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SOP Source and How It Was Modified

This SOP is an adaptation of *SOP1 Field Season Preparation—Version 1.2* of the *Vegetation Monitoring Protocol for the Cumberland Piedmont Network* (White et al. 2011). For a general explanation of how the South Florida/Caribbean Network (SFCN) modified the Cumberland Piedmont Network (CUPN) protocol and its SOPs, see the *South Florida/Caribbean Network Forest Vegetation Monitoring Protocol Implementation Plan* (Whelan et al. 2020). For this specific SOP, the South Florida/Caribbean Network made minor modifications to CUPN *SOP 1* and added or removed a few items from the equipment list, to meet SFCN-specific needs. Additionally, this SOP also used *SOP1.4.07 Field Season Preparation—Version 1* of the *Terrestrial Vegetation Monitoring in Southeast Coast Network Parks* (Boyle et al. 2019) as a guide. Finally, the South Florida/Caribbean Network will not be collecting soil samples. This decision was based on concerns for wilderness designations and cultural resources in the areas where plots will be located.

Staffing

The *South Florida/Caribbean Network Forest Vegetation Monitoring Protocol Implementation Plan* (Whelan et al. 2020) will be implemented by a field crew of three members. The three-person crew will be comprised of members from the SFCN community team, university interns, and other cooperators who will assist through various cooperative agreements available to the network. Additionally, park unit staff, other SFCN personnel, members from other Inventory and Monitoring Networks, and volunteers may assist when available.

At least one member (field crew leader) must possess good plant identification skills. The entire crew will have training in the sampling methods before conducting field work. Additional skills should include knowledge of exotic plants, forest pests, and pathogens. This protocol requires the use of cameras, GPS units, compasses, clinometers, and other field tools (see equipment list below, Table 1). All members of the crew must be trained in basic plant identification techniques.

Planning and Coordination

Network staff must ensure park personnel are fully informed on the locations and marking practices used for this protocol, at least one month before any plots are established at the park. The primary contact person is the park's natural resource manager, who must receive a current version of the protocol (including SOPs) as well as a map of proposed plot locations, a digital list of GPS coordinates, and an expected sampling schedule for the park visit.

Specific feedback is required for the plot marking and tree tagging procedures. If park personnel have issues with the planned procedures, the network can vary the materials used to mark plots or trees. The park's natural resource manager or cultural resource specialist must also approve of plot marking practices for all plot locations (from a map and GPS coordinates). Finally, prior to any revisits to the park, the resource manager must be informed of any updates or changes to the protocol or SOP, be sent a new map of plot locations, and receive the schedule for the sampling.

A day prior to sampling or at the start of the first field day, field crews should stop by the park office for brief introductions and to meet any logistical needs such as picking up keys. Park staff or park interns may be interested in this project, and should be encouraged to join crews for at least one plot to learn more about forest monitoring.

Transportation and Lodging

The SFCN field crew leader reserves an SFCN field vehicle (4WD pickup or minivan) for travel to, from, and within parks. Additionally, boats are reserved prior to sampling in parks that require access to plots via a waterway (e.g., Biscayne National Park). Boat operators are required to have completed the Motorboat Operator Certification Course (MOCC; SAF4102), and taken the MOCC Refresher (SAF4R02-OLT) for re-certification every five years. Some plots may be accessed by airboat, especially in Everglades National Park or Big Cypress National Preserve. In these situations the airboat operator must complete the MOCC Airboat Safety Module for airboat operators.

When scheduling a sampling visit, the network will ask park staff about the availability of park lodging and make reservations at the park when possible. If no park lodging is available, lodging will be reserved near the park, at least one month in advance of the visit. Lodging space must be sufficient to comfortably accommodate all crew members and their gear. In some cases, camping will be necessary to meet the sampling needs.

Scheduling the Field Season

When setting the sampling schedule for a given field season, the community ecologist will plan to sample focal forest communities within a park unit within one field year. The South Florida/Caribbean Network's focal communities are divided into five sampling panels (one to four parks per year):

- Panel 1 (First sample year: 2019–2020)—Big Cypress National Preserve (BICY) Hardwood Hammock plots, Biscayne National Park (BISC) Mangrove plots, and Salt River Bay National Historical Park and Ecological Preserve (SARI) Tropical Dry Forest plots.
- Panel 2 (First sample year: 2020–2021)—Everglades National Park (EVER) Cypress plots, and Virgin Islands National Park (VIIS) Tropical Moist Forest plots and Buck Island Reef National Monument (BUIS) Tropical Dry Forest plot (Manchineel plot).
- Panel 3 (First sample year: 2021–2022)—Big Cypress National Preserve (BICY) Cypress plots.
- Panel 4 (First sample year: 2022–2023)—Everglades National Park (EVER) Coastal Hardwood Hammock plots, Dry Tortugas National Park (DRTO) Mangrove plots, Virgin Islands National Park (VIIS) Tropical Dry Forest plots and Mangrove plots, and Salt River Bay National Historical Park and Ecological Preserve (SARI) Mangrove plots.

- Panel 5 (First sample year: 2023–2024)—Big Cypress National Preserve (BICY) Pineland plots, Biscayne National Park (BISC) Coastal Hardwood Hammock plots, and Virgin Islands National Park (VIIS) Tropical Moist Forest plots.

For the within-year sampling, the goal is to sample a given plot within two weeks of the original sample date. This is to reduce the confounding of seasonal variation with annual variation. As a result, a given forest community within a park is typically revisited in a consistent order over time.

The SFCN community ecologist communicates at least weekly with field crew members to see how the protocol implementation is progressing (e.g., what field techniques are working well, any issues with network to park communication). The SFCN program manager and community ecologist will hold a mid-season meeting with the field crew to discuss the crew's progress and any concerns that have surfaced. This meeting takes place after the first QA/QC plot sampling event has occurred.

Maps and GPS

Prior to each field season, network personnel prepare both GIS maps and aerial photographs showing that year's sampling locations for each park at scales of 1:24,000 or larger. Maps must clearly show the location of all plots in relation to topography, roads, trails and park features. Line and point symbols for roads, streams, plots and other features must be clearly visible but not large enough to obscure other features. Scale bars must show miles in addition to kilometers, to aid navigation by car. Also, overlaying a Universal Transverse Mercator (UTM) grid on a printed map along the outer margins is very helpful for field navigation when used with a GPS unit set to the UTM coordinate system. If possible, smaller locator maps should be included on large scale maps. These maps and aerial photographs are color printed on Rite-in-the-Rain paper. A full set of maps for each park are provided to the field crew prior to sampling.

The crew must also be supplied with road maps for the region surrounding each park visited. Coordinates of each plot are exported, printed, and downloaded directly into the network GPS unit. Trails, park boundaries, and topographic maps are also loaded on GPS units when possible.

When establishing the plots for the first time, maps are sent at least one month in advance of field work to park resource managers. These staff are requested to identify any problems with the location of new plots that the team plans on establishing for that field season. If any plots are clearly in locations identified as exclusion areas (e.g., large road, managed old field, building, or open water), they are replaced by the next point not already assigned for sampling on the list of points (see discussion about this in protocol narrative [Whelan et al. 2020] and SOP 2: *Sampling Design and In Office Review—Version 1.0* [Patterson 2019]) for specifics on criteria for replacing plots). However, if there is doubt as to whether the point is in one of these areas or not, then the point will be kept and field crews will determine whether to keep it or replace it. When planning for plot revisits, maps will contain established plot locations from the plot establishment year.

Using DNRGPS or similar software, network personnel will upload plot coordinates into the SFCN GPS unit(s) or handheld device (see SOP 9: *Using GPS—Version 1.0* [Muxo 2019] and the [DNRGPS](#)

[website](#)). Immediately after uploading the plot coordinates, check the GPS map page to ensure the plot locations are shown correctly and are in the correct projection. One easy way to check that the points are loaded properly is to navigate manually to the park in the GPS's map function and see if the points line up approximately with where they should be based on landmarks such as highways and towns. Although not perfect, this method will help field crews avoid gross projection errors that may place the plot locations in a different state or hemisphere. During plot revisits, coordinates from the established plots will be compared to the original plot coordinates to check for errors in GPS reception or user error.

Quality Control Plot Preparation

Each year, roughly 5% of the plots in the sampling panel will be selected by the data manager for “quality control” repeat visits to ensure consistency in data collection across the network. This will occur at parks that are scheduled for sampling within a given year. Points that are difficult to access—requiring more than two hours of travel time to reach—can be excluded from the 5% that are chosen; otherwise, plots will be selected randomly. Field crews measuring the plots will not be informed as to which plots were chosen. Ideally, a separate field crew will be asked to go back and resample the plot within two weeks of the first team's sample, but the original crew may conduct the resampling provided the data collection roles are changed and a different botanist is responsible for species identifications. Outside botanists can be obtained from network parks, from local universities, or professionals with south Florida or U.S. Virgin Islands botanical expertise. The outside botanist primary role is to confirm species identification. The rest of the plot sampling will be accomplished by personnel familiar with the methodology (attended pre-sampling training and have sampled a number of plots). The list of resampled plots will be given to the network program manager, so logistics can be arranged separately from the regular plot work and so the primary field crew is unaware of which plots will be quality control plots until after they sample them. Plot delineation and the location of tree DBH measurements will not be changed. The quality control crew will measure tree DBH where the original crew marked this parameter with spray paint.

Pre-fieldwork training exercises are scheduled to train all crew members in the proper collection of data (see Training section below). Park personnel and prospective botanists for QA/QC plots will be invited and encouraged to participate in the training sessions so they may become familiar with the SFCN plot measuring methods. Training for occasional helpers will include, at a minimum, reviewing the appropriate SOP for the sampling they are assisting with.

Once completed, the duplicate plot results will be compared to initial results to identify any large differences. If large differences occur, then actions may range from better training the following field season for the measure that showed the largest differences, to “disqualification” of the data for those measurements in that year so the data are not used in trend analyses.

Training

Prior to commencement of each field season, the network must ensure all field personnel fully understand administrative responsibilities and field procedures by conducting in-situ training sessions. Field crew training will begin in early October at an SFCN park scheduled for forest monitoring during the field season. Occasional field visitors or helpers (e.g. volunteers or a botanist to check plant identifications) would ideally attend the field training. If this is not possible, at a minimum they will review the appropriate SOP and generally assist with plot lay out, recording data, and working on the simpler components of the data collection. The location of the initial training session is determined by network staff.

Prior to the training session, a copy of the protocol implementation plan and current SOPs are sent to all participants. Other materials that should be sent include:

- Full vascular plant species list for parks to be sampled that field season (available via NPSpecies)
- Ecological community type key (vegetation mapping classification key) for parks to be sampled that field season
- Invasive Species Early Detection list for the South Florida/Caribbean Network
- Plot navigation ‘cheatsheets’
- Datasheets
- Park contact list

Training includes both the demonstration of all measurements by trainers, and hands-on practice of all measurements by trainees. All trainees must have sufficient opportunity to practice measurements thoroughly and question the trainer as needed. If crew members are involved in data entry, then training must also thoroughly demonstrate how to enter data into the database. Training covers the following topics:

- Safety including:
 - Procedures for checking in with park and network staff (including instructions for park radio use)
 - Weather issues (storms and heat)
 - Challenging driving scenarios, including backcountry or heavy tourist areas
 - Decision-making on when to abandon a plot based on safety concerns

- Safe field practices to avoid injury, such as how to properly pack and wear a field pack and how to work in areas with poison ivy, venomous snakes, and biting or stinging insects
- Protection of park natural and cultural resources:
 - Emphasis on the critical importance of careful plot behavior to minimize plot trampling (e.g., in wetlands or areas with thick herbaceous cover, crew members place and unload packs outside the plot boundary; plans should be made ahead of time to retrieve all necessary gear once rather than making multiple trips across the plot; extra care should be taken to avoid trampling in nested subplots)
 - Precautions to avoid damage to park cultural resources and artifacts while en route to plots
- Overview of field methods:
 - Review of common plants within each park
 - Proper use of equipment, including GPS, digital cameras, compass, clinometer, canopy densiometer, diameter tape, and distance measuring device
 - Methods for efficiently setting up a plot with two to three crew members
 - Methods for tree tagging and mapping
 - Use and layouts of plot datasheets and ecological community type keys (classification keys)
 - Methods for collecting and labeling specimens for identification purposes only
 - Practice estimating percent cover
 - Identification of specific tree condition and foliage problems

Training must emphasize the critical importance of careful, accurate and steady data collection to this long-term monitoring program. Trainers must stress the importance of exact adherence to SOP instructions to prevent bias in measurements among years, which will inhibit the network's ability to detect long-term trends. Trainees are encouraged to discuss with network supervisors any concerns that arise over field procedures or the datasheet or database recording systems during training or later during the field season—the crew must not deviate from established protocols or alter the datasheet or database without first taking this step.

Communication

Field crews will carry an NPS radio at all times during field work; additionally, a programmed inReach device is available. Radios are programmed to the appropriate frequencies for each park. Crew members must know which frequencies to use, how to contact park radio dispatch, and be familiar with proper radio etiquette. In parks with cell phone coverage, crew members will be encouraged to carry a cell phone in the field for safety and to call the community ecologist concerning protocol questions. It is essential for the crew to maintain regular contact with SFCN staff throughout the field season. Establish a regular weekly meeting or telephone call between the team leader and the community ecologist to review the week's work. The update should cover questions or problems related to plots, protocol, logistics, and scheduling.

Additionally, a field plan outlining dates of field work, park contacts, and a detailed sampling schedule including coordinates of plot locations will be sent to parks several weeks before sampling.

Supplies and Equipment

Required equipment and supplies for forest monitoring are listed in Table 1. Equipment must be organized and maintained in good working order. Mark each piece of equipment with a piece of brightly colored flagging tape or duct tape to assist with locating it in the field during data collection. At the end of each season, the field crew leader will inventory the condition of all equipment and prepare a list of required repairs or replacements. Order any new supplies required for work before the beginning of the next field season.

Table 1. SFCN forest monitoring supplies and equipment checklist.

Type	Contents	Source	Check
Master Binder (per field crew/season)	List of park contacts (with phone numbers), park UTM zones, and declinations	In-house	☐
	Paper list of all plots to be visited along with UTM coordinates	In-house	☐
	Paper copies of maps illustrating all selected and alternate plot locations, overlaid on both USGS topographical and aerial image backgrounds; roads, trails, and park boundaries should be included	In-house	☐
	Park maps/brochures with roads and trails, if available	In-house	☐
	Master plant list for each park	In-house	☐
	Key to the ecological communities of each park	In-house	☐
	Laminated sheets with tree data definitions, tree DBH, tree health condition codes, technique for measuring stand height, and a sample diagram of a typical plot with information on the nested subplots	In-house	☐

Type	Contents	Source	Check
Master Binder (per field crew/season, continued)	Paper list of Invasive Species Early Detection for each park	In-house	☐
	SFCN emergency contact information sheet and directions to hospital for each park	In-house	☐
Field Datasheets (per season)	Plot Establishment Years: Set of 10 blank field datasheets on regular paper and set of 150 blank field datasheets on Rite in the Rain paper	In-house	☐
	Resample Years: Set of semi-populated field datasheets of plots to be resampled that year (from database) on Rite in the Rain paper	In-house	☐
Field Equipment for Plot Establishment (per season)	12" long rebar (seven per plot)	Hardware store	☐
	Pillowcases, or similar nylon or heavy-duty bag (for transporting rebar in the field)	Local store	☐
	Orange permanent plastic surveyor's markers (rebar covers; seven per plot), labeled by subplot and corner	Forestry Supply Store	☐
	Hammer w/ prongs	Local stores	☐
	Round numbered aluminum tree tags (four sets of #1–1000 for each field season). Each plot starts with a hundred series, not necessarily the number 1.	Forestry Supply Store	☐
	Plot identification markers (three per plot mounted one each on two trees near plot center and one mounted on the plot center rebar)	Berntsen International Inc.	☐
	Stainless Steel nails at sites with salt water	Local store	☐
	Wood siding sinker head style aluminum nails	Forestry Supply Store	☐
Field Equipment for Plot Resample (per field crew/season)	Orange or green tree marking spray	Forestry Supply Store	☐
	Magnetic Locator	Schonstedt	☐
	Tree tags for tree recruits to the 5 centimeter DBH size	Forestry Supply Store	☐
	12" long rebar (three per plot, for replacing missing rebar)	Hardware store	☐
	Yellow permanent plastic surveyor's markers (rebar covers; seven per plot), labeled by subplot and corner, replacements)	Forestry Supply Store	☐
	Round numbered aluminum tree tags (blank set of 100 tags to replace damaged or missing tags) and die cast set for marking blank tags	Forestry Supply Store	☐

Type	Contents	Source	Check
Measurements (per field crew/season) continued	GPS (two)	Garmin	☐
	Spare batteries, 12 four-packs	Forestry Supply Store	☐
	Laser Rangefinder	Forestry Supply Store	☐
	Enclosed clipboards (two)	Forestry Supply Store	☐
	Pencils (many)	Forestry Supply Store	☐
	Compass (two)	Forestry Supply Store	☐
	Distance measuring device	Forestry Supply Store	☐
	Open reel fiberglass tape, 30- to 50-meter size (five)	Forestry Supply Store	☐
	Chaining pins, set of 11 plus Chaining Pin Quiver (two)	Forestry Supply Store	☐
	Flagging tape (qty 24)	Forestry Supply Store	☐
	Wire stake flags, bundle	Forestry Supply Store	☐
	Spherical densiometer, concave (two)	Forestry Supply Store	☐
	Diameter tape, metric, fabric (two)	Forestry Supply Store	☐
	Trowel	Forestry Supply Store	☐
	Plastic Ruler	Local Store	☐
	Wooden meter sticks (two)	Forestry Supply Store	☐
	Hand pruners (two) (for collecting plant identification samples)	Forestry Supply Store	☐
	Plastic bags for plant samples, 2.5 gallon (20; for collecting plant identification samples)	Associated Bag Company	☐
	Compact binoculars (two)	Forestry Supply Store	☐
	Digital camera	Local Source	☐
	Clinometer, percent + degree markings	Forestry Supply Store	☐
	Backpack, ~2,000 cubic inches (× 2)	Outdoor equipment supplier	☐

Type	Contents	Source	Check
Safety/Personal Gear (per crew member, unless otherwise noted)	inReach device + annual contract (one per field crew)	Outdoor equipment supplier	☐
	First Aid Kit (one per field crew)	Forestry Supply Store	☐
	Insect Repellent	Forestry Supply Store	☐
	Sunscreen	Forestry Supply Store	☐
	Tech-nu poison ivy soap	Forestry Supply Store	☐
	Hip waders	Forestry Supply Store	☐
	Knee boots	Forestry Supply Store	☐
	Hand lens + lanyard	Forestry Supply Store	☐
Field Office Supplies (per field crew/season)	Plant field guides and floras	In-house	☐
	Spare batteries	Forestry Supply Store	☐
	Dissecting microscope	In-house	☐
	Laptop for downloading photos and data entry	In-house	☐
	Document scanner	In-house	☐

Review of Annual Staff Roles

Staff roles and when each task should be implemented during the year are presented in Table 2.

Table 2. List of SFCN forest monitoring protocol tasks, responsible staff, and schedule.

Task	Staff	Timing
Finalize field schedule for crews	community ecologist	September–October
Reserve park housing (where opportunity exists) or non-park housing for field crews	community ecologist and field crew leader	September
Establish and refine annual and seasonal budgets	community ecologist and network program manager	September
Communicate with park staff to (a) review selected and alternate plot locations, (b) schedule/confirm plot sampling dates, and (c) arrange assistance from park personnel in transportation, logistics, field sampling, etc.	community ecologist and field crew leader	September
Prepare, repair, and purchase equipment	field crew leader and field crew	October
Confirm with parks the appropriate method for monumenting plots (i.e., is it okay to mark plots with rebar?) and tagging trees (i.e., is it okay to mark trees with aluminum tags/nails?)	community ecologist	October
Reserve program or park vehicles, boats	field crew leader	October
Randomly select 5% of plots for QA/QC data collection	network assistant data manager	October
Identify who will be taking QA/QC data for that year	community ecologist and network program manager	October
Prepare database and datasheets for the field season (review species list and add crew member names)	community ecologist and field crew leader	October
Compile training and field packets that include maps of all plots, coordinates, species lists, and datasheets	community ecologist and field crew leader	October
Conduct training	community ecologist and field crew leader	October
Coordinate directly with park resource managers when conducting field work in each park; call at least two weeks in advance to confirm field work dates and send completed field plan	community ecologist and field crew leader	November–May
Participate in field season and oversee field crew during sampling, providing logistic and administrative support, and ensure plot work meets quality standards	community ecologist and field crew leader	November–June

Task	Staff	Timing
Ensure effective communication is occurring between park staff, field crew, and other SFCN staff	community ecologist and field crew leader	November–June
Enter all data into master database as soon as practical once data are taken	field crew leader and field crew members	November–July
Review and revise monitoring protocol and SOPs	community ecologist and field crew leader	August
Conduct data verification on 10% of the datasheets once they are entered into the database	community ecologist	August
Conduct data validation after records are entered in the database	community ecologist	August
Compare data between original and QAQC plots	community ecologist	August
Data analysis and report writing	community ecologist	August–December
Submit summary reports	community ecologist	December

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