is disturbance or in areas that are more open and receive a large amount of sunlight (i.e., trails or trail heads, road stops, campgrounds). For our purpose, the goal of surveying the “Corridors of Invasiveness” is to detect exotic plant species that are new to each of the specific parks. This provides park management with the opportunity to treat these exotics before they become established in the park unit.

Corridors of invasiveness are similar to, but also different from, the ‘wildlife corridors’ mentioned in other contexts. For wildlife, corridors assist connectivity between populations, increase effective population size and facilitate establishment or re-establishment of populations. A wildlife corridor, or green corridor, is an area of habitat connecting wildlife populations separated by human activities (such as roads, development, or logging; Bond 2003). Wildlife corridors allow for an exchange of individuals between populations, lowering inbreeding within populations, so increasing effective population size, and facilitating re-establishment of populations that have been decimated or eliminated due to random events. Wildlife corridor’s traits potentially moderate some of the detrimental effects of habitat fragmentation. Conversely, corridors of disturbed habitat (i.e. roads, trails) may also act as avenues for detrimental purposes in the case of exotic plants, which can use corridors for infiltration into undisturbed habitat.

Corridors of invasiveness include paved and unpaved roads, trails, trail heads, ORV trails, boat launch areas, campgrounds, and canals.

Roads—Vehicles such as cars and trucks can transport seeds, which are then dispersed along roadways. These areas are often highly disturbed, allowing exotic plants the opportunity to become established. For some species, this disturbed area itself becomes a corridor, allowing for dispersal.

Trails—Humans transport seeds in hiking gear, on clothing, and on ORV’s and ATV’s. These seeds can then be dispersed along the trails. Also, animals use these trails and may disperse seeds that are attached to them. Similar to roads, trails themselves can become a corridor allowing for dispersal.

Canals—Boats transport seeds and propagules, which are often attached to boat motors, propellers, and trailers. These are then carried to new areas where the boats are taken, where the seeds and propagules fall off and may become established. The canals then act as avenues of faster water movement than the surrounding wetlands.

Campgrounds—Campgrounds are where people congregate and where exotic plant species can become established. Seeds or propagules may be brought into campground areas by attaching themselves to tires, clothing, camping and hiking equipment, or from pets. Seeds from fruits and vegetables may also become established from refuse.

Boat Launches—Boat launches are where people congregate, throw garbage away, and bring in attached plant life on boats and vehicles. Seeds may also collect in bilge water or within motors or attach to propellers and trailer tires. These seeds may fall off and become established populations.

Airboat Trails—Airboats can also carry seeds and propagules to new areas. Seeds may attach to the airboat, trailer, or gear brought and transported by airboat.

Monitoring Objectives

The monitoring goal of this protocol is to detect newly emerging exotic plant species and infestations in the national parks of South Florida in order to provide the IPMT and park management with effective decision-making information. The specific monitoring objectives include:

- 1) Detect new species of exotic plants along selected corridors of invasiveness (i.e., roads, trails, canals, campgrounds, boat launches, and airboat trails).
- 2) Detect new invasions of existing exotic plants along selected corridors of invasiveness.
- 3) Determine status and trends in percent infested area and distribution of infestations along selected corridors of invasiveness.
- 4) Survey all selected corridors of the three target parks within a five-year period.

Due to logistical and time restraints, only three national parks of South Florida will be monitored for this project: Big Cypress National Preserve (BICY), Biscayne National Park (BISC), and Everglades National Park (EVER; Figure 2).

Sampling Design

Sampling Approach and Rationale

The sampling approach identifies all official corridors of invasiveness, i.e., roads, trails, canals, campgrounds, boat launches, and airboat trails where humans may introduce new species to the parks. Areas that are unfeasible to sample, are too dangerous (major highways) or, historically, do not cause species introduction problems (i.e., chickees, which are raised platforms in waterways for canoe or kayak camping) are excluded. All other official corridor survey areas are monitored over the course of a five-year rotation (see Sampling Effort section). Monitoring the corridors focuses sampling effort on areas where plants are likely to be introduced (along the corridors).

Pilot Study Roadside Survey Estimate of Time and Distance

A pilot study was conducted to test the field methods in this protocol and produce realistic estimates of survey times and distance covered (Table 1). This pilot work was used to finalize the sampling frame and level of effort feasible for this protocol.

Table 1. Pilot study estimates of time required for surveys in different habitats.

Location	Distance	Time	Miles/hour	Comments
Chekika Road (EVER)	14 miles (22.5 km]	2.7 hrs	5.4 mph	Wet prairie habitat. Made frequent stops to investigate suspicious plant species or areas of concern. This area is an open prairie habitat with patches of trees and shrubs, sometimes dense stands, which may take longer to survey if there are extensive patches of dense vegetation.
Loop Road (BICY)	27.84 miles (44.8 km)	8 hrs	3.48 mph	Took longer to cover the ground due to a denser, more forested type of habitat than that of the open prairie.
Canal Roads (BISC)	11.31 miles (18.2 km)	4.5 hrs	2.51 mph	This area takes the most amount of time to cover due to dense vegetation and narrow roads contributing to hazardous driving conditions. These are canal roads allowing for the passage of only one vehicle and are sometimes too narrow to turn the vehicle around. Extra precautions are needed, such as driving slowly and having a scout to watch for unseen drop offs. Progress is also slowed by having to survey the eastern extremities of the canal roads and trails by foot.

Sampling Frame

All official, publicly accessible roads, trails, canals, campgrounds, boat ramps, and airboat trails, within the boundaries of Everglades National Park (EVER), Biscayne National Park (BISC), and Big Cypress National Preserve (BICY) were identified as survey sites. At this time unofficial trails are not surveyed as their visitation is assumed to be lower and due to time and wilderness constraints.

Some survey areas were discarded or restricted for safety or for feasibility reasons. For instance, Interstate Highway 75 (which runs through BICY), Tamiami Trail on the northern border of Everglades National Park, and the main EVER park road were discarded for safety reasons as they were considered too dangerous to drive at idle speed. Instead, the focus is on places where people stop and get out of their cars to hike trails, go boating, or sight-see. The chickee campsite platforms are not included in the survey. Chickee campsites usually stand in open water with little or no ground cover for exotic plants to become established. Also, Off Road Vehicle (ORV) trail surveys in Big Cypress National Preserve are restricted to the trailheads and the first 100 meters (328.1 feet [ft]) inland from the trailhead, as near the trailhead was considered the area of highest potential for introduction and due to time and effort concerns of surveying the many miles of these trails (Figure 3). Additional 100-meter segments are added if exotics are still being found along the trail towards the end of the first 100 meters. Airboat trails are similarly restricted to the first 1 kilometer (0.62 mile) from the boat launch. If exotics are found near the end of the first 1 kilometer, then 500-meter (1,640.4 ft) segments are added until no exotics are found.

All these selected corridor survey areas, called “sites,” were then grouped into regions, and different regions within a park are selected for surveying in a given year (Figure 4; for a list of sites see SOP CI09 *Site Selection*—Version 1.0 [SFCN 2022a]). It is possible for this list to be modified through time, e.g., new trails are opened, other trails are closed, and some surveyed roads are determined to be too dangerous.

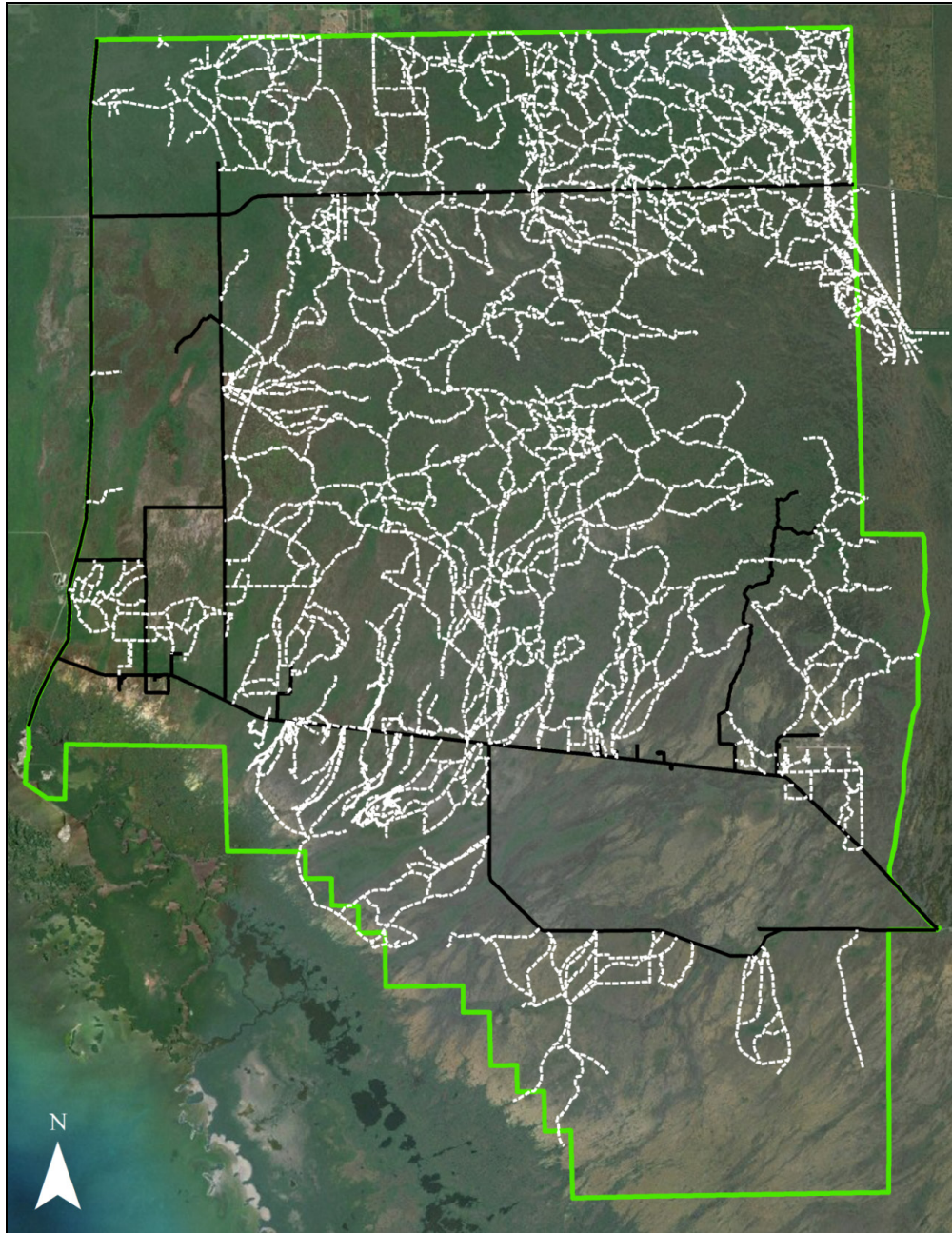


Figure 3. Accepted ORV trails within Big Cypress National Preserve (white lines). Off Road Vehicle (ORV) trail surveys in Big Cypress National Preserve are restricted to the trailheads and the first 100 meters (328.1 ft) inland from the trailhead, due to time and effort concerns of surveying the many miles of these trails.

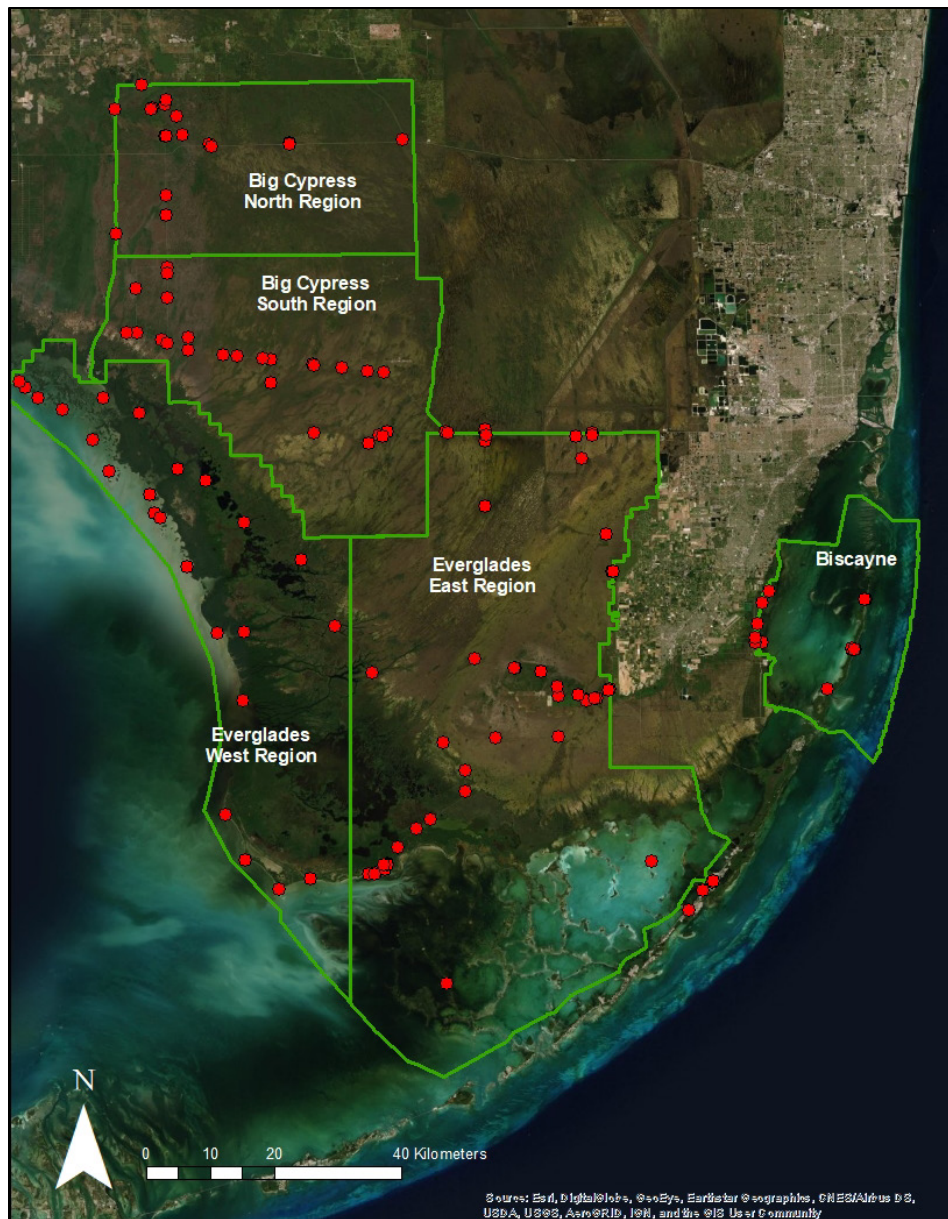


Figure 4. Map of selected corridor survey sites and Regions for Everglades National Park, Big Cypress National Preserve, and Biscayne National Park, as of 2020. Points show starting points for sites to be surveyed for the Corridors of Invasiveness Project.

Sampling Effort

A complete sample of all selected survey sites in the three parks occurs every five years. Sampling effort is balanced across years by using a rotating design, with year one starting in the southern region of Big Cypress National Preserve (Table 2). Year two is dedicated to the western region of Everglades National Park (Table 2). Year three is dedicated to the northern region of Big Cypress National Preserve. Year four is dedicated to Biscayne National Park (Table 2). Because most of the area of Biscayne National Park is marine, survey sites are restricted to areas of the mainland and a few of the offshore keys. Therefore, all of Biscayne National Park can be surveyed within one annual

cycle. Year five is dedicated to the eastern region of Everglades National Park (Table 2). Year six starts the cycle over again and dedicated to the southern region of Big Cypress National Preserve (Table 2). See SOP CI09 (SFCN 2022a) for maps of the park regions, location of sites, and site table.

Table 2. Five-year surveying schedule for invasive exotic plants.

Activity	Year 1	Year 2	Year 3	Year 4	Year 5
Park to be surveyed	BISC	EVER	BICY	EVER	BICY
Sites surveyed per year	All sites	East region sites	south region sites	west region sites	north region sites

A five-year rotation is realistic given the number of corridor survey sites to be monitored and the limits of SFCN and IPMT staff time. However, nothing in this protocol should preclude park staff or other partners from undertaking additional monitoring to expand the frequency or scope if sufficient resources are available.

Timing of Sampling

Field sampling begins in May and ends at the end of October. Field work usually takes three to four weeks (15–20 workdays) to complete but can be spread out over the course of a six- month period to coincide with flowering times which make plant identification easier. Flowering broadleaf plants generally flower in the spring, while grasses generally flower in the fall months. Preparation for field sampling begins in late April of each calendar year (Table 3). April is spent reviewing results from the last monitoring event for the park that is to be sampled that year. For example, if it is the second year of the surveying schedule (Everglades National Park eastern region sites), then a review of the results from the last monitoring event for the eastern sites of Everglades National Park is conducted so that researchers familiarize themselves with locations, previous findings, locations of harder to find species, and areas that were previously treated.

Tracklines and waypoints from the previous sampling event are loaded onto a GPS unit or iPad to act as survey guides for the upcoming sampling event (Figures 5 and 6). Also, during this time, check recent exotic plant listings from EDDMapS for the park to be monitored that year. The herbicide applicator (either a member of the IPMT or park personnel) will review the amount of herbicide used during the last sampling event for the specific park (or region of the park) to gauge the amount needed for the upcoming sampling event. April and May are when preparation for the field and beginning field work takes place. The botanist makes sure all items are prepared for the field, including iPad, cameras, GPS units loaded with the previous sampling’s waypoints and tracklines, and that appropriate vehicles are available and ready to go. Also, during April and May, the herbicide applicator prepares all herbicide needed for field work, and ensures all safety equipment for herbicide application are available and in working order. Approval for herbicide application comes from park personnel in charge of exotic plant treatments. The South Florida/Caribbean Network records herbicide use in the field. At the end of the field season the herbicides and amounts used are reported to the park being surveyed and to the IPMT.

Table 3. Annual sampling timeline and personnel tasks.

Metric / Team Members	Apr-May	April-May Tasks	May-Oct	Oct-Dec
Sampling Timeline	Review previous sampling results for Park to be sampled	Prep for fieldwork	Field sampling is from May through October	Process data and GIS files. Prepare annual resource brief
SFCN Botanist	Review EDDMapS for latest listings of exotic plants for Park to be sampled; review findings from last sampling event for Park to be sampled	Prepare datasheets and maps, load GPS units with waypoints and tracklines from last sampling event for Park	Conduct surveys; make sure all sites are monitored; record data; take pictures as needed; identify unknown specimens	Process data and analyze results for current year sampling, update EDDMapS, write annual data summary report and resource brief
SFCN Community Ecologist	–	–	Assist with fieldwork as needed	Review and editing of annual data summary report and resource brief
Herbicide Applicator	Review EDDMapS for latest listings of exotic plants for Park to be sampled; review how much herbicide was used on last sampling event for Park to be sampled	Prepare herbicide and safety gear	Assist in conducting surveys and recording data; drive vehicle; apply herbicide to small infestations; take pictures as needed	–
SFCN Data Management Team	–	Assist with preparation if needed	Ensure iPad databases are backed up and photographs, tabular data, and track lines are extracted for processing. Assist with fieldwork as needed.	Assist in data verification, update metadata & archive datasets, update EDDMapS, review annual data summary report and resource brief and web page



Figure 5. An example of a surveyed trail complete with tracklines and the starting waypoint located at the trailhead in Everglades National Park (in this case starting location for the Rowdy Bend hiking trail). Tracklines and waypoints from the previous sampling event are loaded on the GPS unit to act as sampling guides for the upcoming field surveys.

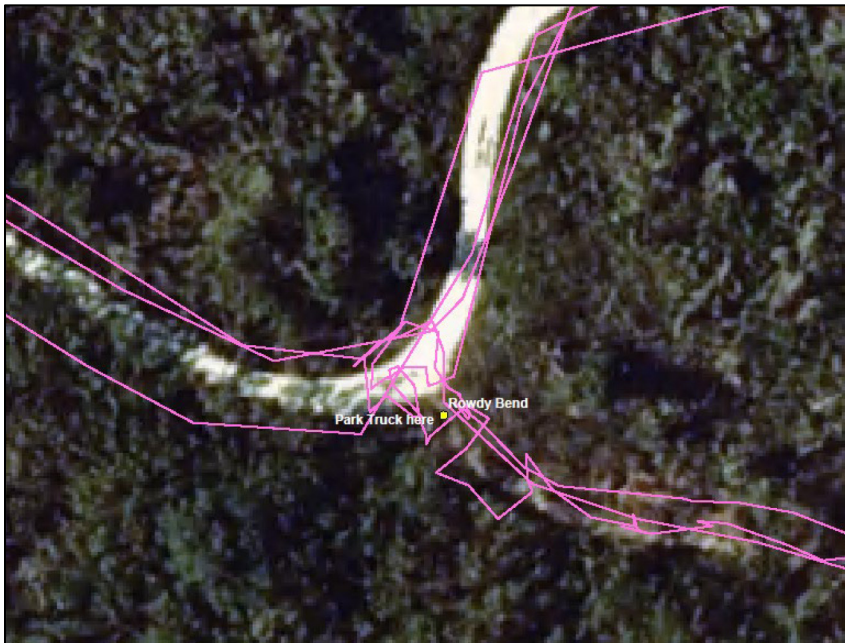


Figure 6. The Rowdy Bend hiking trail site zoomed in (from Figure 5). Notes can be added to show the trailhead, any gates associated with trails and areas where the vehicle may be parked.

Field work begins in May and ends at the end of October. Field work takes approximately 15–20 workdays to complete but can be spread out over the course of a six-month period to coincide with flowering times which make plant identification easier. Flowering broadleaf plants generally flower in the spring, while grasses generally flower in the fall months. In October, data collected in the field is imported into the database and checked for accuracy by the SFCN Botanist and the data management team before initiation of reporting. In late October through December, the annual data summary report is written by the SFCN Botanist with help from the data management team. The resource brief consolidates information from the annual data summary report and is created once the annual data summary report has been reviewed. Upon completion, the reviewed resource brief is distributed to resource managers at the park where the surveys took place. The resource brief is then added to the IRMA Data Store and the SFCN website by the data management team. Writing the annual data summary and the resource brief, distributing it to the appropriate park, and posting it online is done between October and December (Table 3). A more extensive data summary report may be written to document major changes due to large scale disturbances like a major hurricane.

Field Methods

Survey methods and explanations for entering data in the iPad are provided in detail in SOP CI02 *Survey Methods*—Version 2.0 (SFCN 2022b). The field survey consists of, at least, a crew of two: a botanist and a herbicide applicator. The survey crew can be easily augmented by park personnel or other SFCN employees who would like to increase their plant identification skills or learn more about the project. The herbicide applicator drives the vehicle for roadside surveys while the botanist monitors the roadside for new species of exotic plants. A third person is helpful in recording data and taking pictures.

When an exotic plant is discovered, the herbicide applicator is responsible for eradicating small populations immediately (see SOP CI03 *Removing Exotic Plants*—Version 1.1 [SFCN 2022c]). If the herbicide applicator is not available, other SFCN or park staff may be used as an assistant, but no herbicide control will occur unless these staff personnel are certified to apply herbicides. “Field of view” is estimated at the beginning of each survey to describe the distance from trails or roads which are easily observable. The field of view estimate is the distance where the observer has high confidence of identifying exotic (or unknown) plants in all three vegetation structure layers, i.e., herb layer, shrub layer, and tree layer. When a major change occurs in the field of view estimate (e.g., a change from 10 to 20 meters [32.8 to 65.6 ft]), these points are marked with the iPad or GPS and the new field of view estimate is recorded on the iPad or datasheet (datasheet available in Appendix B in SOP CI02 [SFCN 2022b]).

If the observer spots an exotic plant outside this field of view (e.g., trees are visible at greater distances), it is still recorded with a comment noting it as outside this high confidence field of view and with an estimate of the distance and direction of the infestation in relation to the GPS coordinates recorded. Later, this infestation’s coordinates can be displayed in GIS software with aerial imagery. Along with the comment information the observer can more accurately identify the location of this infestation outside the field of view.

Survey Methods

Road Surveying

Road surveys include roads that enter or originate within the park. Also, roads running along the park boundaries will be surveyed, as well as areas of high disturbance or high visitor use, such as stop-offs, picnic areas, and campgrounds. Roads originating outside park boundaries are only surveyed starting at park boundaries.

The road surveying method is performed by a crew of two or three driving a research vehicle at idle speed (2–10 mph) along official park roads (both paved and unpaved) with the goal of detecting early infestations of exotic plant species currently not listed as existing within the park boundaries. The crew includes a driver (herbicide applicator) and a trained botanist but is greatly augmented by a third crewmember who inputs data in the iPad and takes photographs. The botanist views one side of the road on the initial sweep and the other side of the road on the return sweep. When new exotic plants are detected, their location is marked on an iPad or a handheld GPS unit, digital photos are taken of the new species, and notes are recorded regarding species name, plant description, size of

the infestation, number of individuals in the infestation, the plant community the infestation is taking place in, and location characteristics. If the species is unknown to the botanist, pictures and coordinates of the plant are taken for documentation and for species identification.

Walking Surveys

Walking surveys are useful when vegetation is low statured (< 1 meter [3.3 ft] in height), when vegetation is dense (Huebner 2007), when areas are not accessible by vehicle, or when surveying hiking trails, trail heads, some campgrounds, and boat launches. The walking method is a slower and more thorough approach for areas not accessible by vehicle, or areas that require a more detailed investigation.

Hiking Trails—Hiking trails include those originating from visitor centers, parking lots, campgrounds, off-road vehicle (ORV) trails, and at trailheads. Hiking trail trailheads and the beginning 100 meters (328.1 ft) of the trail are the focus of the survey. If exotic plants are still being found after the first 100 meters, then another 100-meter segment is surveyed. ORV trails also originate at trail/road parking areas and continue into the interior of the park. Again, the first 100 meters of the ORV trail is monitored. Hunting camps and old homesteads within the interior of the park are not surveyed.

Campgrounds—The entire campground area, including dump sites, is surveyed. In many instances, campground roads can be monitored by the roadside survey method of driving at idle speed. However, some campgrounds are best surveyed by foot as vegetation is usually tall and dense. By using the walking method in these densely vegetated campgrounds, field of view is increased and smaller plant species such as grasses and forbs are more visible. Special care is taken to survey the campground dump sites and cleaning areas as many species are washed from vehicles and become established in these areas.

Airboat Surveying

Boat Launches—Within park boundaries, boat launches and the immediate surrounding area where people may throw garbage away and where birds may roost will be surveyed. Walking surveys are the preferred method at the landed portion of boat launches. Airboat surveys are used to survey the surrounding waters of airboat launches and airboat trails. Special care is taken when surveying airboat boat launches as these areas occasionally dry out and allow for seed germination, especially grass seeds.

Airboat Trails—Once the airboat is launched, proceed at low speed along main airboat trails. A team of two to three – an airboat operator (usually the herbicide applicator), a botanist, and a third crewmember to input data and take pictures – are needed to perform the airboat survey. While the airboat operator proceeds at low speed, the botanist is on the lookout for early infestations of exotic plant species along the main airboat trails, which may act as corridors into the parks.

Main airboat trails are surveyed for 1 kilometer (0.62 mi). If no exotic plants are located, then the survey for that airboat trail is halted at 1 kilometer from the airboat launch. If, however, a new exotic plant species is found along the survey route, then an additional 500 meters (1,640.4 ft) is surveyed

along the main airboat trails. This process is continued until an entire 500-meter survey is found to have no exotics.

Canals – If there is an available boat launch, canals originating at the edge of the park and continuing into the park interior for 500 meters (1,640.4 ft) or more are sampled by airboat at low speed. Special care is taken to sample submerged aquatic plants for new invasions of exotic plants. To accomplish this, a dip net or boat hook is utilized to pull up mats of submerged aquatic plants to search for exotic species. Submerged aquatic plants are sampled six times during the length of the survey starting at the survey origin and again at approximately every 100 meters (328.1 ft). In many cases the submerged aquatics will be visible from the airboat and infestations are sampled upon sight in addition to the 100-meter sampling interval.

Motorboat Surveying

Motorboats are used for transportation to campsites in Everglades National Park and to the offshore islands in Biscayne National Park. Once at campsites, they are monitored by foot. Other than for transportation, motorboats are not used for surveying.

Data Handling, Analysis and Reporting

Database Design and Data Import/Entry

When using the iPad to collect data, the data are downloaded and imported into the database (see SOP CI04 *Post Field Data Activities*—Version 2.0 [SFCN 2022d]). If paper data sheets are used in the field, they are scanned and stored in a 3-ring binder in the SFCN Conference Room. Scanned copies are placed in: Z:\SFCN\Vital_Signs\Invasive_exotic_plants\data\scanned_data_sheets.

Refer to SOP CI04 (SFCN 2022d) for details on import from the iPad into Microsoft Access, photo naming and storage conventions, and waypoint and trackline naming and storage conventions. The Corridors of Invasiveness database is a Microsoft Access database that stores two general types of data:

- 1) Field data – These data are collected with an iPad using the FileMaker Go app and are then imported directly into the Microsoft Access database. Photographs are also taken via the iPad and are downloaded to the server either after a week of fieldwork or at the end of the field season. If the iPad is not being used for data collection, then photographs are taken with a point and shoot camera. See SOP CI04 (SFCN 2022d) for details. Data collected on paper data sheets are entered into the database using SOP CI04.
- 2) Spatial Data (Waypoints and Infested Area Shapefiles) – The Waypoints shapefile holds raw GPS data and any new waypoints data must be appended to this shapefile. The Infested Areas shapefile contains infested area polygons created during post processing and analysis. This process is described in detail in SOP CI05 *Downloading Waypoints and Tracklines from Handheld GPS Units*—Version 1.1 (SFCN 2022e) from Handheld GPS Units, and SOP CI06 *Geospatial Data Processing*—Version 2.0 (SFCN 2022f). GPS tracklines are also stored in the database but are not linked to any other tables.

Completed field data from the iPad are imported into the Microsoft Access Database as soon as possible after returning from the field. Cameras and GPS units (SOP CI05 [SFCN 2022e]) are downloaded to the correct folders on the server. The details of data import procedures for the Microsoft Access database are provided in SOP CI04 (SFCN 2022d).

Quality Assurance/Quality Control

Quality Assurance/Quality Control (QA/QC) evaluations are done at several levels depending upon the type of data generated.

In field assessment of quality of detection will be accomplished by using a dependent double observer assessment (Nichols et al. 2000) at 5% of the sites. If one of these sites is a long road of 1km or more, then only 10% of the linear distance will be assessed. This is accomplished by having a second botanically knowledgeable observer accompany the primary botanical observer and note any exotic plant infestations missed by the primary botanical observer during the assessment. At the end of sampling at the quality control site the second botanical observer will go over the observations by the primary botanical observer for field of view, cover, abundance, and size estimates and indicate

agreement or if there are substantial differences (30% or more). Any substantial differences will be noted in the comments and brought back to the office and discussed.

The FileMaker Go database has automated checks built-in such as required fields, and a restricted list of species codes which will display a message if the species is not on the list. Lookup lists for years, park unit, site names, and other fields are also used where appropriate. These data are also reviewed by SFCN data management immediately before import into Microsoft Access to look for missing values or other errors across the sites.

Written data from datasheets receive the following QA/QC check:

- Checking for suspicious data (native species, very large infestations) that may have made it past the above checks.
- 100% verification of data in the database by checking all entries with information recorded on datasheets by a second person. If the 100% verification check yields errors, these are reviewed by the project leader who determines if there is a systematic problem that must be addressed with training.
- 100% review and certification of data in the database by the SFCN Community Ecologist.

Unknown Species

The South Florida/Caribbean Network will not collect plant species in the parks. If a species is unidentifiable in the field, pictures of the specimen are taken to aid identification back at the office using books, dichotomous keys, and websites. Coordinates of the plant's location are also collected for documentation and to provide a location for park staff if they would like to collect a specimen.

Analysis

The most important results of this protocol require minimal analysis, i.e., the types, locations, and infestation size of invasive exotic species, with an emphasis on species new to the park. Once all the data are entered, such results are easily exportable as queries and reports from the database.

This protocol will inform two primary trends:

- 1) Spatial trends in the distribution of species and patterns of invasion in and along corridors.
- 2) Percent infested area which can be compared among different areas of the park, along different types of corridors, and through time.

In time it may also be possible to share other trends such as the efficacy of various treatments by species, and how treated versus untreated infestations change over time.

Spatial Data

The infestation waypoints, as well as the digitized survey lines and buffers, will be stored in the database. These can be used to quickly compare visits and highlight any changes in the surveys which may need to be mentioned in reports (e.g., surveys were continued further down trails as exotics were still found near the 100-meter (328.1-ft) cutoff from the trailhead).

Percent Infested Area

Percent infested area is calculated by taking the area of infestations “inside” the field of view buffer and dividing by the total area surveyed (total digitized line buffered area). Calculations are made by species and across all species. Note that infestation area estimates are rapid, the digitization of large polygons is approximate, and estimates of field of view are approximate and it is possible for the area surveyed to shift a small degree through time. Users of these metrics should focus on large differences in percent infested area rather than small changes.

Assessing the effectiveness of the sampling design

After the first three rounds of sampling of all the parks is completed, the effectiveness of the sampling design will be assessed by using the following questions:

- How many new species and infestations of existing species were detected and what types? How many are considered potentially problematic species? What is their spatial distribution within the park’s “corridors”?
- What type of “corridors” and areas of the parks resulted in the newest species detected and greatest infestations? What type resulted in little to none?
- What areas of the park have the greatest percent infested area within the corridors? How great a difference is there in percent infested area within different areas of the parks and types of corridors and among different species?
- Did the number and size distribution of infestations change for different species? Did the percent infested area of the new and existing exotic species change by large amounts between the two visits?
- What is the pattern of spread of new species in/along “corridors”? Or was distribution static or reduced after the previous sampling? What areas are most problematic for re-infestation? Is there a shift in the areas where the newest species and new infestations are detected?
- How large are new infestations?

These questions will be used to evaluate if there are sites which can be dropped from further sampling or areas that should be added; whether the frequency of re-visit is appropriate; whether percent infested area is a useful metric at the precision level; and whether the number and type of new species detected and size of the infestations, coupled with labor and treatment costs, show that this type of monitoring is cost-effective in assisting overall invasive exotic plant control.

Reporting

Reporting associated with this protocol includes an annual data summary report, a resource brief, data, associated shapefiles from the park surveyed in a particular year, and a periodic trend report. Data include individual infestations together with waypoint information, infestation areas, abundance, field of view estimates, treatment data, and comments. Data also include exotic species detected, whether the species are new to the park, number of infestations, minimum size of infestations found, maximum size of infestations found, total area surveyed, and percent infested in the field of view. Maps and photos are included when creating a data summary report. Details for creating these reports can be found in *SOP CI07 Creating the Data Summary Report—Version 1.1*

(SFCN 2022g). A sample annual summary data report template can be found in Appendix A in SOP CI07 (SFCN 2022g).

The completed resource brief and annual data summary report is sent via email to the corresponding park and to the IPMT Coordinator approximately eight weeks after completion of field work.

- Data are uploaded into the Early Detection and Distribution Mapping System (EDDMapS Mapping Project) at [EDDMapS](#). Reporting to EDDMapS is normally done upon completion of field work; however, when a new species or new infestation is discovered, it is reported to EDDMapS as soon as possible.
- The corresponding park is also notified within five days when a new species or unusual infestation is discovered, i.e. by email, phone, or in person.
- The National Park Service database NPSpecies is updated with new exotic plant species. Reporting to NPSpecies is done after completion of field work and when all species are verified.

Reports are uploaded to the [Integrated Resource Management Applications Portal](#) and the [SFCN webpage](#) and included in annual vital signs reporting.

A periodic trend report will occur after there have been three sample events of all five regions. The first surveys established baseline conditions and the following two survey events are measuring changes that have occurred over a known length of time. The completed cycle of all five regions provides a holistic understanding of the presence of exotics and corridors of invasiveness in the South Florida Parks.

Metadata and Data Archival Procedures

All metadata pertaining to the database and spatial files are updated as changes are made and are reviewed and finalized at the end of the calendar year and follow the guidelines for metadata in Chapter 8 of the SFCN Network Data Management Plan (Witcher 2007).

Archiving is started once the SFCN Community Ecologist has conducted the appropriate QA/QC procedures and reviewed the dataset for a specific field season and has notified the network data manager that the dataset is ready for archiving. The target archive date is the end of the calendar year. At this point the network data manager adjusts the data processing level of the dataset and uploads it to the IRMA Data Store along with appropriate metadata.

Once data records have a data processing level of ‘Accepted’ or ‘Certified’ any changes made to the data are documented in an edit log. Backup copies of the database are maintained at the South Florida office and the IMD office in Fort Collins, Colorado. For further detail about the archiving procedure please refer to the SFCN Data Management Plan.

Paper datasheets (when used) are stored in a protocol 3-ring binder in the SFCN conference room.

Voucher Specimens

Voucher specimens will not be collected by the South Florida/Caribbean Network. The network will inform the park of any new or unknown exotic plant species and provide photographs and coordinates of the plant. Collection of voucher specimens will be at the discretion of the park.

Personnel Requirements and Training

Roles and Responsibilities

This protocol calls for the identification and treatment of new and existing infestations of exotic plants. To accomplish this goal, a trained botanist and a certified herbicide applicator make up the primary field crew members. Each team member must be properly trained in their respective duties. The botanist is responsible for identifying exotic plants and recording data associated with the infestations of exotic plants. The herbicide applicator is responsible for vehicle operation and proper handling and use of herbicides for treatment of small populations of exotic plants. A third person may be added to the field team to assist with data entry and photo taking in the field. The SFCN Community Ecologist reviews and certifies data and edits the resource brief or data summary report. The data manager oversees the database design, building in adequate quality control procedures into the database, maintaining data security, and data archiving. The assistant data manager oversees data imports and GIS processing. See Table 3 for additional detail on roles and tasks.

Personnel assigned to data collection, analysis and storage are properly trained in the procedures relevant to the assigned tasks. Responsibility of proper adherence to procedure, quality control and quality assurance rests with all pertinent personnel. Rules and regulations applicable to the performance of these tasks are observed, with note to individual park policies.

Nothing in this protocol is implied or meant to imply deviations from established federal, departmental, or local safety rules and regulations applicable to the performance of assigned tasks. It is the responsibility of everyone to be familiar with such rules and regulations.

Qualifications and Training for the Botanist Position

For this protocol, the botanist is the team leader and needs a comprehensive knowledge of South Florida flora and knowledge of the National Parks of South Florida (Big Cypress National Preserve, Biscayne National Park, and Everglades National Park). Training includes college course work with a concentration in botany and/or the equivalent in work experience. The level of knowledge of South Florida flora must be sufficient that the botanist can readily identify most species (both native and exotic) and quickly identify likely new invasive species. Knowledge of the National Parks themselves is imperative to know where the site locations are and how to navigate to them, as well as knowing the areas of the park that may be more susceptible to exotic plant invasions.

Qualifications and Training for the Herbicide Applicator

To work in the National Parks in Florida, the herbicide applicator must have received an Applicator License from the Florida Department of Agriculture and Consumer Services Pesticide Certification Office. This license requires training that includes mixing of herbicide concentrates, equipment care, application precautions, herbicide storage, transport, and disposal, as well as safety, emergency procedures, and first aid. In addition to this training, the applicator must also attend the Natural Area Weed Management training from the Florida Department of Agriculture and Consumer Services to apply pesticides in the Natural Area Weed Management category which covers pesticide use in natural areas.

Training

Personnel must thoroughly review this protocol and any associated Job Hazard Analyses (JHA's) before implementing procedures.

In many cases, the sampling sites can only be reached by motorboat, swamp buggy, airboat, or ATV. The botanist and the herbicide applicator must have the training described in the Safety section of this protocol narrative. The intent is that this protocol will be the responsibility of the South Florida/Caribbean Network. However, in the case of staff turnover or if park staff wish to implement this protocol during “off” years, new personnel will be accompanied by SFCN and/or IPMT staff experienced with this protocol, the parks themselves, and the needed equipment.

The botanist is expected to seek ongoing training and knowledge about South Florida botany. Each year the botanist also downloads EDDMapS information on the assigned park to see if there are new species reported and consults with the IPMT to learn of new exotic species to be aware of and familiarizes him/herself with these plants.

Data entry procedures are addressed in SOP CI04 *Post Field Data Activities*—Version 2.0 (SFCN 2022d), and any questions with regards to data entry and verification procedures should be directed to the SFCN Data Manager. Experienced personnel will oversee data entry by new personnel until they are familiar with the procedures.

Operational Requirements

Annual Workload and Field Schedule

Monitoring can be conducted at any time during the year; however, late spring to early fall months are preferable due to flowering times which make identification easier. Flowering broadleaf plants generally flower in the spring, while grasses generally flower in the fall months. Reporting of new species and/or problematic infestations occurs as soon as possible to park resource management and the IPMT Coordinator. Generally, the annual resource brief is completed approximately eight weeks after completion of field work. Data archiving occurs after completion and internal review of the annual resource brief. Table 3 provides additional detail on the schedule.

Two people minimum are required for the field work: a vehicle driver (truck, airboat, motorboat) and a trained botanist. However, a crew of three is optimal when using an iPad to collect data in the field. The third crew member enters the data into the iPad and takes photos. The driver is the herbicide applicator who also has the duty of treating small infestations of exotic plants. If an herbicide applicator is not available, then another SFCN or park staff member may substitute in driving the vehicles if properly trained, but no herbicides will be used unless the staff member has been certified in herbicide application. To drive the truck, a valid driver's license is required. Motorboat Operator Certification Course (MOCC) training is required to operate a motorboat or airboat. Three to four weeks (15–20 days) of field time per year are required for the two- to three-person team to complete the field work portion of the project. Another three weeks per year is required for a two-person team to input data, check data, and write the resource brief. Another three weeks per year is required for data management to check databases, make corrections as needed, and assist with writing resource briefs. This amounts to 45 days to complete this project in a given year.

Facility and Equipment Needs

Following is a general list of equipment needed for this project:

- A vehicle from the South Florida/Caribbean Network's fleet. In many cases, a towing vehicle is needed to trailer the motorboat or airboat.
- Motorboat or airboat including boating safety equipment. Safety equipment includes personal floatation devices (PFD's), first aid kit, whistles and flares, depth charts, and ear protection like earmuffs (required for airboat operation).
- Field gear including an iPad, GPS units, backup datasheets, pencils, sharpies, a park radio, and a 5-gallon (18.9-liter [l]) water container (for crew hydration).
- Equipment for treating exotic plants. This includes the herbicide sprayers, storage containers, the herbicides, and machetes for girdling trees. The herbicide applicator is required to wear rubber gloves, eye protection, long-sleeve shirt, boots with socks, and long pants for protection from herbicides.
- Cautionary equipment such as orange vests, roadside caution signs or orange cones, and magnetic orange strobe light.

Startup Costs and Budget Considerations

Since most of the equipment used (see above) has already been purchased for other vital signs and projects, no substantial startup costs are included here. Budget considerations include fuel and maintenance for the vehicles and boats plus salary for the botanist, herbicide applicator, SFCN Assistant Data Manager, and SFCN Community Ecologist (Table 4). These costs will vary from year to year depending on the sites. Sites in the Everglades west region (site maps located in SOP CI09 – Site Selection) will require more fuel for both the truck and the motorboat than for the Everglades east region (site maps located in SOP CI09 *Site Selection*—Version 1.0 [SFCN 2022a]), which requires less motor boating and is closer to the office. Costs for herbicide and associated equipment are covered by IPMT.

Table 4. Project budget estimates per annual sampling event. Budget estimates are based on 15 field days. Note: These costs are approximate based upon initial surveys and 2020 salary estimates. Costs of boats, ATVs, trailers, vehicles, computers, and software are not included. Travel costs within the parks will vary depending on type of transportation used and distance.

Expense	Time	Cost
Botanist (GS-7)	45 days	\$ 11,880
Herbicide Applicator (GS-12)	20 days	\$ 10,400
Assistant Data Manager (GS-9)	30 days	\$ 8,880
Community Ecologist (GS-12)	5 days	\$ 2,600
Fuel and Vehicle Maintenance	20 days	\$ 2,000
Herbicide	20 days	\$ 500
Software	15 days	\$ 500
Total Cost	n/a	\$ 36,760

An estimate of personnel time for field and office work (Table 5) can be summarized as follows:

- Forty-five workdays at a GS-7 level (botanist)
- Twenty workdays at a GS-12 level (Herbicide Applicator)
- Thirty workdays at a GS-9 level (Data Management)
- Five workdays at a GS-12 level (Community Ecologist)

Software required includes Microsoft Access, Microsoft Word, Microsoft Excel, Adobe Acrobat, and ESRI ArcGIS. These software programs are used across multiple protocols and projects. The IPMT program supplies herbicides.

Table 5. Project time estimates per annual sampling event. Time estimates are based on 15 field days.

Position	Duty	Time
Botanist (GS-7)	Pre-field preparations	5 days
	Fieldwork - Surveys	15 days
	Data QA/QC	10 days
	Reports	15 days
Herbicide Applicator (GS-12)	Pre-field preparations	5 days
	Fieldwork – Surveys	15 days
Assistant Data Manager (GS-9)	Pre-field preparations	5 days
	Data QA/QC	5 days
	GIS files cleanup	15 days
	Report tables and figures	5 days
Community Ecologist (GS-12)	Review & certify data	3 days
	Edit resource brief	2 days
Total Time	n/a	105 days

Safety

Personnel must review the respective SOPs, Go-No Go checklists, safety signout sheet, and radio ID sheet associated with this protocol. They must also review and sign all Job Hazard Analyses associated with this protocol. These SOPs and JHAs are located in the SFCN Safety SOP & JHA Binder. Electronic versions are available on the SFCN server at Z:\Safety\ with filenames given by protocol in SFCN_Safety_SOP_and_JHA_Binder.pdf. Although every attempt will be made to keep this protocol current, it's possible for a delay to occur between updates of a Safety SOP in Z:\Safety\ and updates of this protocol.

All NPS-SFCN personnel will follow the Safe Practices Manual and Emergency Operations Plan specific to the respective park they are operating within.

In many cases, the sampling sites can only be arrived at by motorboat, swamp buggy, airboat, or ATV. The botanist and/or the applicator must have training in the use of the appropriate vehicle before use.

- MOCC (ref 36 CFR part 3, 485 DM 22) (necessary if driving an NPS boat)
- MOCC Airboat Safety Module
- ATV and/or UTV training
- Swamp Buggy training

Completion of the Department of Interior's Motorboat Operator Certification Course (MOCC) is required for the solo operation of an NPS vessel. Non-certified MOCC personnel may drive a park boat under the supervision of an MOCC certified operator.

In general, an attitude of a "culture of safety" and "operational leadership" should prevail in which problems are considered proactively and each person must feel empowered to think about potential problems and speak up early and act upon safety concerns regardless of their position and those concerns must be addressed seriously and respectfully by management.

Nothing in this protocol is meant to imply deviations from established federal, departmental, or local safety rules and regulations applicable to the performance of assigned tasks. It is the responsibility of each individual to be familiar with such rules and regulations. Personnel must follow any park specific requirements, and any other requirements of the National Park Service not otherwise specified herein.

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