Rare Plant Monitoring and Restoration on Long Pine Key, Everglades National Park

Year End Report, YEAR 3
Cooperative Agreement #H5284-03-0044

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SUMMARY OF ACTIVITIES

Background

Long Pine Key is composed of an elevated ridge of limestone that separates the Taylor Slough and Shark River Slough drainage ways in the eastern portion of Everglades National Park (EVER). It is the southernmost portion of the Miami Rock Ridge, which extends south and west from the Miami River area near present-day downtown Miami. The vegetation of Long Pine Key is dominated by pine rocklands, marl prairies and rockland hammocks, ecosystems that harbor a number of rare plant and animal species including federally-listed species and candidates, South Florida endemics, and tropical species at or near the northern limit of their ranges. Long Pine Key has long been recognized as one of the most important regions in southern Florida for vascular plant diversity and has been researched by a number of prominent botanists and naturalists including John Kunkel Small, Frank C. Craighead and George N. Avery. Like several other regions of southern Florida, Long Pine Key has also been long noted for its loss of rare plant diversity and abundance due to anthropogenic factors including poaching, fire suppression and dry-season fires, hydrologic modifications, including drainage and impoundment, and other factors.

In 2002, The Institute for Regional Conservation (IRC) published the book *Rare Plants of South Florida: Their History, Conservation, and Restoration* (Gann, Bradley & Woodmansee, 2002). This book identified 355 taxa of plants that were ranked as presumed extirpated, possibly extirpated or critically imperiled in South Florida – defined as the 10 southernmost counties of Florida and roughly extending from the northern shore of Lake Okeechobee south. Of these, 30 species had been previously recorded or reported for the Long Pine Key area. Twenty of the 30 species were thought to be extant in the Long Pine Key area and 10 species were reported as presumed or possibly extirpated there (Table 1). Only one species thought to be extirpated in the Long Pine Key area was known to be extant elsewhere in Everglades National Park (*Oncidium undulatum*). Three of the nine remaining species possibly extirpated in the Long Pine Key area and in Everglades National Park were known to be present elsewhere in South Florida. The remaining six species reported as presumed or possibly extirpated in Everglades National Park were reported as presumed or possibly extirpated in the South Florida region and the continental United States.

In 2003, George D. Gann (IRC) and Thomas V. Armentano (EVER) submitted a 5-year proposal to the U.S. Department of the Interior's Critical Ecosystems Study Initiative (CESI) to survey and map the 30 rare species identified in Gann et al. (2002), to establish a long-term monitoring program to evaluate population responses of these species to Everglades restoration, and to augment or reintroduce populations of select species if warranted. While the Everglades restoration presumably should have a positive effect on rare plant populations, there is some potential for negative impacts and it is in fact unknown whether the proposed restoration and associated hydrological modifications will have a positive or negative impact on these species.

Cover Photo: *Oncidium undulatum* at Coot Bay Hammock near Flamingo in Everglades National Park. *O. undulatum* is extirpated in the Long Pine Key area; it was previously known from Royal Palm Hammock.

Table 1. Gann et al. (2002) rankings for 30 plants previously recorded for the Long Pine Key area of Everglades National Park.

Taxon	Status in South Florida	Status in Everglades National Park	Status on Long Pine Key
Adiantum melanoleucum	Critically Imperiled	Present	Present
Anemia wrightii	Critically Imperiled	Present	Present
Basiphyllaea corallicola	Critically Imperiled	Present	Present
Bourreria cassinifolia	Critically Imperiled	Present	Present
Brassia caudata	Presumed Extirpated	Presumed Extirpated	Presumed Extirpated
Croton lobatus	Critically Imperiled	Assumed Present (last observed in 1987)	Assumed Present (last observed in 1987)
Dalea carthagenensis var. floridana	Critically Imperiled	Possibly Extirpated	Possibly Extirpated
Desmodium lineatum	Critically Imperiled	Present	Present
Digitaria pauciflora	Critically Imperiled	Present	Present
Eltroplectris calcarata	Critically Imperiled	Present	Present
Galeandra beyrichii	Critically Imperiled	Present	Present
Govenia utriculata	Possibly Extirpated	Possibly Extirpated	Possibly Extirpated
Helenium flexuosum	Critically Imperiled	Present	Present
Lomariopsis kunzeana	Critically Imperiled	Present	Present
Macradenia lutescens	Presumed Extirpated	Presumed Extirpated	Presumed Extirpated
Oncidium ensatum	Critically Imperiled	Present	Present
Oncidium undulatum	Critically Imperiled	Present	Presumed Extirpated
Passiflora sexflora	Critically Imperiled	Assumed Present (reported)	Assumed Present (reported)
Pecluma plumula	Critically Imperiled	Present	Present
Ponthieva brittoniae	Possibly Extirpated	Possibly Extirpated	Possibly Extirpated
Prescotia oligantha	Presumed Extirpated	Presumed Extirpated	Presumed Extirpated
Schizaea pennula	Critically Imperiled	Presumed Extirpated (reported)	Presumed Extirpated (reported)
Sideroxylon reclinatum subsp. austrofloridense	Critically Imperiled	Present	Present
Spiranthes costaricensis	Critically Imperiled	Present	Present
Spiranthes torta	Critically Imperiled	Present	Present
Sporobolus compositus var. clandestinus	Critically Imperiled	Present	Present
Thelypteris reticulata	Critically Imperiled	Present	Present
Thelypteris serrata	Critically Imperiled	Assumed Present (needs verification)	Assumed Present (needs verification)
Tillandsia fasciculata var. clavispica	Presumed Extirpated	Presumed Extirpated	Presumed Extirpated
Trichomanes punctatum subsp. floridanum	Critically Imperiled	Presumed Extirpated	Presumed Extirpated

Relation to the Comprehensive Everglades Restoration Plan

Hydrology is a key ecosystem property that affects rare plant distributions and their viability. Historically sheet flow from Shark River Slough and Taylor Slough did not reach the upland portions of Long Pine Key. During the wet season, however, increased surface water flow in the sloughs generated a rise in ground water levels across the region. Even the dry upland areas of Long Pine Key received water as solution holes filled with groundwater and short-hydroperiod transverse glades (a.k.a. marl prairies) diverted excess sheet flow from the main sloughs. As a result, soil water availability and other moisture conditions in upland hammock and pineland habitats were sufficient to maintain populations of moisture dependent plants such as orchids, ferns, bromeliads and ecologically related species. As artificial drainage became more widely practiced, however, regional groundwater supplies declined. A study by Ewe et al. (1999) on water usage by pineland and hardwood tree species in Long Pine Key led them to speculate these regional groundwater declines could adversely affect growth of these species, especially during droughts. While their study focused on tree species, it seems evident that water stress would similarly affect understory and herbaceous plants, particularly if they (unlike epiphytes) depend on higher levels of soil and solution hole moisture that once characterized upland habitats. Epiphytic species that primarily meet their water needs from the atmosphere could also be adversely affected by decreased moisture levels. Both terrestrial and epiphytic plants could be affected by lower temperatures during freezing events and more intense and penetrating fires, both linked to lowered humidity.

In addition to the potential impacts of artificial drainage, historic patterns of water flow through Long Pine Key are further confounded by road construction. Water flow through Long Pine Key (Figure 1) was originally concentrated in the marl prairies that traversed the area in a north-south direction. Construction of the main park road dissected Long Pine Key in an east-west direction, thus impeding sheet flow across Long Pine Key. Water was either impounded to the north of the main park road or was diverted around the southern part of Long Pine Key through Taylor Slough and Shark River Slough. Research Road is believed to similarly affect the water supply of the southern portions of Long Pine Key.

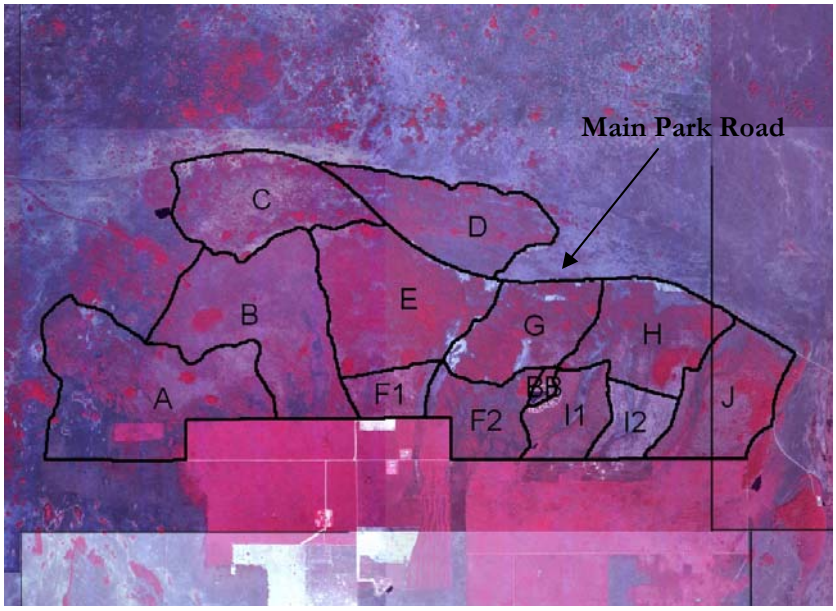


Figure 1. Long Pine Key (Pine Blocks A-J), Everglades National Park.

Presumably, if hydrological restoration is successful, ground water levels will be raised, wet season flows will return to the marl prairies and fire intensities will decrease, resulting in improved growing conditions for rare plants, including those in hammocks and pinelands. However, such a benefit must be verified by conducting field measurements of habitats and populations. Implementation of the Comprehensive Everglades Restoration Plan (CERP) could also lead to further impoundment of water north of the main park road, possibly flooding rare plant populations while failing to provide relief to habitats on Long Pine Key that are compartmentalized by the Main Park Road and Research Road and have suffered from long-term drainage.

Project Approval and Permits

Following review, the Gann & Armentano proposal was approved and in August, 2003 IRC and EVER signed cooperative agreement H5284-03-0044, Rare Plant Monitoring and Restoration on Long Pine Key, Everglades National Park. The project was reviewed and approved for Year 2 funding in September, 2004, with Craig S. Smith (EVER) replacing Tom Armentano (who retired) as co-Principal Investigator. Research has been conducted under permits EVER-2003-SCI-0084 and EVER-2004-SCI-0098. This report covers activities for Year 3 from October 1, 2005 through September 30, 2006. Results of Year 1 and 2 were reported in Gann et al. (2005); minor errors or omissions are corrected without comment and are incorporated into this report.

Initial Project Goals

The project initially had three primary goals:

1. Establish a long-term monitoring program to evaluate population responses of rare and imperiled species to regional restoration.
2. Contribute to the understanding of environmental requirements of rare and imperiled species.
3. Restore and enhance species diversity of uplands and the Everglades region by reintroduction of plants of extirpated or depleted species considered as rare or imperiled as a result of direct or indirect actions by man.

Modified Project Goals

Implementation and evaluation of this project has led to minor modifications of the goals in order to clarify research methods and results. The modified goals are:

1. Conduct surveys and map populations of rare plants in the Long Pine Key area.
2. Establish a long-term monitoring program to evaluate population and habitat responses of rare species to regional restoration.
3. Restore and enhance species diversity of the Long Pine Key area and Everglades National Park through the augmentation or reintroduction of plants considered rare as a result of direct or indirect actions by man.
4. Contribute to a broader understanding of the environmental requirements of rare species both inside and outside of Everglades National Park.

Methods to carry out these goals were developed into tasks as described below.

Activities

Goal 1: Conduct surveys and map populations of rare plants in the Long Pine Key area.

Survey Methods, Years 1 & 2

Surveys were conducted for the 30 target rare species identified in Gann et al. (2002) and one additional species (*Hypelate trifoliata*) which was re-ranked as critically imperiled in South Florida following the publication of Gann et al. (2002). Prior to the initiation of this study, there were 43 known locations for the 31 target rare plant species in the Long Pine Key area of Everglades National Park, representing 89 rare plant occurrences (Table 2). Previously known locations varied from very precise (e.g. a small, named hammock) to imprecise (e.g. Pine Block D). In every case, all known locations were surveyed by at least two biologists who walked transects within view of each other. Surveys were conducted until the study species was located or until the entire locality was surveyed. Discrete stations were mapped and documented. At least one GPS coordinate was recorded for each rare plant occurrence and in many cases multiple stations within an occurrence location were recorded. When appropriate, herbarium vouchers were collected and deposited at a NPS-approved herbarium. In order to provide a baseline for future monitoring work, population estimates or counts were made for each newly recorded occurrence and station. Estimates were based on a $\log_{10}$ scale. Counts of individuals were made for all occurrences and stations with fewer than 11 plants and whenever practicable.

Survey Results, Years 1 & 2

Thirty-five of the known locations were visited during Year 1 and four were visited during Year 2, leaving four locations to be surveyed in subsequent years: Atoll Hammock, Avery Hammock, Bootlegger Hammock and Hammock #120 a.k.a. Brookfield Hammock.

Fifty-eight previously known rare plant occurrences were re-documented by the end of Year 2. Twenty historic occurrences were determined to be extirpated, leaving 11 occurrence locations to be surveyed or revisited in subsequent years. Of the 10 species thought to be possibly extirpated in the Long Pine Key region prior to this study, only one species, *Ponthieva brittoniae*, was rediscovered.

Surveys of known and new locations resulted in the discovery of 50 new occurrences of rare plant species in the Long Pine Key area, representing a 56% increase in the total number of known rare plant occurrences in the area (extant and extirpated), and an 86% increase in the number of known extant occurrences. All previously documented species included in Gann et al. (2002) and thought to be extant in the Long Pine Key area of Everglades National Park at the start of this study were re-documented. An estimate of the abundance of each species for the Long Pine Key area was made at the end of Year 2.

The following herbarium specimens were collected for documentation during Year 1: **Sadle 393** *Tillandsia fasciculata* var. *densispica*, **Sadle 394** *Desmodium lineatum*, **Sadle 395** *Tillandsia fasciculata* var. *densispica*, **Sadle 396** *Ponthieva brittoniae*, **Sadle 397** *Passiflora sexflora*, **Sadle 398** *Scleria ciliata* var. *ciliata*, **Sadle 408** *Rhynchospora grayi*, **Sadle 409** *Galactia smallii*, **Woodmansee 1363,** *Anemia adiantifolia*, **Woodmansee 1364** *Platythelys latifolia*, **Woodmansee 1365** *Jacquemontia curtisii*, **Woodmansee 1366** *Rhynchosia* sp.; and Year 2: **Hodges 118** *Croton lobatus*.

Table 2. Known locations of target rare plant species prior to this research.

Location	Species previously recorded
Atoll Hammock	*Spiranthes costaricensis*
Avery Hammock	*Spiranthes costaricensis*
Baker Hammock	*Oncidium ensatum*
Bootlegger Hammock	*Bourreria cassinifolia*
Cadwallader Hammock	*Pecluma plumula*
Deer Hammock	*Brassia caudata, Hypelate trifoliata, Macradenia lutescens, Oncidium ensatum*
Dewhurst Hammock	*Pecluma plumula*
East Boundary	*Dalea carthagenensis var. floridana*
Fairchild Hammock	*Spiranthes costaricensis*
Frampton Hammock	*Eltroplectris calcarata, Oncidium ensatum*
Grimshawe Hammock	*Oncidium ensatum*
Hammock #120	*Eltroplectris calcarata, Spiranthes costaricensis*
Hole-in-the-Donut Area	*Digitaria pauciflora, Thelypteris reticulata*
Mosier Hammock	*Eltroplectris calcarata, Galeandra beyrichii*
Mosier Hammock Edge	*Croton lobatus*
North of Long Pine Key	*Sideroxylon reclinatum subsp. austrofloridense*
Osteen Hammock	*Adiantum melanoleucum, Brassia caudata, Eltroplectris calcarata, Lomariopsis kunzeana, Macradenia lutescens, Oncidium ensatum, Passiflora sexflora, Spiranthes costaricensis*
Palma Vista Hammock #2	*Bourreria cassinifolia, Eltroplectris calcarata, Govenia utriculata, Oncidium ensatum, Prescotia oligantha, Spiranthes costaricensis, Tillandsia fasciculata* var. *clavispica*
Paradise Key	*Sideroxylon reclinatum* subsp. *austrofloridense*
Pay-Fee Hammock	*Eltroplectris calcarata*
Pfleuger Hammock Area	*Anemia wrightii*
Pilsbry Hammock	*Eltroplectris calcarata*
Pine Block A	*Digitaria pauciflora, Spiranthes torta*
Pine Block B	*Basiphyllaea corallicola, Helenium flexuosum, Hypelate trifoliata*
Pine Block C	*Digitaria pauciflora, Helenium flexuosum*
Pine Block D	*Digitaria pauciflora*
Pine Block E	*Bourreria cassinifolia, Helenium flexuosum, Ponthieva brittoniae*
Pine Block F	*Bourreria cassinifolia, Ponthieva brittoniae*
Pine Block H	*Basiphyllaea corallicola, Bourreria cassinifolia, Desmodium lineatum, Digitaria pauciflora, Sporobolus compositus* var. *clandestinus*
Pine Block I	*Basiphyllaea corallicola*
Pine Block J	*Basiphyllaea corallicola, Desmodium lineatum*
Pine Island area	*Thelypteris reticulata, Thelypteris serrata*
Redd Hammock	*Eltroplectris calcarata, Oncidium ensatum*
Roadside and canal bank, 14 miles SW of Paradise Key	*Dalea carthagenensis* var. *floridana*
Robertson Hammock	*Oncidium ensatum*
Royal Palm Hammock	*Galeandra beyrichii, Macradenia lutescens, Oncidium ensatum, Oncidium undulatum, Passiflora sexflora, Schizaea pennula, Spiranthes costaricensis, Thelypteris reticulata, Trichomanes punctatum* subsp. *floridanum*
Say Hammock	*Oncidium ensatum*
Torre Hammock	*Hypelate trifoliata*
Turkey Hammock	*Brassia caudata, Macradenia lutescens, Oncidium ensatum*
Warren Hammock Area	*Anemia wrightii*
Wild Lime Hammock	*Oncidium ensatum*
Winkley Hammock	*Brassia caudata, Macradenia lutescens, Oncidium ensatum*
Wright Hammock	*Oncidium ensatum*

By the end of Year 2, the total abundance estimates for the Long Pine Key area ranged from 2-10 individuals (*Adiantum melanoleucum, Galeandra beyrichii, Lomariopsis kunzeana, Passiflora sexflora, Spiranthes torta*) to 10,000-100,000 individuals (*Sideroxylon reclinatum* subsp. *austrofloridense*).

Survey Recommendations for Year 3

At the end of Year 2, survey results were reviewed to look for gaps in coverage, and additional surveys were recommended, both for species that had potential new locations and for locations that had relatively few rare plant occurrences. Based on this review, the Year 2 annual report identified the following specific tasks for Year 3:

- Continue surveys for species presumed to be extirpated in the Long Pine Key area.
- Conduct surveys of four remaining historic rare plant locations: Atoll Hammock (*Spiranthes costaricensis*), Avery Hammock (*Spiranthes costaricensis*), Bootlegger Hammock (*Bourreria cassinifolia*) and Hammock #120 a.k.a. Brookfield Hammock (*Eltroplectris calcarata*, *Spiranthes costaricensis*).
- Conduct follow-up surveys for *Basiphyllaea corallicola* (Pine Blocks H & I), *Bourreria cassinifolia* (Pine Block F), *Digitaria pauciflora* (Hole-in-the-Donut), *Eltroplectris calcarata* (Pay-fee Hammock) and *Helenium flexuosum* (Pine Block C).
- Survey remaining potential locations for *Basiphyllaea corallicola* (Pine Blocks C & D), *Digitaria pauciflora* (Pine Block J), *Helenium flexuosum* and *Sideroxylon reclinatum* subsp. *austrofloridense* (Pine Blocks B & C).
- Continue new surveys for other species as time allows, especially in Pine Blocks C, D, G and I.
- Establish baseline abundance estimates for each species at end of Year 3.

Survey Activities for Year 3 (methods)

All of the above outlined tasks were completed during Year 3. In addition, we conducted surveys to the northwest and north of Pine Block D in transitional pinelands and marl prairies between Long Pine Key and Shark Slough. These surveys were intended specifically for *Digitaria pauciflora* and *Sideroxylon reclinatum* subsp. *austrofloridense* as we continued to search for the limits of their ranges in the Long Pine Key area.

Summary of Survey Results for Year 3

- No species previously thought to be extirpated on Long Pine Key were re-discovered.
- New surveys of the remaining four historic locations re-documented *Bourreria cassinifolia* at Bootlegger Hammock and yielded a new location for *Oncidium ensatum* at Brookfield Hammock.
- Follow-up surveys of historic locations yielded two additional extant occurrences of previously documented species: *Digitaria pauciflora* in the Hole-in-the-Donut and *Helenium flexuosum* in Pine Block C.
- Surveys of potential new locations identified at the end of Year 2 yielded three new locations for *Helenium flexuosum* (Pine Blocks A, G & I) and two new locations for *Sideroxylon reclinatum* subsp. *austrofloridense* (Pine Blocks B & C).
- Additional surveys of Pine Blocks C, D, G and I (and associated hammock) yielded a new location for *Eltroplectris calcarata* (Clench Hammock) and seven new locations for *Oncidium ensatum* (Courrerier Hammock, Decamp Hammock, Jones Hammock, Poppenhagger

Hammock, Von Paulsen Hammock, an unnamed hammock in Pine Block C, and an unnamed hammock in Pine Block D).

- We also discovered an additional station for *Hypelate trifoliata* in Pine Block A, near Deer Hammock, when conducting other work.
- Counts and estimates at individual stations through the dry season of 2006 were reviewed, allowing for the establishment of baseline abundance estimates for each species.
- All data collected through the dry season 2006 was entered into an Access database.

Summary of Survey Results, Year 1 through Year 3 (see also Appendix A)

By the end of 2003, all known locations for the 10 species thought to be possibly extirpated in the Long Pine Key region prior to this study were visited, some on numerous occasions. Only one species, *Ponthieva brittoniae*, was rediscovered.

Through the end of Year 3, 61 previously known rare plant occurrences were re-documented. Twenty historic occurrences were determined to be extirpated, leaving only eight occurrence locations to be re-surveyed in subsequent years.

Surveys of known and new locations have resulted in the discovery of 66 new occurrences of rare plant species in the Long Pine Key area, representing a 74% increase in the total number of known rare plant occurrences in the area (extant and extirpated), and a 108% increase in the number of known extant occurrences. All previously documented species included in Gann et al. (2002) and thought to be extant in the Long Pine Key area of Everglades National Park at the start of this study have been re-documented. In addition, at least one GPS coordinate was recorded for each occurrence location, clarifying the locality data for previously imprecise locations (e.g. Pine Block D).

A total of 127 rare plant occurrences for 22 rare plant species have now been recorded for the Long Pine Key area. These occurrences are represented by nearly 600 discrete stations with recorded GPS coordinates (Figure 2).

Based on data collected through April, 2006, the total abundance estimates for the Long Pine Key area continue to range from 2-10 individuals (*Adiantum melanoleucum, Galeandra beyrichii, Lomariopsis kunzeana, Passiflora sexflora, Spiranthes torta*) to 10,000-100,000 individuals (*Sideroxylon reclinatum* subsp. *austrofloridense*) (Table 3). These data establish an effective baseline for future monitoring programs.

Discussion of Survey Results to date

Most of the initial survey work for this project is now complete. We can expect to find new occurrences of *Oncidium ensatum* in additional small hammocks, and new occurrences of *Digitaria pauciflora* and *Sideroxylon reclinatum* subsp. *austrofloridense* as we continue to seek the limits of their habitat requirements. Both of the latter two species appear to have much wider ranges than previously thought.

Historical occurrences of the ephemeral terrestrial orchids *Basiphyllaea corallicola*, *Eltroplectris calcarata*, and *Spiranthes costaricensis* continue to elude us, but this is to be expected. Searches for these species will continue. However, it is reasonable to say that we now have a fairly advanced understanding of which of the 31 rare species in the study are present on Long Pine Key and where they are located.

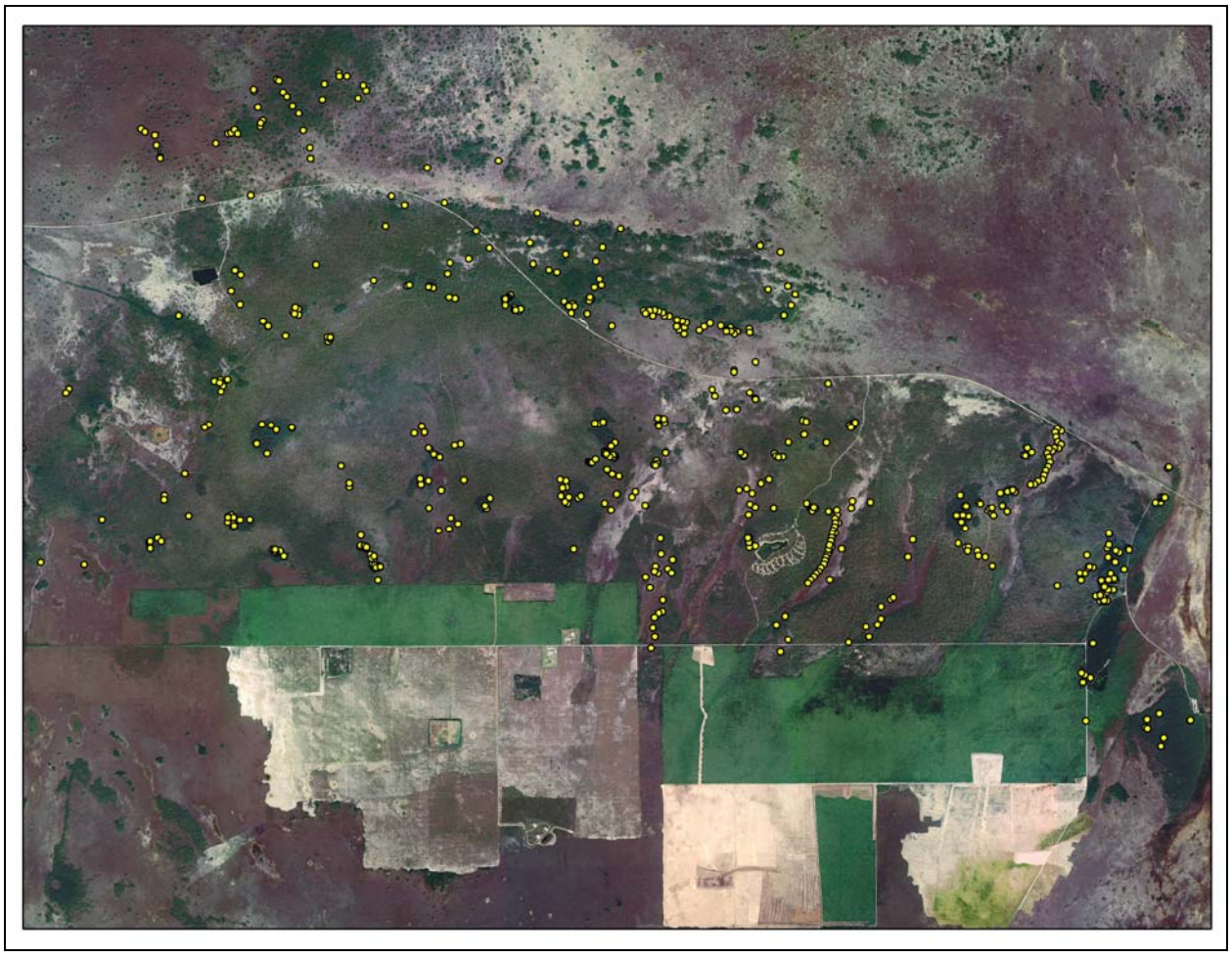


Figure 2. Rare plant stations as of Year 2 in the Long Pine Key area (outliers excluded).

Plants associated with hammocks represent about one-half of the species in this study and all of the species thought to be extirpated on Long Pine Key except for *Dalea carthagenensis* var. *floridana* (Table 4). However, *D. carthagenensis* var. *floridana* was documented only two times in Everglades National Park (Gann et al. 2002), and both of these records may represent waif populations established on road fill or disturbed soil. Also, *Schizaea pennula*, a fern more typically associated with swamps in our area (e.g. Everglades tree islands), was reported only once for Royal Palm Hammock in the Long Pine Key area of Everglades National Park (Small 1938). Hammock species in this study are all herbs with the exception of one vine which is typically herbaceous but sometimes woody (*Passiflora sexflora*)[1], and two shrubs typical of hammock/pineland ecotones (*Bourreria cassinifolia, Hypelate trifoliata*). These herbs grow on several substrates including soil (terrestrial), rocks (lithophytes) and other plants (epiphytes). Nine of the hammock plants are orchids, four are ferns or their allies, and two are from other taxonomic groups.

All of the extirpated hammock herbs are orchids (Orchidaceae) with the exception of one fern, *Trichomanes punctatum* subsp. *floridanum*, which was collected a single time in Royal Palm Hammock in 1909, and one bromeliad (Bromeliaceae), *Tillandsia fasciculata* var. *clavispica*, which was collected two

[1] A new hammock vine was discovered on Long Pine Key immediately prior to the initiation of this study by IRC biologists Steven Woodmansee and Jimi Sadle. It was first determined as *Rhynchosia phaseoloides*, a new taxon for South Florida, but there is some doubt as to its identification and nativity. At present, it is excluded from these results.

Table 3. Baseline abundance estimates for 22 extant rare plant species in the Long Pine Key area of EVER as of April, 2006.

Species	Occurrences	Stations recorded	Log_{10} abundance estimate
Adiantum melanoleucum	2	2	2 to 10
Anemia wrightii	2	5	11-100
Basiphyllaea corallicola	5	11	11-100
Bourreria cassinifolia	5	12	11-100
Croton lobatus	1	1	100-1,000
Desmodium lineatum	3	15	100-1,000
Digitaria pauciflora	13	105	1,000-10,000
Eltroplectris calcarata	12	47	100-1,000
Galeandra beyrichii	3	3	2 to 10
Helenium flexuosum	9	19	1,000-10,000
Hypelate trifoliata	6	12	11-100
Lomariopsis kunzeana	1	1	2 to 10
Oncidium ensatum	32	98	100-1,000
Passiflora sexflora	1	3	2 to 10
Pecluma plumula	2	3	11-100
Ponthieva brittoniae	3	49	101-1,000
Sideroxylon reclinatum subsp. austrofloridense	14	149	10,000-100,000
Spiranthes costaricensis	6	17	100-1,000
Spiranthes torta	1	2	2 to 10
Sporobolus compositus var. clandestinus	1	1	2 to 10
Thelypteris reticulata	4	6	11-100
Thelypteris serrata	1	1	11-100

times in Palma Vista Hammock #2 in the 1950s. Harry Luther of Marie Selby Botanical Gardens (personal communication) believes that this latter taxon is ephemeral in South Florida, with new populations becoming quickly genetically swamped through hybridization with the very common *Tillandsia fasciculata* var. *densispica*. Most of the extant hammock species appear to have suffered significant declines since the beginning of the 20th century. Population declines and/or the extirpation of hammock species have been casually linked to a variety of factors, including collecting, off-season fires or improper burning, and hydrological modifications, especially drainage, but actual species requirements have yet to be tested.

A second group of ten species (with some overlap) are associated with pinelands. Life forms include terrestrial herbs and shrubs and a variety of taxonomic groups are represented. Surveys during this study indicate that most of the species in this group are more abundant than previously thought. The only species to be rediscovered on Long Pine Key, *Ponthieva brittoniae*, also belongs here.

Table 4. Summary of 31 rare plants species at end of Year 3.

Species	Long Pine Key Status after Year 3	Taxonomic Group	Life Form	Major Habitats
Adiantum melanoleucum	Present	Pteridophyte	Lithophytic herb	Hammock solution holes
Anemia wrightii	Present	Pteridophyte	Lithophytic herb	Hammock/prairie ecotones
Basiphyllaea corallicola	Present	Orchidaceae	Terrestrial herb	Pinelands
Bourreria cassinifolia	Present	Dicot	Shrub	Pinelands, Hammock/ pineland ecotones
Brassia caudata	Presumed extirpated	Orchidaceae	Epiphytic herb	Hammocks
Croton lobatus	Present	Dicot	Terrestrial herb	Hammock/pineland ecotones
Dalea carthagenensis var. *floridana*	Presumed extirpated	Dicot	Shrub	Uncertain
Desmodium lineatum	Present	Dicot	Terrestrial herb	Pinelands
Digitaria pauciflora	Present	Other Monocot	Terrestrial herb	Pineland/prairie ecotones, Prairies
Eltroplectris calcarata	Present	Orchidaceae	Terrestrial herb	Hammocks
Galeandra beyrichii	Present	Orchidaceae	Terrestrial herb	Hammocks
Govenia utriculata	Presumed extirpated	Orchidaceae	Terrestrial herb	Hammocks
Helenium flexuosum	Present	Dicot	Terrestrial herb	Pinelands, Pineland/prairie ecotones
Hypelate trifoliata	Present	Dicot	Shrub	Hammock/pineland ecotones, Pinelands
Lomariopsis kunzeana	Present	Pteridophyte	Lithophytic herb	Hammock solution holes
Macradenia lutescens	Presumed extirpated	Orchidaceae	Epiphytic herb	Hammocks
Oncidium ensatum	Present	Orchidaceae	Epiphytic herb	Hammocks
Oncidium undulatum	Presumed Extirpated	Orchidaceae	Epiphytic herb	Hammocks
Passiflora sexflora	Present	Dicot	Vine	Hammocks
Pecluma plumula	Present	Pteridophyte	Epiphytic herb	Hammocks
Ponthieva brittoniae	Present	Orchidaceae	Terrestrial herb	Pinelands
Prescotia oligantha	Presumed extirpated	Orchidaceae	Terrestrial herb	Hammocks
Schizaea pennula	Presumed Extirpated	Pteridophyte	Terrestrial herb	Hammocks
Sideroxylon reclinatum subsp. *austrofloridense*	Present	Dicot	Shrub	Pinelands, Pineland/prairie ecotones, Prairies
Spiranthes costaricensis	Present	Orchidaceae	Terrestrial herb	Hammocks
Spiranthes torta	Present	Orchidaceae	Terrestrial herb	Pinelands
Sporobolus compositus var. *clandestinus*	Present	Other Monocot	Terrestrial herb	Pinelands
Thelypteris reticulata	Present	Pteridophyte	Terrestrial herb	Hammocks, Tree islands, Schinus thickets
Thelypteris serrata	Present	Pteridophyte	Terrestrial herb	Schinus thicket, Tree islands?, Hammocks?
Tillandsia fasciculata var. *clavispica*	Presumed extirpated	Other Monocot	Epiphytic herb	Hammocks
Trichomanes punctatum subsp. *floridanum*	Presumed extirpated	Pteridophyte	Lithophytic herb	Hammock solution holes

Six species are associated with wetland habitats. Three of these are associated with low elevation pinelands and pineland/marl prairie ecotones that flood each summer: *Digitaria pauciflora*, *Helenium flexuosum*[2] and *Sideroxylon reclinatum* subsp. *austrofloridense*. *D. pauciflora* and *S. reclinatum* subsp. *austrofloridense* are both federal candidates for listing under the Endangered Species Act. *H. flexuosum* is a temperate species with a disjunct distribution in South Florida and a unique morphological character – it lacks the ray flowers of its northern counterparts. All three of these species appear to be fairly abundant, but due to the lack of baseline data it is impossible to say whether they are more or less abundant than they were prior to widespread hydrological modification. Based upon data collected in Year 1, *S. reclinatum* subsp. *austrofloridense* was down-ranked to imperiled in South Florida by IRC, but is maintained in the study due to its status as a candidate for federal listing.

Two fern species, *Thelypteris reticulata* and *T. serrata*, are historically associated with wet hammocks or, more typically, swamps in South Florida. *T. reticulata* is the more abundant of the two, both historically and at present. It is known from several locations in and around Royal Palm Hammock, including Everglades tree islands and disturbed wetlands with a *Schinus terebinthifolius* canopy. Historically, this species was reported as common and widespread in the southern Everglades and Big Cypress Swamp, although by the 1930s its habitat had been largely "destroyed by fire" (Small 1938). Curiously, *T. serrata* is also known to grow in disturbed wetlands with a *Schinus terebinthifolius* canopy as well as in cypress domes and other types of forested wetlands. Apparently, it was never common in the Long Pine Key area of Everglades National Park and, at present, is not known from any natural habitat there.

The last wetland species, *Anemia wrightii*, is limited to hammock/prairie ecotones with extremely jagged limestone outcrops. Plants in the Long Pine Key area are limited to one small area on either side of main park road. Other plants in Everglades National Park are known from the Context Road area to the northeast of Long Pine Key.

Survey Objectives for Year 4

Based on results through the end of Year 3, the following objectives for Year 4 are identified:

- Continue surveys for species presumed to be extirpated in the Long Pine Key area.
- Conduct follow-up surveys for *Basiphyllaea corallicola* (Pine Blocks C, D, G, H & I), *Bourreria cassinifolia* (Pine Block F), *Digitaria pauciflora* (Pine Block J), *Eltroplectris calcarata* (Pay-fee Hammock and Hammock #120 a.k.a. Brookfield Hammock), *Helenium flexuosum* (Pine Block J) and *Spiranthes costaricensis* (Atoll Hammock, Avery Hammock, and Hammock #120 a.k.a. Brookfield Hammock).
- Continue surveys for other species as time allows.

Goal 2: Establish a long-term monitoring program to evaluate population and habitat responses of rare species to regional restoration.

Long-term Monitoring Methods, Years 1 & 2

The original scope of work established that long-term monitoring plots would be established in key rare plant habitats in the Long Pine Key area: rockland hammocks, rockland hammock solution holes, pine rocklands, and pine rockland/marl prairie ecotones. Plots for all habitats would be situated both north and south of the main park road. Changes in population status would be

[2] *Helenium flexuosum* appears to be native to pineland/marl prairie ecotones and very low elevation pinelands on Long Pine Key. Oddly, it is also found in linear bands upland of these habitats along the margins of fire breaks.

correlated with water availability as determined from the EVER hydrological monitoring database, soil water measurements and solution hole water depths. Plots north and south of the main park road would be compared, using appropriate statistical techniques. Additional environmental variables measured would include ground layer and solution hole humidity, soil texture, soil nutrient status and organic content, soil water-holding capacity, and canopy cover. Community composition within 5 m of the rare plant population would be inventoried to help define the habitat and to select promising introduction sites. Plots were to focus especially on those species that may be affected by CERP.

Plots. Plots were centered on an individual or within a population of the plant being studied. The location of the center of each plot was recorded with a GPS unit. Each plot was visually divided into the following four vegetation classes: solution hole (< 0 m); herb layer (0-1 m); shrub layer (1-3 m); and sub-canopy and canopy layer (>3 m). All taxa occurring in each class were recorded and percent cover was estimated for each species within each layer (0, <1%, 1-5%, 6-25%, 26-50%, 51-75%, 76-100%). In all cases, rare species were individually counted or their abundance estimated. For plots established in Year 1, baseline community composition was recorded during the wet season of 2004 (September, October) and the dry season of 2005 (March, April). For plots established in Year 2, recording of baseline community composition was initiated in the dry season of 2005 and continued in the wet season of 2005. Water level data collection for all plots was initiated in Year 2 in the dry season of 2005 and primarily consisted of measurements taken at prominent solution holes next to study plants. Data collection was further expanded in the wet season of 2005 to better understand habitat requirements of each species. Substrate type, canopy height, mean tree circumference and relative humidity (RH) were also measured at each plot and canopy photos were taken at thirteen plots to test methodology for quantifying canopy cover; substrate type, canopy height, and mean tree circumference are recoded a single time for each plot. In addition, a total of nine ibutton DS1923-F5 dataloggers were installed at three control plots, two *Lomariopsis kunzeana* plots and one *Adiantum melanoleucum* plot in Osteen Hammock to record temperature and relative humidity.

Transects. Based on observations of plants in the field, it was determined that belt transects rather than radius plots would be more appropriate for *Digitaria pauciflora* and *Sideroxylon reclinatum* subsp. *austrofloridense*. Both of these species were thought to grow along an elevational gradient that extends from within the marl prairie community up and into the pineland, with higher densities of plants near the ecotone than in either pineland or prairie. Belt transects would allow for observations of plant movements along this elevational gradient in response to regional hydrological restoration. Based on preliminary observations, we hypothesized that *D. pauciflora* would be less likely to have a pineland distribution and that regional restoration would push both species up the elevational gradient. The expected result of restoration would be an increase in *S. reclinatum* subsp. *austrofloridense* abundance in the pineland while *D. pauciflora* would become limited to a narrower band on the prairie side of the ecotone, probably not entering the pineland proper.

In Year 2, the installation of belt transects for these two species was initiated. A total of twelve 50 m transects were installed, three for each species south of main park road and three for each species north of main park road. Each transect was placed with the center at the approximate point where the two habitats meet. The endpoints and center of each transect were recorded with a Trimble GPS unit. Meter 0 marks the start of the line in the prairie and meter 49 marks the endpoint in the pineland. Data collection was initiated in the dry season of '05 (March, April). Each transect was divided into fifty 1x1 m quadrats. For *Digitaria pauciflora* and *Sideroxylon reclinatum* subsp. *austrofloridense*, an estimate of percent cover was made for each quadrat. The number of plants of

each study species rooted in the plot and the number of plants of each study species rooted outside of the plot was also recorded. Dominant species (species with greatest cover of all species <3 m in height) were also recorded for each quadrat. Water levels were measured along the line at 5 m intervals.

Long-term Monitoring Results, Years 1 & 2

Plots. Twenty-five 5 m radius monitoring plots were established in Year 1 and 18 additional monitoring plots were established in Year 2 for a total of 43 plots covering 15 of the 22 extant rare plant species in the Long Pine Key area. All major habitat types were covered except for pineland/prairie ecotone, which we chose to monitor with belt transects. Preliminary results showing dominant species of rare plant habitats were reported at the end of Year 2.

Transects. During dry season 2005, a total of 32 dominant species were found along the *Digitaria pauciflora* transects and 28 dominant species along the *Sideroxylon reclinatum subsp. austrofloridense* transects. *D. pauciflora* was found growing in association with nine dominant species and *S. reclinatum* subsp. *austrofloridense* was found growing in association with 16 dominant species. Both species were found to be growing nearly throughout the length of the line. Based on these preliminary results it was suggested in the Year 2 annual report that the transects might be too short to capture the complete habitat range for the species of concern and that the transects be lengthened by 25 m on each end in Year 3.

Long-term Monitoring Recommendations for Year 3

In the Year 2 annual report the following specific tasks for Year 3 were identified:

- Re-monitor plots during the wet season of 2005 and the dry and wet seasons of 2006.
- Reassess frequency and type of vegetation data collected in habitat plots.
- Add additional monitoring plots for *Anemia wrightii* (2 north of main park road, 1 south of main park road), *Croton lobatus* (1), *Spiranthes costaricensis* (2), *Spiranthes torta* (1), *Sporobolus compositus* var. *clandestinus* (1), *Thelypteris reticulata* (3), and *Thelypteris serrata* (1).
- Complete re-monitoring of all habitat transects during the wet season 2005 and the dry and wet seasons of 2006. Extend the length of habitat transects to 100 m and increase data collected (e.g. sample water depth every meter, estimate % cover of dominant vegetation).
- Continue initial data analysis to determine if patterns in community composition correspond to rare plant locations.
- Install humidity data loggers in *Ponthieva brittoniae* solution holes.
- Collect and analyze soil samples to determine soil texture, nutrient status, organic content and water-holding capacity.

Long-Term Monitoring Activities for Year 3 (methods)

- Monitoring of plots during the wet season of 2005 was completed except for plots of *Galeandra beyrichii*, *Helenium flexuosum*, and *Spiranthes costaricensis*, which still needed wet season community composition data collected.
- We determined to collect data on community composition during the wet and dry seasons every 3 years.
- In the dry season 2006, we re-monitored all plots, but ceased collection of community composition data for plots with pre-existing wet and dry season data. One *Oncidium ensatum* plot was missed, and this plot still needs dry season community composition data collected.

- Wet season monitoring of plots was initiated in September, 2006.[3] Water level monitoring data collection is being modified to further detect the unique habitat requirements of each species being monitored. Water depth is being recorded at the study plant, at the edge of the solution hole nearest the plant, and at the deepest point in the same solution hole. The distance from the plant to the nearest solution hole is being recorded, as well as the size of the solution hole (based on perimeter measurements). In plots that are inundated with water, an estimate of overall water coverage is being made instead. Coverage estimates use the same scale as is used for community composition (0, <1%, 1-5%, 6-25%, 26-50%, 51-75%, 76-100%). The logistics of taking canopy photos were deemed impractical for this project so a spherical densitometer is being used instead to estimate canopy cover. In addition to relative humidity (RH), temperature is being recorded at the study species.
- As recommended, the following plots were added in the dry season of 2006: *Anemia wrightii* (1 north of main park road, 1 south of main park road), *Croton lobatus* (1 south), *Spiranthes torta* (1 south), *Thelypteris reticulata* (1 south, 1 in the Pine Island area), *Thelypteris serrata* (1 in the Pine Island area). In addition, we added one plot of *Oncidium ensatum* north of main park road. We were unable to add a third plot for *Anemia wrightii* north of main park road due to lack of sufficient habitat. We still needed to add two additional plots for *Spiranthes costaricensis* and one plot for *Sporobolus compositus* var. *clandestinus* as recommended in the Year 2 annual report.[4]
- In the dry season 2006, we re-monitored all transects. We reviewed belt transect methods and determined: to collect dominant vegetation data every three years at one meter intervals during the dry season; not to increase belt transect length to 100 m; to double the sampling of study species by sampling each side of the transect line; and, not to count individuals of *Sideroxylon reclinatum* subsp. *austrofloridense*.
- Wet season monitoring of transects was initiated in September, 2006.[5] While water measurements were taken at 5 m increments in 2005, henceforth they will be taken every meter. To further understand the role micro-topography plays in distribution of these species, water depth is also being recorded for each study plant located within plots on either side of the transect.
- In order to improve the quality of long-term monitoring of *Digitaria pauciflora* and *Sideroxylon reclinatum* subsp. *austrofloridense*, we added eighteen 5 m radius plots: six plots of *Digitaria pauciflora* in prairie (three north of main park road and three south of main park road), six plots of *S. reclinatum* subsp. *austrofloridense* in prairie (three north of main park road and three south of main park road), and six plots of *S. reclinatum* subsp. *austrofloridense* in pineland (three north of main park road and three south of main park road).
- We continued data analyses to determine if patterns in community composition correspond to rare plant locations.
- Humidity data loggers were installed in three *Ponthieva brittoniae* solution holes. Data was downloaded from humidity loggers, reset to collect hourly data for six months instead of the previous schedule of half-hour collections for three months, and returned to the plots. After calibration errors were discovered, all data loggers we pulled from the field.
- Soil samples were collected during the wet season 2005 and deposited at The Institute of Food and Agricultural Sciences, University of Florida (IFAS). Additional soil sample

[3] Wet season monitoring of plots was completed on October 31, during Year 4 of the project.
[4] A plot for *Sporobolus compositus* var. *clandestinus* was added in November, 2006, during Year 4 of the project.
[5] Wet season monitoring of transects was completed on October 31, during Year 4 of the project.

collections were initiated during the wet season 2006. Data on % nitrogen and % carbon from wet season 2005 soil samples were received from IFAS during 2006.

- All data for vegetation and transect plots through dry season 2006 have been entered into an Access database.

Summary of Long-Term Monitoring Results for Year 3

- Twenty-eight new long-term monitoring plots were installed.
- Data collection for plots and transects was completed in the wet season of 2005, the dry season of 2006 and initiated in the wet season of 2006.
- Collection of environmental data was expanded and preliminary soils data were received.

Summary of Long-term Monitoring Results, Years 1 through 3

Plots: By the end of Year 3, 71 long-term monitoring plots had been established in the Long Pine Key area (Figure 3, Appendix B); 18 north of main park road, 49 south of main park road, three southeast of main park road and one west of main park road. All major habitat types are being sampled both north and south of main park road except for rockland hammock sinkhole, which is only being sampled in the south (Table 5). The 71 plots cover all but one of the 22 extant species in the study (*Sporobolus compositus* var. *clandestinus*)[6]. Cumulatively, the plots contain about 300 species, or nearly 30% of the flora of Everglades National Park. Interestingly, only four species of introduced exotic plants have been found growing in association with any of the rare plants: *Ardisia elliptica*, *Eremochloa ophiuroides*, *Oeceoclades maculata* and *Schinus terebinthifolius*.

Table 6 provides preliminary data on plot diversity and structure. Plot diversity ranges from a low of nine species for one plot of *Sideroxylon reclinatum* subsp. *austrofloridense* to a high of 71 species for one plot of *Ponthieva brittoniae*. Overall, pineland plots are the most diverse, with an average of 51 species, followed by hammocks (41 species), prairies (36 species), and hammock solution holes (30 species). Pineland plots south of main park road are more diverse than those to the north, while the opposite is true of hammocks; diversity of prairie plots was essentially the same on both sides of main park road.

While more intensive statistical analyses remain to be performed, preliminary data suggests that each rare study species has very specific habitat requirements that may not correlate to dominant vegetation except in a very coarse manner. Rare plants in this study are found mostly in association with common species with broad ecological tolerances (Table 7, Appendix C) and rarely with each other. Only *Sideroxylon reclinatum* subsp. *austrofloridense*, the most common of the study species, is found in close association with more than one other rare plant species; it is found in long-term monitoring plots of *Anemia wrightii*, *Bourreria cassinifolia*, *Desmodium lineatum*, *Digitaria pauciflora*, and *Helenium flexuosum*. Other rare species growing in association with one another are: *Basiphyllaea corallicola* in one *Bourreria cassinifolia* plot; *Oncidium ensatum* in one *Eltroplectris calcarata* plot; *Ponthieva brittoniae* in one *Hypelate trifoliata* plot; and *Spiranthes costaricensis* in one *Adiantum melanoleucum* plot.

As previously reported, few study species are found north of main park road: *Anemia wrightii*, *Digitaria pauciflora*, *Oncidium ensatum*, *Helenium flexuosum*, *Pecluma plumula* and *Sideroxylon reclinatum* subsp. *austrofloridense*; only *D. pauciflora* and *S. reclinatum* subsp. *austrofloridense* are fairly abundant there. *P. plumula* is not found south of main park road, while the remainder of these species have

[6] A *Sporobolus compositus* var. *clandestinus* plot was installed in early November, 2006, during Year 4.

Figure 3. Long-term monitoring plots in the Long Pine Key area (outliers excluded).

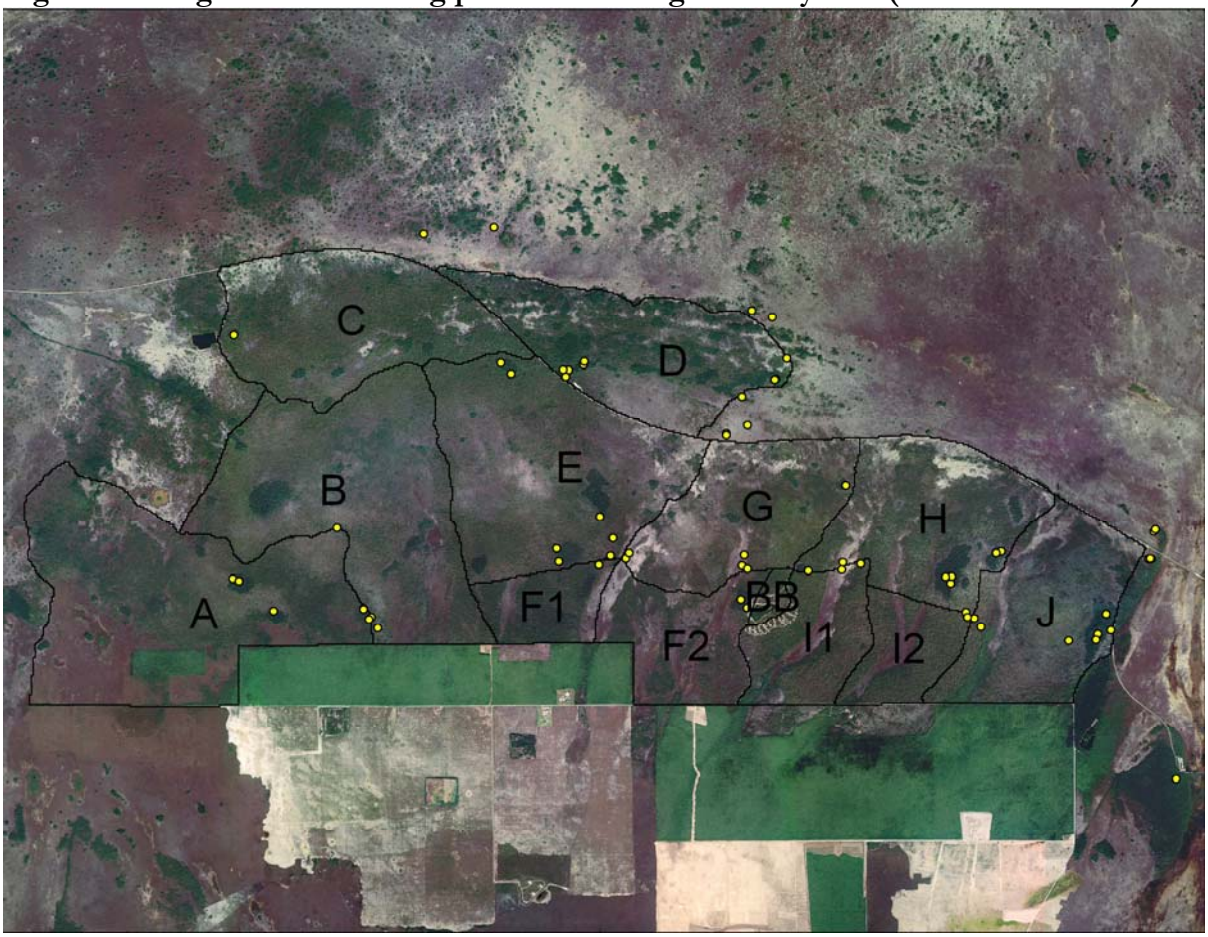


Table 5. Summary of monitoring plots in the Long Pine Key area by major habitat.

Habitat	# plots	Orientation to main park road	Study species
Hammock	12	South	*Eltroplectris calcarata, Galeandra beyrichii, Hypelate trifoliate, Oncidium ensatum, Passiflora sexflora, Spiranthes costaricensis, Thelypteris reticulata*
Hammock	4	North	*Oncidium ensatum, Pecluma plumula*
Hammock solution hole	4	South	*Adiantum melanoleucum, Lomariopsis kunzeana*
Pineland	24	South	*Basiphyllaea corallicola, Bourreria cassinifolia, Croton lobatus, Desmodium lineatum, Helenium flexuosum, Hypelate trifoliata, Ponthieva brittoniae, Sideroxylon reclinatum* subsp. *austrofloridense, Spiranthes torta.*
Pineland	6	North	*Helenium flexuosum, Sideroxylon reclinatum* subsp. *austrofloridense*
Marl prairie	6	South	*Digitaria pauciflora, Sideroxylon reclinatum* subsp. *austrofloridense*
Marl prairie	6	North	*Digitaria pauciflora, Sideroxylon reclinatum* subsp. *austrofloridense*
Other	3	Southeast	*Thelypteris reticulata, Thelypteris serrata*
Other	3	South	*Anemia wrightii*
Other	2	North	*Anemia wrightii*
Other	1	West	*Pecluma plumula*

Table 6. Preliminary data from 62 plots covering major rare plant habitats.

Major habitat type	Study species	number of plots	av. # of species in plot (one sampling period)	av. canopy height (m)	Dominant canopy (>25% cover in one or more plots in one or more sampling period)
Hammocks (South)		**12**	**38**	**9.8 (est.)**	
	Eltroplectris calcarata	3	45	10.2	*Lysiloma latisiliquum, Sideroxylon salicifolium*
	Galeandra beyrichii	1	24	10 (est.)	*Gymnanthes lucida*
	Hypelate trifoliata	3	40	8.6	*Gymnanthes lucida, Lysiloma latisiliquum, Ocotea coriacea, Sideroxylon salicifolium*
	Oncidium ensatum	2	47	10.9	*Quercus virginiana, Sideroxylon salicifolium*
	Passiflora sexflora	1	30	9.5	none
	Spiranthes costaricensis	1	23	10.8	*Sideroxylon salicifolium*
	Thelypteris reticulata	1	30	9.2	none
Hammocks (North)		**4**	**48**	**6.3**	
	Oncidium ensatum	2	59	6.0	none
	Pecluma plumula	2	37	6.6	*Lysiloma latisiliquum, Sideroxylon salicifolium*
Hammock solution holes (South)		**4**	**30**	**11**	**none**
	Adiantum melanoleucum	2	30	9.8	none
	Lomariopsis kunzeana	2	30	12.2	none
Pinelands (South)		**24**	**55**	**12.7 (est.)**	
	Basiphyllaea corallicola	3	59	16 (est.)	*Pinus elliottii* var. *densa*
	Bourreria cassinifolia	3	58	11.5	*Pinus elliottii* var. *densa*
	Croton lobatus	1	50	13.7	none
	Desmodium lineatum	3	54	16 (est.)	none
	Helenium flexuosum	3	54	10.6	none
	Hypelate trifoliata	3	65	12.3	*Pinus elliottii* var. *densa*
	Ponthieva brittoniae	3	67	9.0	none
	Sideroxylon reclinatum subsp. *austrofloridense*	3	34	13.6 (est.)	*Pinus elliottii* var. *densa*
	Spiranthes torta	2	53	11.7	none
Pinelands (North)		**6**	**34**	**11.9**	**none**
	Helenium flexuosum	3	46	13.3 (est.)	none
	Sideroxylon reclinatum subsp. *austrofloridense*	3	22	10.5	none
Prairies (South)		**6**	**36**	**none**	**none**
	Digitaria pauciflora	3	36	none	none
	Sideroxylon reclinatum subsp. *austrofloridense*	3	35	none	none
Prairies (North)		**6**	**35**	**none**	**none**
	Digitaria pauciflora	3	35	none	none
	Sideroxylon reclinatum subsp. *austrofloridense*	3	34	none	none

Table 7. Twenty-five most common species in long-term monitoring plots.

Species	Life form	# of plots (N=71)	# of layers (N=284)	Layers	Major Habitats
Sabal palmetto	Shrub/tree	47	93	Shrub, herb, solution hole	Hammocks, hammock solution holes, pinelands, prairies
Rapanea punctata	Shrub/tree	46	114	Canopy, shrub, herb, solution hole	Hammocks, hammock solution holes, pinelands
Ardisia escallonioides	Shrub/tree	44	105	Canopy, shrub, herb, solution hole	Hammocks, hammock solution holes, pinelands
Metopium toxiferum	Shrub/tree	42	112	Canopy, shrub, herb, solution hole	Hammocks, hammock solution holes, pinelands
Sideroxylon salicifolium	Tree/shrub	40	100	Canopy, shrub, herb, solution hole	Hammocks, hammock solution holes, pinelands
Dyschoriste angusta	Herb	40	54	Herb, solution hole	Pinelands, prairies
Smilax auriculata	Vine	38	78	Canopy, shrub, herb, solution hole	Hammocks, hammock solution holes, pinelands
Morinda royoc	Vine	38	65	Canopy, shrub, herb, solution hole	Hammocks, hammock solution holes, pinelands
Anemia adiantifolia	Herb	38	62	Herb, solution hole	Hammocks, hammock solution holes, pinelands
Randia aculeata	Shrub	37	51	Shrub, herb, solution hole	Hammocks, pinelands, prairies
Myrica cerifera	Shrub/tree	36	84	Canopy, shrub, herb, solution hole	Hammocks, pinelands
Mikania scandens	Vine	36	62	Shrub, herb, solution hole	Hammocks, pinelands, prairies
Solidago stricta	Herb	36	57	Shrub, herb, solution hole	Hammocks, pinelands, prairies
Tetrazygia bicolor	Shrub	35	77	Canopy, shrub, herb, solution hole	Hammocks, hammock solution holes, pinelands
Passiflora suberosa	Vine	34	51	Shrub, herb, solution hole	Hammocks, hammock solution holes, pinelands
Pinus elliottii var. *densa*	Tree	32	100	Canopy, shrub, herb, solution hole	Hammocks, pinelands
Persea palustris	Shrub/tree	31	70	Canopy, shrub, herb, solution hole	Hammocks, pinelands
Cladium jamaicense	Herb	31	69	Shrub, herb, solution hole	Hammocks, pinelands, prairies
Piriqueta caroliniana	Herb	31	44	Herb, solution hole	Pinelands, prairies
Lysiloma latisiliquum	Tree	30	81	Canopy, shrub, herb, solution hole	Hammocks, hammock solution holes, pinelands
Hyptis alata	Herb	30	51	Shrub, herb, solution hole	Pinelands, prairies
Angadenia berteroi	Herb	30	40	Herb, solution hole	Pinelands, prairies
Schizachyrium rhizomatum	Herb	30	36	Shrub, herb, solution hole	Hammocks, pinelands, prairies

populations both north and south of main park road. *O. ensatum* has been found only in one hammock north of main park road – it is far more abundant to the south. Because of the small population north of main park road, only two plots of *O. ensatum* have been installed in the north, paired with two plots south of main park road. *H. flexuosum*, which grows in low elevation pinelands and along the upland side of the pineland/marl prairie ecotone, does have a small population north of main park road. *A. wrightii*, which grows on the eastern edge of Long Pine Key, is the only other species to be found both north and south of main park road and it appears that a single population was split in two by the construction of that road. No hammock solution hole species have been found north of main park road.

Transects: Twelve 50 m monitoring belt transects have been established along the ecotone between pine rockland and marl prairie, six for *Digitaria pauciflora* and six for *Sideroxylon reclinatum* subsp. *austrofloridense* (Figure 4), with 50 1 x 1 m plots running on each side of the line. In the dry season of 2006, *S. reclinatum* subsp. *austrofloridense* was found along the entire length of the transect (Figure 5). *D. pauciflora*, however, is restricted almost entirely to the prairie end of the transects (Figures 6 and 7); plants recorded at 39, 46 and 48 m (14, 21 and 23 m into the pineland) in the dry season of 2005 were not located during the dry season of 2006.

Discussion of Long-term Monitoring Results to date

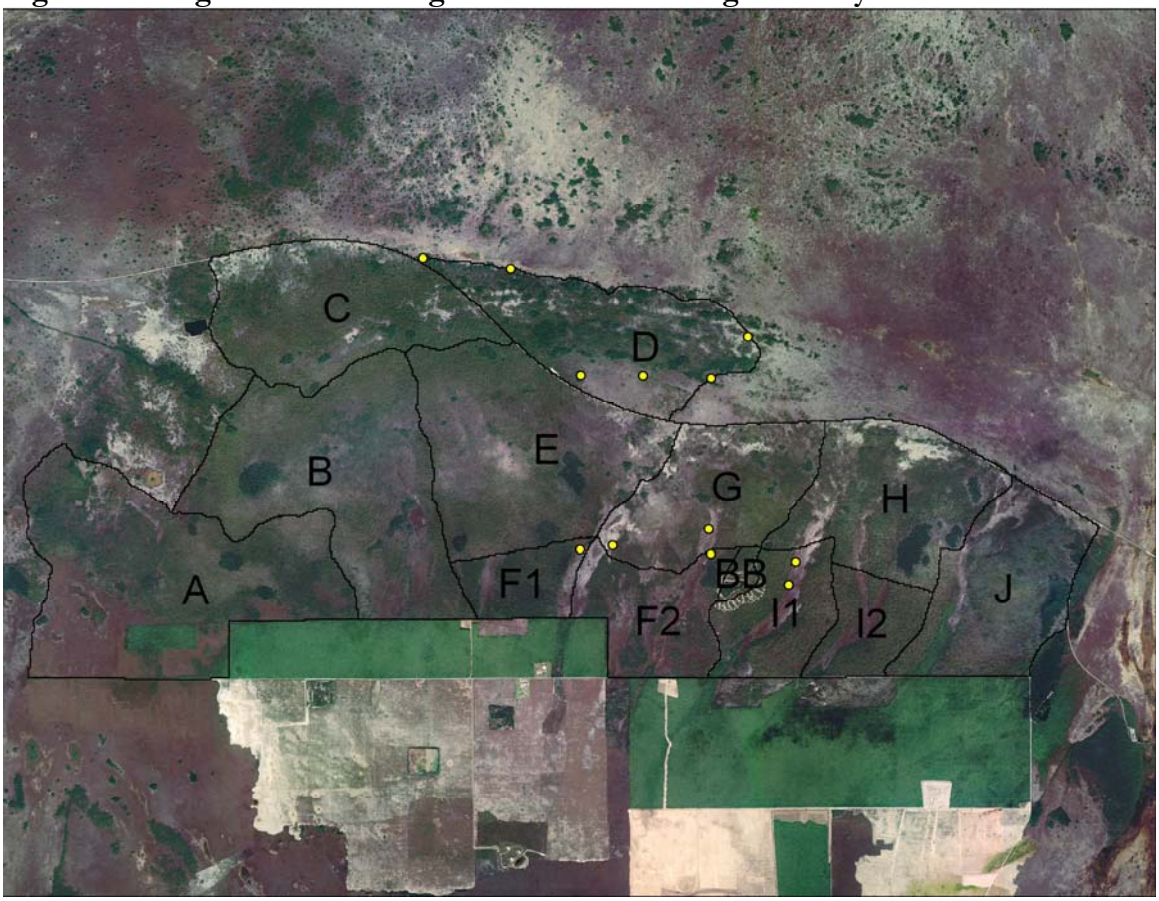
Establishment of long-term monitoring plots and transects is nearly complete. Only three plots previously recommended for establishment remained uninstalled at the end of Year 3: two plots for *Spiranthes costaricensis* and one plot for *Sporobolus compositus* var. *clandestinus*.

Recommendations at the end of Year 2 to establish long-term monitoring plots only for a subset of the study species (i.e., those we thought most likely to be affected by CERP) were abandoned in favor of a broader approach covering all extant species in the study. This will allow for a comprehensive monitoring program better designed to capture unpredicted changes in rare species populations and associated environmental variables as a result of hydrologic change. At least annual counts or estimates of all study species within plots or transects was initiated in the dry season of 2005. Additional measurements, such as the number of leaves on individual plants, the length of leaves of individual plants, the number of fertile plants, and so on, may be recommended after more abundance data have been gathered.

The decision to limit collection of community composition data to once every three years was based on little observed variability of community composition between years and known variability of observer data. Nevertheless, we propose to collect community composition data for all long-term monitoring plots and transects in the wet season of 2007 to establish a single baseline before the end of the study.

We have learned much about *Digitaria pauciflora* and *Sideroxylon reclinatum* subsp. *austrofloridense*, the two federal candidate species in the study. During the dry season of 2006, attempts to extend habitat belt transect length from 50 m to 100 m were deemed inappropriate. Due to the mosaic-style distribution of pineland and prairie habitats, transect extension yielded habitat repeat rather than the intended extension into each distinct habitat type on each end. To address differences between the distinct habitats (marl prairie and pineland), we decided instead to install new radius plots for *D. pauciflora* in marl prairie and new radius plots for *S. reclinatum* subsp. *austrofloridense* in both pineland and prairie habitats as discussed above. This will allow us to monitor changes of both species, both in the lower elevation prairies (using plots) as well as along the ecotone (using belt transects), and within the pineland proper for *S. reclinatum* subsp. *austrofloridense* (using plots).

Figure 4. Long-term monitoring transects in the Long Pine Key area.



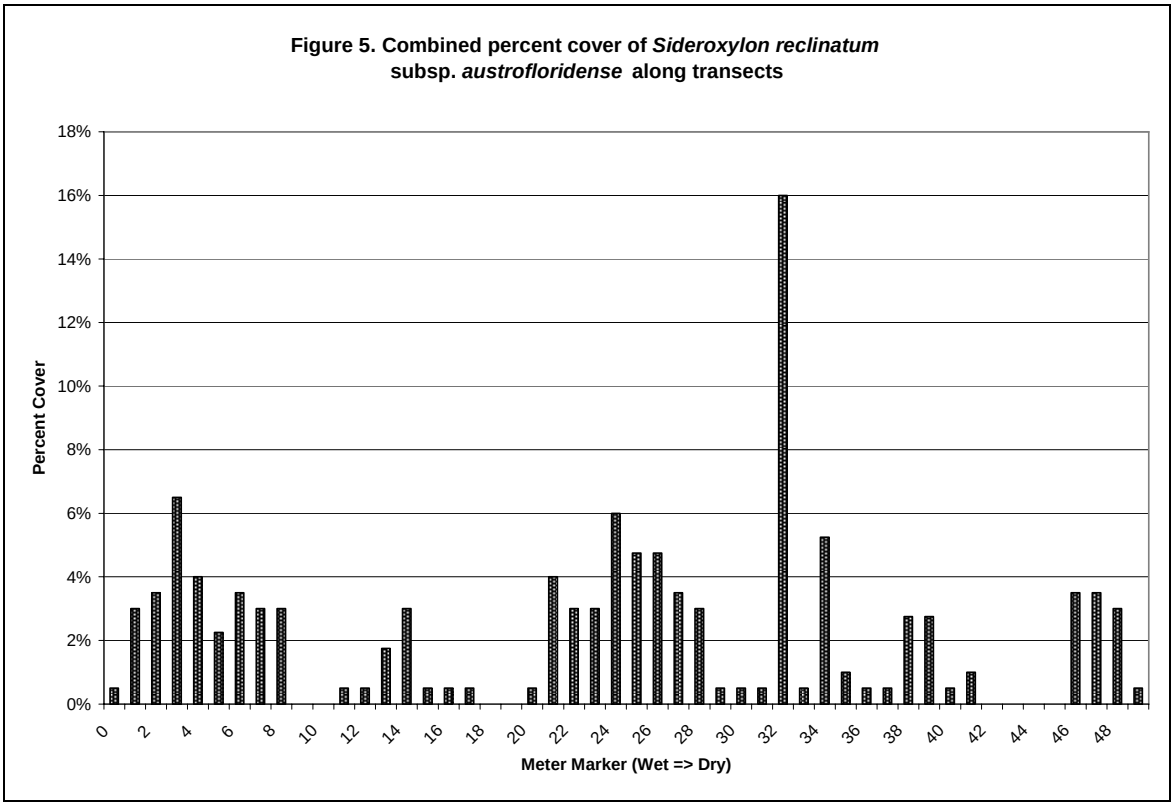


Figure 6. Combined counts of *Digitaria pauciflora* along transects

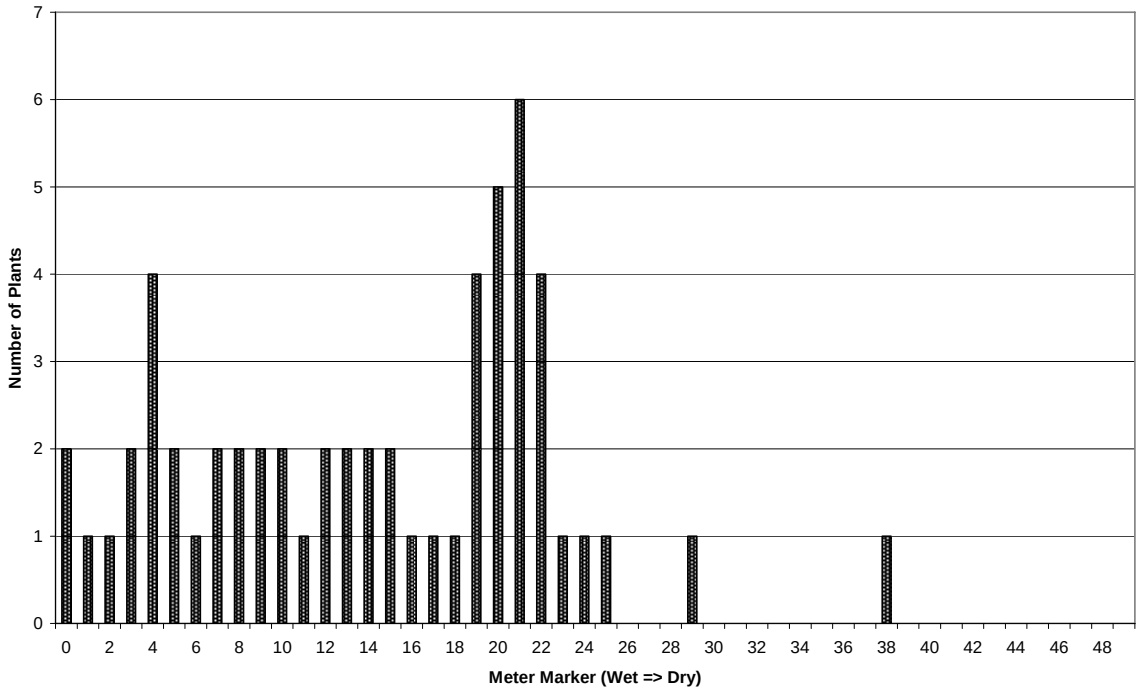
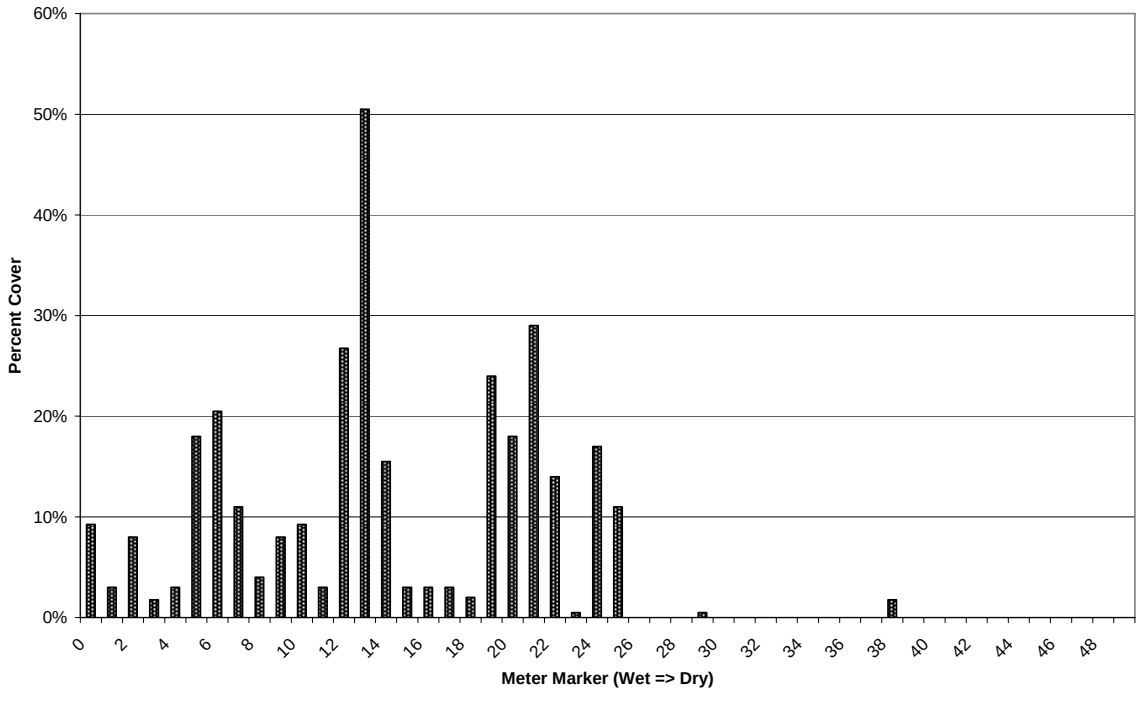


Figure 7. Combined percent cover of *Digitaria pauciflora* along transects



The prairie plots may be especially useful in measuring shorter-term responses to changes in hydrology caused by CERP. Although we reported in our Year 2 annual report a possible relationship between *D. pauciflora* and *S. reclinatum* subsp. *austrofloridense* and dominant species along the belt transect, these data need further analysis. Similarly, we need to conduct more analyses of the distribution of both *D. pauciflora* and *S. reclinatum* subsp. *austrofloridense* along the transect line.

Collection of environmental data, including canopy cover, temperature, RH, and water level are all still considered experimental. However, new methods used in the wet season of 2006 should elucidate methods that can be replicated and provide the baseline environmental data needed for a successful long-term monitoring program.

The one major need that we have identified for plots and transects is permanent marking.

Monitoring Objectives for Year 4
Based on results through the end of Year 3, the following objectives for Year 4 are identified:

- Complete wet season monitoring in 2006, conduct dry season monitoring in 2007 and initiate wet season monitoring in 2007.
- Collect community composition data for any plots with data for only one season.
- Add two plots for *Spiranthes costaricensis* and one plot for *Sporobolus compositus* var. *clandestinus*.
- Permanently mark centers of all radius plots and the endpoints and centers of all transects.
- Continue data analysis to determine if patterns in community composition correspond to rare plant locations, and to study the relationship between rare plant distributions and abundance and environmental variables.
- Collect soil samples in the dry season of 2007; if warranted expand data collection to additional plots and collect leaves of dominant plants in plots to conduct nutrient analyses.

Goal 3: Restore and enhance species diversity of the Long Pine Key area and Everglades National Park through the augmentation or reintroduction of plants considered rare as a result of direct or indirect actions by man.

Rare Plant Restoration Methods, Years 1 & 2. The original scope of work established that we would investigate the appropriateness and feasibility of augmenting populations of rare study species in imminent danger of being extirpated from Everglades National Park, including the feasibility of augmenting populations of these species in the Long Pine Key area. Opportunities for the reintroduction of plants that had been extirpated from the Long Pine Key area would also be investigated. This group included species that are extirpated from the continental Unites States (e.g. *Brassia caudata*) as well as species that are still extant in Everglades National Park (e.g. *Oncidium undulatum*) or elsewhere in South Florida (e.g. *Trichomanes punctatum* subsp. *floridanum).* If appropriate and feasible, augmentation and reintroduction trials would be initiated, using community composition and measurements of environmental variables to help identify favorable reintroduction sites. NPS compliance review would be conducted when required.

During Years 1 and 2, meetings and field visits were held to assess augmentation and reintroduction needs and to develop management recommendations for all species being studied. Collaborators attending one of more of these sessions included Craig Smith of EVER, Joyce Maschinski and Jennifer Possley from Fairchild Tropical Botanical Garden (FTBG) and Bruce Holst, Harry Luther,

Wesley Higgins and John Beckner from Marie Selby Botanical Gardens (MSBG). During Year 2, the collaboration with FTBG was broadened to include Miami-Dade County's Natural Areas Management group (NAM) to allow for research and germplasm collection by IRC and FTBG at sties in Miami-Dade County outside of EVER.

IRC, MSBG, and FTBG staff visited rare plant populations of *Adiantum melanoleucum, Lomariopsis kunzeana, Oncidium ensatum, Oncidium undulatum, Thelypteris reticulata, Thelypteris serrata,* and *Trichomanes punctatum* subsp. *floridanum* within EVER and in Miami-Dade County Parks as well as cultivated populations of *Thelypteris reticulata* and *Thelypteris serrata*. Potential augmentation/reintroduction sites were visited and practical issues that may be encountered when initiating augmentations were discussed. An initial recommendation to conduct trial augmentations and reintroductions at Hattie Bauer Hammock Park in Miami-Dade County and Royal Palm Hammock in Everglades National Park was suggested.

Fertile material of *Adiantum melanoleucum, Lomariopsis kunzeana,* and *Trichomanes punctatum* subsp. *floridanum* was collected from outside of EVER in Miami-Dade County parks, *Thelypteris reticulata* from cultivated plants, and *Oncidium ensatum* within EVER. *Passiflora sexflora* was already in cultivation at FTGB. Possible sources for *Brassia caudata* and *Macradenia lutescens* were being investigated by MSBG staff. Cultivation of material by FTBG and MSBG for trial augmentation was initiated.

Rare Plant Restoration Results, Years 1 & 2

By the end of Year 2, a revised summary of augmentation and reintroduction recommendations was completed. *Adiantum melanoleucum, Lomariopsis kunzeana,* and *Trichomanes punctatum* subsp. *floridanum* were successfully propagated. Seeds of *Oncidium ensatum,* which had been only recently collected, were sown.

Rare Plant Restoration Recommendations, Year 3

Based on results through the end of Year 2, the following research objectives for Year 3 were identified:

- Continue collecting germplasm and cultivating plants recommended for augmentation or reintroduction.
- Proceed with trials at Hattie Bauer Hammock outside EVER.
- Proceed with trials at Royal Palm Hammock, pending NPS compliance review.

Rare Plant Restoration Activities for Year 3 (methods)

IRC and MSBG staff visited populations of *Oncidium ensatum*, *Oncidium undulatum*, *Pecluma plumula Thelypteris reticulata*, and *Thelypteris serrata*, within EVER; fertile material of *P. plumula* and *T. reticulata* was collected. No fertile material was found for *O. ensatum, O. undulatum* or T. *serrata.* We did find spikes on both *Oncidium* species but many spikes on *O. undulatum* appeared to be dying back because of a small fly, *Melanagromyza miamiensis*, which deposits its eggs in the inflorescence where its larvae develop. A trial hand-pollination was conducted on two *O. undulatum* plants to see if the lack of a pollinator might also be involved. Spores from the *Adiantum melanoleucum* population at Harden Hammock (outside EVER) were sent to MSBG.

MSBG obtained seeds of *Brassia caudata* from Jamaica to begin propagation trials. Two *Oncidium undulatum* plants from Jamaica were also obtained for mycorrhizae experiments, and MSBG began work to isolate mycorrhizae from greenhouse-grown *Oncidium ensatum* (of Florida origin).

We collaborated with FTBG in a trial augmentation of *Passiflora sexflora* at Hattie Bauer Hammock (outside EVER). No other trails were initiated because the remaining material was too small.

Summary of Rare Plant Restoration Results for Year 3

- Augmentation and reintroduction recommendations were revised (Table 8).
- Additional plants of *Adiantum melanoleucum* and *Oncidium ensatum* were brought into cultivation.
- New propagation trials began for *Brassia caudata* and *Pecluma plumula*.
- Augmentation trials of *Passiflora sexflora* were initiated outside EVER by FTBG.

Summary of Rare Plant Restoration Results to date

Twelve of the 31 study species have been recommended for augmentation or reintroduction in the Long Pine Key area of EVER. Propagation trials have begun for eight species and cultivation has begun for seven of these. Germplasm still is needed for *Galeandra beyrichii*, *Macradenia lutescens*, *Oncidium undulatum* and *Thelypteris serrata*. Spores of *Thelypteris reticulata* have been collected, but no plants have recruited.

Plants in cultivation at MSBG and collaborating institutions:

FERNS

Adiantum melanoleucum (spores from outside EVER)

- Seven plants 4-6 cm tall, possibly ready to pot; healthy
- Two 8 cm^2 containers full of sporophytes ca. 2.5cm tall and many new sporophytes; healthy
- One 15 cm x 25 cm container with 50 clusters of gametophytes; struggling
- One 15 cm x 25 cm container with 20 clusters of gametophytes; struggling

Lomariopsis kunzeana (spores from outside EVER)

- One 8 cm^2 container full of sporophytes with "beginner leaves"; healthy

Pecluma plumula (spores from inside EVER)

- One 15 cm x 25 cm container with 80-100 plants, a few to 6mm tall with "beginner leaves"; most <3 mm; healthy (Figure 8)

Thelypteris reticulata (spores from inside EVER)

- Spores sown March, 2005; never germinated; eventually dumped 10/2006

Trichomanes punctatum var. *floridanum* (spores from outside EVER)

- Two pots each with a cluster about 5cm diameter -- about 80 plants total, some to 12mm; healthy
- A collaborating institution is experimenting with the propagation of these on agar, but has not produced sporophytes

ORCHIDS

Brassia caudata

- Seed from Jamaica, 15 of 17 flasks have germinated

Oncidium ensatum

- Seed from EVER in September, 2005; 4 of 8 flasks have germinated (original crop lost).

Table 8. Augmentation and Reintroduction Recommendations.

Taxon	Recommendation	Reason	Location
Adiantum melanoleucum	Augment	In imminent danger of extirpation	Hattie Bauer Hammock (Outside EVER)/Royal Palm Hammock
Anemia wrightii	No action at present	Population not obviously depleted	
Basiphyllaea corallicola	No action at present	Population not obviously depleted	
Bourreria cassinifolia	No action at present	Population not obviously depleted	
Brassia caudata	Reintroduce	Extirpation documented	Royal Palm Hammock
Croton lobatus	No action at present	Population not obviously depleted	
Dalea carthagenensis var. floridana	No action at present	Perhaps never established in EVER	
Desmodium lineatum	No action at present	Population not obviously depleted	
Digitaria pauciflora	No action at present	Abundant	
Eltroplectris calcarata	No action at present	Population not obviously depleted	
Galeandra beyrichii	Augment	In imminent danger of extirpation	Hattie Bauer Hammock (Outside EVER)/Royal Palm Hammock
Govenia utriculata	Not Decided	Taxonomic difficulty	
Helenium flexuosum	No action at present	Habitat in EVER not well understood, but augmentation trials could increase understanding	
Hypelate trifoliata	No action at present	Population not obviously depleted	
Lomariopsis kunzeana	Augment	In imminent danger of extirpation	Hattie Bauer Hammock (Outside EVER)/Royal Palm Hammock
Macradenia lutescens	Reintroduce	Extirpation documented	Royal Palm Hammock
Oncidium ensatum	Augment	Population depleted	Hattie Bauer Hammock (Outside EVER)/Royal Palm Hammock
Oncidium undulatum	Reintroduce	Extirpation documented	Royal Palm Hammock
Passiflora sexflora	Augment	In imminent danger of extirpation	Hattie Bauer Hammock (Outside EVER)/Royal Palm Hammock
Pecluma plumula	Augment	In imminent danger of extirpation	Royal Palm Hammock
Ponthieva brittoniae	No action at present	Population not obviously depleted	
Prescotia oligantha	No action at present	Perhaps introduced in EVER	
Schizaea pennula	No action at present	Presence reported, never documented	
Sideroxylon reclinatum subsp. austrofloridense	No action at present	Abundant	
Spiranthes costaricensis	No action at present	Population not obviously depleted	
Spiranthes torta	Not Decided	Habitat in EVER not well understood	
Sporobolus compositus var. clandestinus	Not Decided	Habitat in EVER not well understood	
Thelypteris reticulata	Augment	In imminent danger of extirpation	Royal Palm Hammock
Thelypteris serrata	Augment	In imminent danger of extirpation	Royal Palm Hammock
Tillandsia fasciculata var. clavispica	No action at present	Perhaps never well established in EVER	
Trichomanes punctatum subsp. *floridanum*	Reintroduce	Extirpation documented	Hattie Bauer Hammock (Outside EVER)/Royal Palm Hammock

Plants in cultivation at FTBG:
Passiflora sexflora

- About 50 surplus plants available for trials at Royal Palm Hammock.[7]

Seed pods were observed on two of the hand pollinated *Oncidium undulatum* plants in EVER at the beginning of June 2006 (one on each plant). Research by MSBG suggested that these seed pods would be ready for collection between September and November, 2006. By the end of September, both unripened capsules remained, although one was partially depredated.

Rare Plant Restoration Recommendations, Year 4
Based on results through the end of Year 2, the following research objectives for Year 4 are identified:

- Initiate propagation trials for *Galeandra beyrichii*, *Macradenia lutescens*, *Oncidium undulatum* and *Thelypteris serrata*.
- Continue attempts to propagate *Thelypteris reticulata.*
- Continue cultivation of *Adiantum melanoleucum*, *Brassia caudata*, *Lomariopsis kunzeana*, *Oncidium ensatum*, *Pecluma plumula*, and *Trichomanes punctatum* var. *floridanum*.
- Initiate augmentation trials of Passiflora sexflora at Royal Palm Hammock.
- If material is ready, initiate other trials as appropriate.

Figure 8. Young sporophyte of *Pecluma plumula* in cultivation at MSBG.

[7] 50 *Passiflora sexflora* plants were transferred from FTBG to IRC's nursery in November, 2006.

Goal 4: Contribute to a broader understanding of the environmental requirements of rare species both within and outside of Everglades National Park.

Environmental Requirements Methods, Years 1 & 2

By Year 2 it had become clear that some study species were sufficiently rare inside the Long Pine Key area of EVER to warrant the collection of additional data concerning their environmental requirements. These data were needed both to obtain a better understanding of extant populations inside the Long Pine Key area as well as to glean information that might be helpful in augmenting or reintroducing populations. In Year 2, we began establishing off-site characterization plots for species with fewer than three long-term monitoring plots in the Long Pine Key area, as well as for species extirpated in the Long Pine Key area with extant populations either elsewhere in EVER or outside of the park. Although we were primarily interested in community composition data to begin with, we did collect some additional environmental data.

Environmental Requirements Results, Years 1 & 2

Off-site characterization plots were established at Coot Bay Hammock near Flamingo inside EVER for *Oncidium undulatum* (1) and in conservation areas on the Miami Rock Ridge outside of EVER for *Adiantum melanoleucum* (1), *Galeandra beyrichii* (1), *Lomariopsis kunzeana* (1), *Passiflora sexflora* (2), *Spiranthes torta* (1) and *Trichomanes punctatum* subsp. *floridanum* (1).

Control plots on Long Pine Key were also established for the following species: *Adiantum melanoleucum, Galeandra beyrichii, Lomariopsis kunzeana, Oncidium ensatum,* and *Passiflora sexflora.* A paired design was chosen to compare plant composition and environmental factors between habitats that supported these species and habitats that did not, using baseline data collected from established long-term monitoring plots. For each species, we installed three plots comparable to each species' habitat type (but lacking that species) for a total of 15 control plots. Plots were located in the same hammock or a hammock adjacent to where the study species was known.

Environmental Requirement Recommendations, Year 3

Based on results through the end of Year 2, the following research objectives for Year 3 were identified:

- Complete monitoring of off-site characterization plots and control plots during the wet season of 2005 and re-monitor existing plots in the dry and wet seasons of 2006 using the same methodology as that for long-term monitoring plots.
- Outside of EVER, establish one additional off-site characterization plot for *Galeandra beyrichii*, one additional off-site characterization plot for *Spiranthes torta*, and two additional off-site characterization plots for *Trichomanes punctatum* subsp. *floridanum*.
- Establish two additional off-site characterization plots for *Oncidium undulatum* in EVER.

Environmental Requirement Activities, Year 3 (methods and results)

Monitoring of off-site characterization plots and control plots was completed in the wet season of 2005 and the dry season of 2006. Monitoring of off-site characterization plots was initiated in the wet season of 2006[8]; control plots were not planned for re-monitoring in the wet season of 2006.

[8] Monitoring of off-site characterization plots was completed in the wet season of 2006, during Year 4.

As recommended, new off-site characterization plots were installed for: *Oncidium undulatum* (2); *Trichomanes punctatum* subsp. *floridanum* (2 outside EVER). We also installed two plots for *Anemia wrightii* in the Context Road area of EVER and one additional plot for *Thelypteris serrata* outside EVER.

Summary of Environmental Requirement Results to date

A total of 15 off-site characterization plots have been installed, five in EVER and 10 outside EVER (Table 9). We did not add an off-site plot for *Spiranthes torta* as recommended since we were able to add an additional plot in the Long Pine Key area. We have a possible additional plot for *Galeandra beyrichii* inside the Long Pine Key area based on a tentative identification of a sterile specimen.

Three species still need additional plots in order to achieve a minimum of three plots per study species: *Croton lobatus* (2), *Galeandra beyrichii* (1), and *Thelypteris serrata* (1).

Table 9. Summary of plots for study species with off-site characterization plots.

Study Species	Long-term Monitoring Plots in the Long Pine Key Area	Off-Site Characterization Plots inside EVER	Off-Site Characterization Plots outside EVER	Total number of plots
Adiantum melanoleucum	2	0	1	3
Anemia wrightii	5	2	0	7
Croton lobatus	1	0	0	1
Galeandra beyrichii	1	0	1	2
Lomariopsis kunzeana	2	0	1	3
Oncidium undulatum	0	0	3	3
Passiflora sexflora	1	0	2	3
Spiranthes torta	2	0	1	3
Thelypteris serrata	1	0	1	2
Trichomanes punctatum subsp. *floridanum*	0	0	3	3
Total	15	2	13	30

Environmental Requirement Recommendations, Year 4

Based on results through the end of Year 2, the following research objectives for Year 3 were identified:

- Install additional plots for *Croton lobatus* (2), *Galeandra beyrichii* (1), and *Thelypteris serrata* (1).
- Analyze data already collected from off-site characterization plots and control plots.
- If analyses suggest and time permits, collect additional environmental data from off-site characterization plots and control plots.

PUBLICATION HISTORY

Two articles on the rediscovery of *Ponthieva brittoniae* were published during Year 2.

Sadle, J.L. S.W. Woodmansee, G.D. Gann, and T.V. Armentano. 2005. Rediscovery of *Ponthieva brittoniae* (Orchidaceae) in Everglades National Park. Sida 21(3): 1917-2920.

Sadle, J.L. 2005. *Ponthieva brittoniae*: Rediscovering a population of Mrs. Britton's Shadow Witch. Orchids May: 380-382.

RESEARCH PERSONNEL

Project organization and development was conducted by George D. Gann, principal investigator, in collaboration with Craig Smith, EVER botanist and co-principal investigator. Field research during Year 3 was conducted by Kirsten N. Hines, Emilie Verdon Grahl, Steven W. Woodmansee, Stephen Hodges, Eric Fleites, Josh Mahoney, Steven Green, and Patty Castillo-Trenn. Augmentation needs are being developed in collaboration with Joyce Maschinski (FTBG), Jennifer Possley (FTBG**),** Joe Maguire (NAM), Bruce Holst (MSBG), Harry Luther (MSBG), Wesley Higgins (MSBG) and John Beckner (formerly with MSBG). Tom Philippi (Florida International University) and Tiffany Troxler-Gann of (Florida International University and IRC) have assisted on plot and transect design and data analysis. Soil collection, methodology, and analysis are being developed in collaboration with Yuncong Li, The Institute of Food and Agricultural Sciences, University of Florida (IFAS).

ATTACHMENTS

Location data, population estimates and field notes from rare plant surveys during Year 3 are included with this report in an Access database entitled IRC_LPK_RarePlantResults_Year3. Vegetation plot, control plot, and belt transect data and locations are included as tables in the same Access database. Copies of the original field datasheets are also provided.

CITATIONS

Gann, G.D., K.A. Bradley, and S.W. Woodmansee. 2002. Rare Plants of South Florida: Their History, Conservation, and Restoration. Miami: The Institute for Regional Conservation.

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Sadle, J.L. 2005. *Ponthieva brittoniae*: Rediscovering a population of Mrs. Britton's Shadow Witch. Orchids May: 380-382.

Small, J.K. 1938. Fern of the Southeastern States. Lancaster: The Science Press.

Appendix A. Rare Plant Occurrences in the Long Pine Key area.

Species	Location	Surveys complete?	Status	New Occurrence?
Adiantum melanoleucum	Osteen Hammock	yes, Year 1	Present	No
Adiantum melanoleucum	Rattlesnake Hammock	yes, Year 2	Present	yes, Year 2
Anemia wrightii	Pfleuger Hammock Area	yes, Year 1	Present	No
Anemia wrightii	Warren Hammock Area	yes, Year 1	Present	No
Basiphyllaea corallicola	Pine Block A	yes, Year 1	Present	yes, Year 1
Basiphyllaea corallicola	Pine Block B	yes, Year 1	Present	No
Basiphyllaea corallicola	Pine Block C	No, follow up needed	?	Potential
Basiphyllaea corallicola	Pine Block D	No, follow up needed	?	Potential
Basiphyllaea corallicola	Pine Block E	yes, Year 1	Present	yes, Year 1
Basiphyllaea corallicola	Pine Block F	yes, Year 1	Present	yes, Year 1
Basiphyllaea corallicola	Pine Block G	No, follow up needed	?	Potential
Basiphyllaea corallicola	Pine Block H	No, follow up needed	Possibly extirpated	No
Basiphyllaea corallicola	Pine Block I	No, follow up needed	Possibly extirpated	No
Basiphyllaea corallicola	Pine Block J	yes, Year 1	Present	No
Bourreria cassinifolia	Bootlegger Hammock	Yes, Year 3	Present	No
Bourreria cassinifolia	Palma Vista Hammock #2	yes, Year 1	Present	No
Bourreria cassinifolia	Pine Block E	yes, Year 1	Present	No
Bourreria cassinifolia	Pine Block F	No, follow up needed	Possibly extirpated	No
Bourreria cassinifolia	Pine Block H	yes, Year 1	Present	No
Bourreria cassinifolia	Pine Block J	yes, Year 2	Present	yes, Year 2
Brassia caudate	Deer Hammock	yes, Year 1	Presumed extirpated	No
Brassia caudate	Osteen Hammock	yes, Year 1	Presumed extirpated	No
Brassia caudate	Turkey Hammock	yes, Year 1	Presumed extirpated	No
Brassia caudate	Winkley Hammock	yes, Year 1	Presumed extirpated	No
Croton lobatus	Mosier Hammock Edge	yes, Year 2	Present	No
Dalea carthagenensis var. floridana	East boundary	yes, Year 1	Presumed extirpated	No
Dalea carthagenensis var. floridana	Roadside and canal bank, 14miles SW of Paradise Key	yes, Year 1	Presumed extirpated	No

Desmodium lineatum	Pine Block H	yes, Year 1	Present	No
Desmodium lineatum	Pine Block I	yes, Year 1	Present	yes, Year 1
Desmodium lineatum	Pine Block J	yes, Year 1	Present	No
Digitaria pauciflora	Hole-in-the-Donut area	yes, Year 3	Present	No
Digitaria pauciflora	Pine Block A	yes, Year 1	Present	No
Digitaria pauciflora	Pine Block B	yes, Year 1	Present	yes, Year 1
Digitaria pauciflora	Pine Block C	yes, Year 1	Present	No
Digitaria pauciflora	Pine Block D	yes, Year 2	Present	No
Digitaria pauciflora	Pine Block E	yes, Year 1	Present	yes, Year 1
Digitaria pauciflora	Pine Block F	yes, Year 1	Present	yes, Year 1
Digitaria pauciflora	Pine Block G	yes, Year 2	Present	yes, Year 2
Digitaria pauciflora	Pine Block H	yes, Year 2	Present	No
Digitaria pauciflora	Pine Block I	yes, Year 2	Present	yes, Year 2
Digitaria pauciflora	Pine Block J	No, follow up needed	?	Potential
Digitaria pauciflora	Pinelands west of Pine Block A	yes, Year 1	Present	yes, Year 1
Digitaria pauciflora	Pinelands west of Pine Block B	yes, Year 1	Present	yes, Year 1
Digitaria pauciflora	Prairies and transitional pinelands north and west of Pine Block D	yes, Year 3	Present	yes, Year 3
Eltroplectris calcarata	Clench Hammock	Yes, Year 3	Present	yes, Year 3
Eltroplectris calcarata	Fairchild Hammock	yes, Year 1	Present	yes, Year 1
Eltroplectris calcarata	Frampton Hammock	yes, Year 1	Present	No
Eltroplectris calcarata	Grimshawe Hammock	yes, Year 1	Present	yes, Year 1
Eltroplectris calcarata	Brookfield Hammock (Hammock #120)	No, follow up needed	Possibly extirpated	No
Eltroplectris calcarata	Mosier Hammock	yes, Year 2	Present	No
Eltroplectris calcarata	Osteen Hammock	yes, Year 1	Present	No
Eltroplectris calcarata	Palma Vista Hammock #1	yes, Year 1	Present	yes, Year 1
Eltroplectris calcarata	Palma Vista Hammock #2	yes, Year 1	Present	No
Eltroplectris calcarata	Pay-Fee Hammock	No, follow up needed	Possibly extirpated	No
Eltroplectris calcarata	Pilsbry Hammock	yes, Year 1	Present	No
Eltroplectris calcarata	Rattlesnake Hammock	yes, Year 1	Present	yes, Year 1
Eltroplectris calcarata	Redd Hammock	yes, Year 1	Present	No
Eltroplectris calcarata	Winkley Hammock	yes, Year 1	Present	yes, Year 1
Galeandra beyrichii	Mosier Hammock	yes, Year 2	Present	No
Galeandra beyrichii	Pay-Fee Hammock	yes, Year 2	Present	yes, Year 2
Galeandra beyrichii	Royal Palm Hammock	yes, Year 1	Present	No

Govenia utriculata	Palma Vista Hammock #2	yes, Year 2	Presumed extirpated	No
Helenium flexuosum	Pine Block A	Yes, Year 3	Present	yes, Year 3
Helenium flexuosum	Pine Block B	yes, Year 1	Present	No
Helenium flexuosum	Pine Block C	yes, Year 3	Present	No
Helenium flexuosum	Pine Block D	yes, Year 1	Present	yes, Year 1
Helenium flexuosum	Pine Block E	yes, Year 1	Present	No
Helenium flexuosum	Pine Block F	yes, Year 2	Present	yes, Year 2
Helenium flexuosum	Pine Block G	Yes, Year 3	Present	yes, Year 3
Helenium flexuosum	Pine Block H	yes, Year 1	Present	yes, Year 1
Helenium flexuosum	Pine Block I	Yes, Year 3	Present	yes, Year 3
Helenium flexuosum	Pine Block J	No, follow up needed	?	Potential
Hypelate trifoliata	Deer Hammock	yes, Year 1	Present	No
Hypelate trifoliata	Pine Block A	yes, Year 1	Present	yes, Year 1
Hypelate trifoliata	Pine Block B	yes, Year 1	Present	No
Hypelate trifoliata	Pine Block F	yes, Year 2	Present	yes, Year 2
Hypelate trifoliata	Torre Hammock	yes, Year 1	Present	No
Hypelate trifoliata	Unnamed Hammock west of Baker Hammock	yes, Year 2	Present	yes, Year 2
Lomariopsis kunzeana	Osteen Hammock	yes, Year 1	Present	No
Macradenia lutescens	Deer Hammock	yes, Year 1	Presumed extirpated	No
Macradenia lutescens	Osteen Hammock	yes, Year 1	Presumed extirpated	No
Macradenia lutescens	Royal Palm Hammock	yes, Year 1	Presumed extirpated	No
Macradenia lutescens	Turkey Hammock	yes, Year 1	Presumed extirpated	No
Macradenia lutescens	Winkley Hammock	yes, Year 1	Presumed extirpated	No
Oncidium ensatum	Baker Hammock	yes, Year 1	Present	No
Oncidium ensatum	Bequaert Hammock	yes, Year 2	Present	yes, Year 2
Oncidium ensatum	Brookfield Hammock (Hammock #120)	yes, Year 3	Present	yes, Year 3
Oncidium ensatum	Courrier Hammock	yes, Year 3	Present	yes, Year 3
Oncidium ensatum	Decamp Hammock	yes, Year 3	Present	yes, Year 3
Oncidium ensatum	Deer Hammock	yes, Year 1	Present	No
Oncidium ensatum	Frampton Hammock	yes, Year 1	Present	No
Oncidium ensatum	Gifford Hammock	yes, Year 2	Present	yes, Year 2
Oncidium ensatum	Grimshawe Hammock	yes, Year 1	Present	No
Oncidium ensatum	Henderson Hammock	yes, Year 1	Present	yes, Year 2
Oncidium ensatum	Jones Hammock	yes, Year 3	Present	yes, Year 3
Oncidium ensatum	Junk Hammock	yes, Year 2	Present	yes, Year 2
Oncidium ensatum	Mystery Hammock	yes, Year 1	Present	yes, Year 1
Oncidium ensatum	Osteen Hammock	yes, Year 1	Present	No
Oncidium ensatum	Palma Vista Hammock #1	yes, Year 1	Present	yes, Year 1
Oncidium ensatum	Palma Vista Hammock #2	yes, Year 1	Present	No
Oncidium ensatum	Poppenhager	yes, Year 3	Present	yes, Year 3

	Hammock			
Oncidium ensatum	Rattlesnake Hammock	yes, Year 1	Present	yes, Year 1
Oncidium ensatum	Redd Hammock	yes, Year 1	Present	No
Oncidium ensatum	Robertson Hammock	yes, Year 1	Present	No
Oncidium ensatum	Royal Palm Hammock	yes, Year 1	Present	No
Oncidium ensatum	Say Hammock	yes, Year 2	Presumed extirpated	No
Oncidium ensatum	Simmons Hammock	yes, Year 2	Present	yes, Year 2
Oncidium ensatum	Torre Hammock	yes, Year 1	Present	yes, Year 1
Oncidium ensatum	Turkey Hammock	yes, Year 1	Present	No
Oncidium ensatum	Unnamed Hammock 200m NW of Pineland Trail	yes, Year 1	Present	yes, Year 1
Oncidium ensatum	Unnamed Hammock 550m SW of Pine Glades Lake	yes, Year 1	Present	yes, Year 1
Oncidium ensatum	Unnamed Hammock in Pine Block C	yes, Year 3	Present	yes, Year 3
Oncidium ensatum	Unnamed Hammock in Pine Block D	yes, Year 3	Present	yes, Year 3
Oncidium ensatum	VonPaulsen Hammock	yes, Year 3	Present	yes, Year 3
Oncidium ensatum	Wild Lime Hammock	yes, Year 1	Present	No
Oncidium ensatum	Winkley Hammock	yes, Year 1	Present	No
Oncidium ensatum	Wright Hammock	yes, Year 1	Present	No
Oncidium undulatum	Royal Palm Hammock	yes, Year 1	Presumed extirpated	No
Passiflora sexflora	Osteen Hammock	yes, Year 1	Present	No
Passiflora sexflora	Royal Palm Hammock	yes, Year 1	Presumed extirpated	No
Pecluma plumula	Cadwalader Hammock	yes, Year 1	Present	No
Pecluma plumula	Dewhurst Hammock	yes, Year 1	Present	No
Ponthieva brittoniae	Pine Block A	yes, Year 1	Present	yes, Year 1
Ponthieva brittoniae	Pine Block B	yes, Year 1	Present	yes, Year 1
Ponthieva brittoniae	Pine Block E	yes, Year 1	Present	No
Ponthieva brittoniae	Pine Block F	yes, Year 1	Presumed extirpated	No
Prescotia oligantha	Palma Vista Hammock #2	yes, Year 2	Presumed extirpated	No
Schizaea pennula	Royal Palm Hammock	yes, Year 1	Presumed extirpated	No
Sideroxylon reclinatum subsp. austrofloridense	East of Pine Block J	yes, Year 1	Present	yes, Year 1
Sideroxylon reclinatum subsp. austrofloridense	North of Long Pine Key	yes, Year 1	Present	No
Sideroxylon reclinatum subsp. austrofloridense	Paradise Key	yes, Year 1	Present	No
Sideroxylon reclinatum subsp. austrofloridense	Pine Block A	yes, Year 1	Present	yes, Year 1

Sideroxylon reclinatum subsp. austrofloridense	Pine Block B	yes, Year 3	Present	yes, Year 3
Sideroxylon reclinatum subsp. austrofloridense	Pine Block C	yes, Year 3	Present	yes, Year 3
Sideroxylon reclinatum subsp. austrofloridense	Pine Block D	yes, Year 1	Present	yes, Year 1
Sideroxylon reclinatum subsp. austrofloridense	Pine Block E	yes, Year 1	Present	yes, Year 1
Sideroxylon reclinatum subsp. austrofloridense	Pine Block F	yes, Year 2	Present	yes, Year 2
Sideroxylon reclinatum subsp. austrofloridense	Pine Block G	yes, Year 2	Present	yes, Year 2
Sideroxylon reclinatum subsp. austrofloridense	Pine Block H	yes, Year 1	Present	yes, Year 1
Sideroxylon reclinatum subsp. austrofloridense	Pine Block I	yes, Year 1	Present	yes, Year 1
Sideroxylon reclinatum subsp. austrofloridense	Pine Block J	yes, Year 1	Present	yes, Year 1
Sideroxylon reclinatum subsp. austrofloridense	Prairies and transitional pinelands west of Pine Block D	yes, Year 3	Present	yes, Year 3
Spiranthes costaricensis	Atoll Hammock	No, follow up needed	Possibly extirpated	No
Spiranthes costaricensis	Avery Hammock	No, follow up needed	Possibly extirpated	No
Spiranthes costaricensis	Fairchild Hammock	yes, Year 1	Present	No
Spiranthes costaricensis	Brookfield Hammock (Hammock #120)	No, follow up needed	Possibly extirpated	No
Spiranthes costaricensis	Osteen Hammock	yes, Year 1	Present	No
Spiranthes costaricensis	Palma Vista Hammock #2	yes, Year 1	Present	No
Spiranthes costaricensis	Rattlesnake Hammock	yes, Year 1	Present	yes, Year 1
Spiranthes costaricensis	Royal Palm Hammock	yes, Year 1	Present	No
Spiranthes costaricensis	Winkley Hammock	yes, Year 1	Present	yes, Year 1
Spiranthes torta	Pine Block A	yes, Year 1	Present	No
Sporobolus compositus var.	Pine Block H	yes, Year 2	Present	No

clandestinus				
Thelypteris reticulata	East Boundary Cypress Dome	yes, Year 1	Present	yes, Year 1
Thelypteris reticulata	Hole-in-the-Donut area	yes, Year 1	Present	No
Thelypteris reticulata	Pine Island area	yes, Year 1	Present	No
Thelypteris reticulata	Royal Palm Hammock	yes, Year 1	Present	No
Thelypteris serrata	Pine Island area	yes, Year 1	Present	No
Tillandsia fasciculata var. clavispica	Palma Vista Hammock #2	yes, Year 1	Presumed extirpated	No
Trichomanes punctatum subsp. floridanum	Royal Palm Hammock	yes, Year 1	Presumed extirpated	No

Appendix B. Long-term Monitoring Plots in the Long Pine Key area.

Study Species	Year established	Specific Habitat	Orientation from main park road and general location
Adiantum melanoleucum	Year 1	Rockland hammock solution hole (bowl shaped)	South, Osteen Hammock
Adiantum melanoleucum	Year 2	Rockland hammock solution hole (bowl shaped)	South, Rattlesnake Hammock
Anemia wrightii	Year 1	Rocky prairie along hammock edge	North, Warren Hammock area
Anemia wrightii	Year 3	Rocky prairie along hammock edge	North, Warren Hammock area
Anemia wrightii	Year 1	Rocky prairie along hammock edge	South, Pfleuger Hammock area
Anemia wrightii	Year 1	Rocky prairie along hammock edge	South, Pfleuger Hammock area
Anemia wrightii	Year 3	Rocky prairie along hammock edge	South, Pfleuger Hammock area
Basiphyllaea corallicola	Year 1	Higher elevation pineland	South, Pine Block B
Basiphyllaea corallicola	Year 1	Higher elevation pineland	South, Pine Block E
Basiphyllaea corallicola	Year 1	Higher elevation pineland	South, Pine Block J
Bourreria cassinifolia	Year 2	Higher elevation pineland	South, Pine Block E
Bourreria cassinifolia	Year 2	Higher elevation pineland	South, Pine Block J
Bourreria cassinifolia	Year 2	Higher elevation pineland	South, Pine Block H
Croton lobatus	Year 3	Pineland/hammock ecotone	South, Mosier Hammock edge
Desmodium lineatum	Year 1	Pineland (Redland soil pockets)	South, Pine Block H
Desmodium lineatum	Year 1	Pineland (Redland soil pockets)	South, Pine Block I
Desmodium lineatum	Year 1	Pineland (Redland soil pockets)	South, Pine Block J
Digitaria pauciflora	Year 3	Prairie	North, east of Pine Block D
Digitaria pauciflora	Year 3	Prairie	North, east of Pine Block D
Digitaria pauciflora	Year 3	Prairie	North, northeast of Pine Block D
Digitaria pauciflora	Year 3	Prairie	South, Pine Block G
Digitaria pauciflora	Year 3	Prairie	South, Pine Block G
Digitaria pauciflora	Year 3	Prairie	South, Pine Block H
Eltroplectris calcarata	Year 1	Rockland hammock	South, Grimshawe Hammock
Eltroplectris calcarata	Year 1	Rockland hammock	South, Pilsbry Hammock
Eltroplectris calcarata	Year 1	Rockland hammock	South, Rattlesnake Hammock
Galeandra beyrichii	Year 2	Rockland hammock	South, Mosier Hammock
Helenium flexuosum	Year 2	Pineland (low elevation)	North, Pine Block D
Helenium flexuosum	Year 2	Pineland (low elevation)	North, Pine Block D
Helenium flexuosum	Year 2	Pineland (low elevation)	North, Pine Block D
Helenium flexuosum	Year 2	Pineland (low elevation)	South, Pine Block E
Helenium flexuosum	Year 2	Pineland (low elevation)	South, Pine Block E
Helenium flexuosum	Year 2	Pineland (low elevation)	South, Pine Block F
Hypelate trifoliata	Year 2	Pineland	South, Pine Block A
Hypelate trifoliata	Year 2	Pineland	South, Pine Block B
Hypelate trifoliata	Year 2	Pineland	South, Pine Block A
Hypelate trifoliata	Year 2	Rockland hammock edge	South, Deer Hammock
Hypelate trifoliata	Year 2	Rockland hammock edge	South, Deer Hammock
Hypelate trifoliata	Year 2	Rockland hammock edge	South, Torre Hammock
Lomariopsis kunzeana	Year 1	Rockland hammock solution hole (cylinder shaped)	South, Osteen Hammock
Lomariopsis kunzeana	Year 1	Rockland hammock solution hole (cylinder shaped)	South, Osteen Hammock

Oncidium ensatum	Year 1	Rockland hammock (near edge)	North, Unnamed hammock in Pine Block D
Oncidium ensatum	Year 1	Rockland hammock (near edge)	South, Grimshawe Hammock
Oncidium ensatum	Year 1	Rockland hammock (near edge)	South, Robertson Hammock
Oncidium ensatum	Year 3	Rockland hammock (near edge)	North, Unnamed hammock in Pine Block D
Passiflora sexflora	Year 1	Rockland hammock (edge)	South, Osteen Hammock
Pecluma plumula	Year 1	Rockland hammock	North, Cadwalader Hammock
Pecluma plumula	Year 1	Rockland hammock	North, Cadwalader Hammock
Pecluma plumula	Year 1	Prairie hammock	West, Dewhurst Hammock
Ponthieva brittoniae	Year 1	Pineland sinkhole	South, Pine Block A
Ponthieva brittoniae	Year 1	Pineland sinkhole	South, Pine Block B
Ponthieva brittoniae	Year 1	Pineland sinkhole	South, Pine Block E
Sideroxylon reclinatum subsp. *austrofloridense*	Year 3	Pineland	North, northeast of Pine Block D
Sideroxylon reclinatum subsp. *austrofloridense*	Year 3	Pineland	North, east of Pine Block D
Sideroxylon reclinatum subsp. *austrofloridense*	Year 3	Pineland	North, northwest of Pine Block D
Sideroxylon reclinatum subsp. *austrofloridense*	Year 3	Pineland	South, Pine Block E
Sideroxylon reclinatum subsp. *austrofloridense*	Year 3	Pineland	South, Pine Block G
Sideroxylon reclinatum subsp. *austrofloridense*	Year 3	Pineland	South, Pine Block H
Sideroxylon reclinatum subsp. *austrofloridense*	Year 3	Prairie	North, northeast of Pine Block D
Sideroxylon reclinatum subsp. *austrofloridense*	Year 3	Prairie	North, east of Pine Block D
Sideroxylon reclinatum subsp. *austrofloridense*	Year 3	Prairie	North, northwest of Pine Block D
Sideroxylon reclinatum subsp. *austrofloridense*	Year 3	Prairie	South, Pine Block G
Sideroxylon reclinatum subsp. *austrofloridense*	Year 3	Prairie	South, Pine Block G
Sideroxylon reclinatum subsp. *austrofloridense*	Year 3	Prairie	South, Pine Block H
Spiranthes costaricensis	Year 2	Rockland hammock	South, Palma Vista Hammock #2
Spiranthes torta	Year 3	Pineland	South, Pine Block A
Spiranthes torta	Year 3	Pineland	South, Pine Block A
Thelypteris reticulata	Year 3	Schinus thicket	South, Pine Island area
Thelypteris reticulata	Year 3	Rockland hammock	Hole-in-the-Donut area
Thelypteris reticulata	Year 3	Cypress dome	South, east boundary cypress dome
Thelypteris serrata	Year 3	Schinus thicket	South, Pine Island area

Appendix C. Dominant species in long-term monitoring plots by layer (>25% cover in any plot during any sampling period).

Dominant species by Layer	Hammocks South (12)	Hammocks North (4)	Hammock Solution Holes South (4)	Pinelands South (24)	Pinelands North (6)	Marl Prairies South (6)	Marl Prairies North (6)
Canopy Layer							
Coccoloba diversifolia	1		1				
Exothea paniculata			1				
Ficus aurea			1				
Gymnanthes lucida	1						
Lysiolma latisiliquum	3	2	1				
Ocotea coriacea	4		2				
Pinus elliottii var. densa				7			
Prunus myrtifolia	1						
Quercus virginiana	3						
Sideroxylon foetidissimum			2				
Sideroxylon salicifolium	5	1					
Simarouba glauca	1						
Shrub Layer							
Eugenia axillaris	1						
Gymnanthes lucida	1						
Lysiloma latisiliquum				1			
Myrcianthes fragrans	1	1					
Ocotea coriacea			1				
Psychotria nervosa		2					
Rapanea punctata		1					
Rhus copallina				1			
Schoepfia chrysophylloides	1						
Herb Layer							
Angadenia berteroi				1			
Andropogon ternarius				7			
Cladium jamaicense					1		3
Lysiloma latisiliquum				1			
Muhlenbergia capillaris				3		4	3
Myrica cerifera				1			
Ocotea coriacea	2		1				
Psychotria nervosa		1					
Pteridium aquilinum var. *caudatum*				3			
Schizachyrium gracile				1			
Schizachyrium rhizomatum				1	1	2	2
Schizachyrium sanguineum				4			
Serenoa repens				3			
Sorghastrum secumdum				1			

Solution Hole Layer							
Adiantum tenerum			1				
Anemia adiantifolia				1			
Cladium jamaicense				2	1	1	5
Conoclinium coelestinum						1	
Dichanthelium erectifolium						1	
Digitaria pauciflora							1
Guettarda scabra				1			
Ilex cassine				1			
Melanthera angustifolia						1	
Paspalum monostachyum						1	1
Phyla stoechadifolia						1	
Psidium longipes				1			
Pteris bahamensis				1			
Sabal palmetto				1			
Serenoa repens				1	1		