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

Year End Report, YEAR 2
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 extension of the Miami Rock Ridge, which extends south and west from about the Miami River near present-day downtown Miami. The vegetation of Long Pine Key is dominated by pine rocklands 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 types 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, in fact it is unknown whether or not the proposed restoration and associated hydrological modifications will have a positive or negative impact on these species.

Cover Photo of lobed croton (*Croton lobatus*) taken by IRC biologist Stephen Hodges. *Croton lobatus* was rediscovered in Everglades National Park in 2005, 18 years after the most recent previous observation.

Table 1. Plants covered in Gann et al. (2002) previously recorded for the Long Pine Key area of Everglades National Park

Taxon	South Florida Rank in Gann et al. 2002	Everglades National Park Status in Gann et al. 2002	Long Pine Key Status in Gann et al. 2002
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	Present (last observed in 1987)	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	Present (reported)	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. However, the regional rise in ground water table during the wet season that accompanied surface water flows in the sloughs also raised ground water levels within Long Pine Key, including in solution holes and short-hydroperiod transverse glades (a.k.a. marl prairies). Both solution holes, by retaining water well into, or sometimes through the dry season, and the marl prairies, by conveying water to areas within Long Pine Key, maintained moisture conditions and soil water availability in hammock and pineland habitats sufficient to support the many moisture dependent orchids, ferns, bromeliads and ecologically related species. Ewe et al. (1999), after comparing water use patterns of Long Pine Key species, concluded that regional ground water declines tied to artificial drainage could adversely affect growth of pineland and hardwood tree species, especially during droughts. Although their research concerned trees, 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 the hammocks. Epiphytic species, although meeting water needs principally from the atmosphere, could be killed or stressed by fires that penetrate hammocks and adversely affected by lowered within-hammock relative humidity. Both terrestrial and epiphytic plants could be affected by lower temperatures during freezing events linked to lowered within-hammock humidity.

Historically, water flow through Long Pine Key (Figure 1) was concentrated in the marl prairies that traversed the area in a north-south direction. The 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 impounded to the north of the main park road while water was diverted around the southern part of Long Pine Key through Taylor Slough and Shark River Slough. Research Road is believed to be similarly affecting the water supply of the southern portions of Long Pine Key.

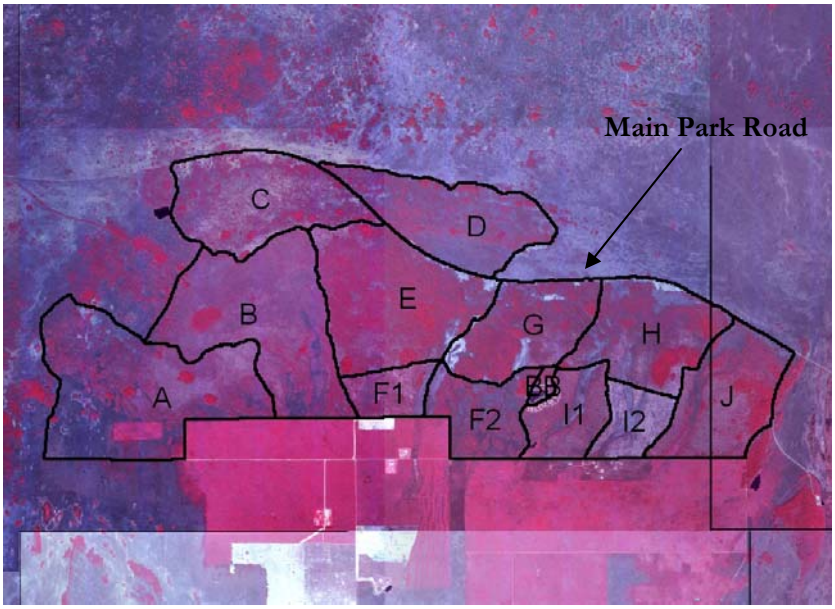


Figure 1. Long Pine Key (Pine Blocks A-J), Everglades National Park.

Presumably, if hydrological restoration is successful, ground water levels will be raised, wet season flows returned to the marl prairies and fire intensities decreased, all to a degree that improves growing conditions for rare plants, including those growing in hammocks and pinelands. However, such a benefit must be verified by conducting field measurements of habitats and populations before declaring success. Implementation of the Comprehensive Everglades Restoration Plan (CERP) also could further impound 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 2 from September 23, 2004 through September 30, 2005.

Project Goals

The project has 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.

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

Activities

Goal 1: Establish long-term monitoring program to evaluate population responses of rare and imperiled species to regional restoration (Task 1: Surveying, mapping, and monitoring of critically imperiled plants & Task 2: Surveying for historical and extirpated plants)

Year 1 Methods and Results. Tasks 1 & 2 in the original scope of work established that surveys will be conducted for the 30 target rare species identified in Gann et al. (2002). Discrete populations are to be mapped and documented. Where appropriate, herbarium vouchers will be collected and deposited at a NPS-approved herbarium. Long-term population monitoring protocols will be developed for key rare species that may be affected by CERP: e.g. *Anemia wrightii; Digitaria pauciflora;* and *Helenium flexuosum* and any species that are rediscovered. One additional species, which was re-ranked as critically imperiled in South Florida following the publication of Gann et al. (2002), was added to the study in 2003: *Hypelate trifoliata.*

Prior to the initiation of this study, there were 43 known locations for 31 target rare plant species in the Long Pine Key area of Everglades National Park, representing 91 rare plant occurrences (Table 2). Thirty-five of these locations were visited during Year 1, resulting in the re-documentation of 52 rare plant occurrences (Appendix A). Eighteen occurrences were determined to be extirpated, leaving 21 occurrences to be surveyed or revisited. Surveys of known and new locations resulted in the discovery of 35 new occurrences of critically imperiled taxa in the Long Pine Key area, representing a 38% increase in the number of known rare plant occurrences in the area (extant and extirpated). All known locations for plants thought to be possibly extirpated in the Long Pine Key region prior to this study were visited. Only one species, *Ponthieva brittoniae*, was rediscovered. At least one GPS coordinate was recorded for each rare plant occurrence and in many cases multiple stations within a location were recorded. Population estimates or counts were made for each 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**.** The following herbarium specimens of target rare plant species were collected for documentation during Year 1: **Sadle 394** *Desmodium lineatum*, **Sadle 396** *Ponthieva brittoniae*, **Sadle 397** *Passiflora sexflora* (Currently deposited at Fairchild Tropical Garden-FTG).

Year 2 Objectives. In the proposal for Year 2, the following general research objectives were identified:

Task 1 – Surveying, mapping, and monitoring of critically imperiled plants. Monitoring of critically imperiled plants will continue and surveys of new locations will be conducted for all critically imperiled species documented for the Long Pine Key area. Discrete populations will be mapped and documented. Number of plants present will be counted or estimated using a $\log_{10}$ scale for each rare plant population. Where appropriate, herbarium vouchers will be collected and deposited at a NPS-approved herbarium.

Task 2 – Surveying for historical and extirpated plants. Surveys in new locations will be conducted for all historical and extirpated plants documented for the Long Pine Key area. In addition, historical localities will be resurveyed for certain ephemeral species. If plants are located, discrete populations will be mapped and documented. Number of plants present will be counted or estimated using a $\log_{10}$ scale for each rare plant population. Where appropriate, herbarium vouchers will be collected and deposited at a NPS-approved herbarium.

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

Year First Surveyed	**Location (species recorded)**
not yet surveyed	Atoll Hammock (*Spiranthes costaricensis*)
not yet surveyed	Avery Hammock (*Spiranthes costaricensis*)
Year 1	Baker Hammock (*Oncidium ensatum*)
not yet surveyed	Bootlegger Hammock (*Bourreria cassinifolia*)
Year 1	Cadwallader Hammock (*Pecluma plumula*)
Year 1	Deer Hammock (*Brassia caudata*, *Hypelate trifoliata*, *Macradenia lutescens*, *Oncidium ensatum*)
Year 1	Dewhurst Hammock (*Pecluma plumula*)
Year 1	East Boundary (*Dalea carthagenensis* var. *floridana*)
Year 1	Fairchild Hammock (*Spiranthes costaricensis*)

Table 2 - Known locations of target rare plant species prior to this research (continued)	
Year First Surveyed	**Location (species recorded)**
Year 1	Frampton Hammock (*Eltroplectris calcarata, Oncidium ensatum*)
Year 1	Grimshawe Hammock (*Oncidium ensatum*)
not yet surveyed	Hammock #120 (*Eltroplectris calcarata*, *Spiranthes costaricensis*)
Year 1	Hole-in-the-Donut Area (Digitaria pauciflora, *Thelypteris reticulata*)
Year 2	Mosier Hammock (*Eltroplectris calcarata, Galeandra beyrichii*)
Year 2	Mosier Hammock Edge (*Croton lobatus*)
Year 1	North of Long Pine Key (*Sideroxylon reclinatum subsp. austrofloridense*)
Year 1	Osteen Hammock (*Adiantum melanoleucum*, *Brassia caudata*, *Eltroplectris calcarata*, *Lomariopsis kunzeana*, *Macradenia lutescens*, *Oncidium ensatum*, *Passiflora sexflora* and *Spiranthes costaricensis*)
Year 1	Palma Vista Hammock #2 (*Bourreria cassinifolia*, *Eltroplectris calcarata*, *Govenia utriculata, Oncidium ensatum, Prescotia oligantha, Spiranthes costaricensis,* and *Tillandsia fasciculata* var. *clavispica*)
Year 1	Paradise Key (*Sideroxylon reclinatum* subsp. *austrofloridense*)
Year 1	Pay-Fee Hammock (*Eltroplectris calcarata*)
Year 1	Pfleuger Hammock (*Anemia wrightii*)
Year 1	Pilsbry Hammock (*Eltroplectgris calcarata*)
Year 1	Pine Block A (*Digitaria pauciflora, Spiranthes torta*)
Year 1	Pine Block B (*Basiphyllaea corallicola*, *Helenium flexuosum*, *Hypelate trifoliata*)
Year 1	Pine Block C (*Digitaria pauciflora, Helenium flexuosum*)
Year 2	Pine Block D (*Digitaria pauciflora*)
Year 1	Pine Block E (*Bourreria cassinifolia*, *Helenium flexuosum*, *Ponthieva brittoniae*)
Year 1	Pine Block F (*Bourreria cassinifolia, Ponthieva brittoniae*)
Year 1	Pine Block H (*Basiphyllaea corallicola*, *Bourreria cassinifolia*, *Desmodium lineatum, Digitaria pauciflora, Sporobolus compositus* var. *clandestinus*)
Year 1	Pine Block I (*Basiphyllaea corallicola*)
Year 1	Pine Block J (*Basiphyllaea corallicola, Desmodium lineatum*)
Year 1	Pine Island area (*Thelypteris reticulata*, *Thelypteris serrata*)
Year 1	Redd Hammock (*Eltroplectris calcarata, Oncidium ensatum*)
Year 1	Roadside and canal bank, 14miles SW of Paradise Key (*Dalea carthagenensis* var. *floridana*)
Year 1	Robertson Hammock (*Oncidium ensatum*)
Year 1	Royal Palm Hammock (*Galeandra beyrichii, Macradenia lutescens, Oncidium ensatum, Oncidium undulatum, Passiflora sexflora, Schizaea pennula, Spiranthes costaricensis, Thelypteris reticulata, and Trichomanes punctatum subsp. floridanum*)
Year 2	Say Hammock (*Oncidium ensatum*)
Year 1	Torre Hammock (*Hypelate trifoliata*)
Year 1	Turkey Hammock (*Brassia caudata, Macradenia lutescens, Oncidium ensatum*)
Year 1	Warren Hammock (*Anemia wrightii*)
Year 1	Wild Lime Hammock (*Oncidium ensatum*)
Year 1	Winkley Hammock (*Brassia caudata, Macradenia lutescens, Oncidium ensatum*)
Year 1	Wright Hammock (*Oncidium ensatum*)

In the Year 1 annual report the following specific research objectives for Year 2 were identified:

Task 1: Surveying, mapping, and monitoring of critically imperiled plants

- Continue surveys and map additional known stations for *Digitaria pauciflora*, *Eltroplectris calcarata*, *Galeandra beyrichii, Helenium flexuosum*, and *Spiranthes costaricensis*.
- Resurvey known station of *Sporobolus compositus* var. *clandestinus*.
- Conduct surveys in additional locations for all species as time allows.

Task 2: Surveying for historical and extirpated plants

- Survey recently burned hammock margins for *Croton lobatus*.
- Conduct further surveys for *Dalea cathagenensis* var. *floridana* along the eastern edge of EVER.
- Resurvey Palma Vista Hammock #2 for *Govenia utriculata* and *Prescotia oligantha*.
- Conduct surveys in additional locations for all species as time allows.

Year 2 Methods & Results: Surveying and Mapping. Additional surveys were conducted, bringing the total number of previously documented locations visited to 39 (Table 2). Fifty-eight previously known rare plant occurrences have now been re-documented (Appendix A). Twenty-one occurrences have been determined to be extirpated, leaving 12 occurrences to be surveyed or revisited. Surveys of known and new locations to date have resulted in the discovery of 49 new occurrences of critically imperiled species in the Long Pine Key area, representing a 54% increase in the number of known rare plant occurrences in the area (Figure 2; extant and extirpated). Several known locations for plants thought to be possibly extirpated in the Long Pine Key region prior to this study were revisited, but no new species were rediscovered in Year 2. All previously documented species ranked as critically imperiled in South Florida and thought to be extant in the Long Pine Key area of Everglades National Park have now been re-documented. At least one GPS coordinate was recorded for each rare plant occurrence and in many cases multiple stations within a location were recorded. Population estimates or counts were made for each newly recorded occurrence and station. Estimates are based on a $\log_{10}$ scale. Counts of individuals were made for all occurrences and stations with fewer than 11 plants and whenever practicable. Total abundance estimates for the Long Pine Key area range (see Appendix B) from 2-10 individuals (*Adiantum melanoleucum, Galeandra beyrichii, Lomariopsis kunzeana, Passiflora sexflora, Spiranthes torta*) to 10,000-100,000 individuals (*Sideroxylon reclinatum* subsp. *austrofloridense*). The following herbarium specimens of target rare plant species were collected for documentation during Year 2: **Hodges 118** *Croton lobatus*.

All surveying and mapping objectives identified under Task 1 & Task 2 for Year 2 were completed or continued, but further follow-up or new survey work is needed for *Basiphyllaea corallicola, Bourreria cassinifolia, Digitaria pauciflora*, *Eltroplectris calcarata*, *Helenium flexuosum*, *Sideroxylon reclinatum* subsp. *austrofloridense* and *Spiranthes costaricensis* (see Appendix A).

Year 2 Methods & Results: Long-term Population Monitoring. In order to help predict which species might be affected by CERP and thus warrant long-term population monitoring, the 31 species of rare plants in this study were placed into groups by typical habitat, life form and

taxonomic group (Table 3). All but five of the species in this study are herbaceous plants, with only four shrubs[1] and one vine represented (Figure 3).

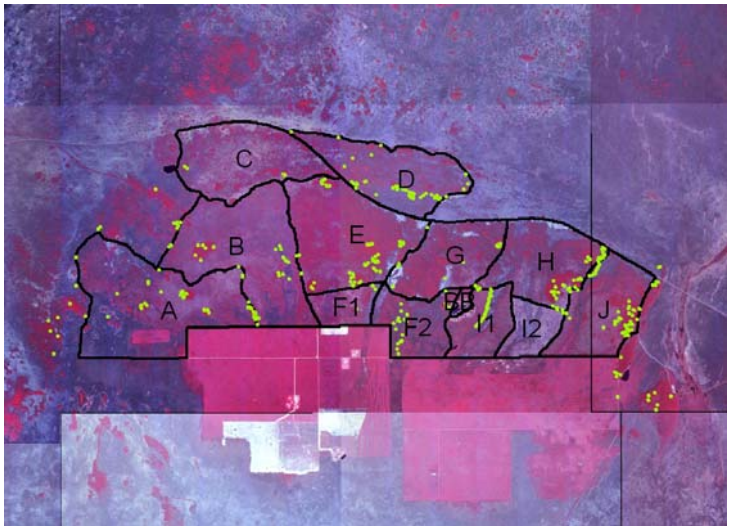
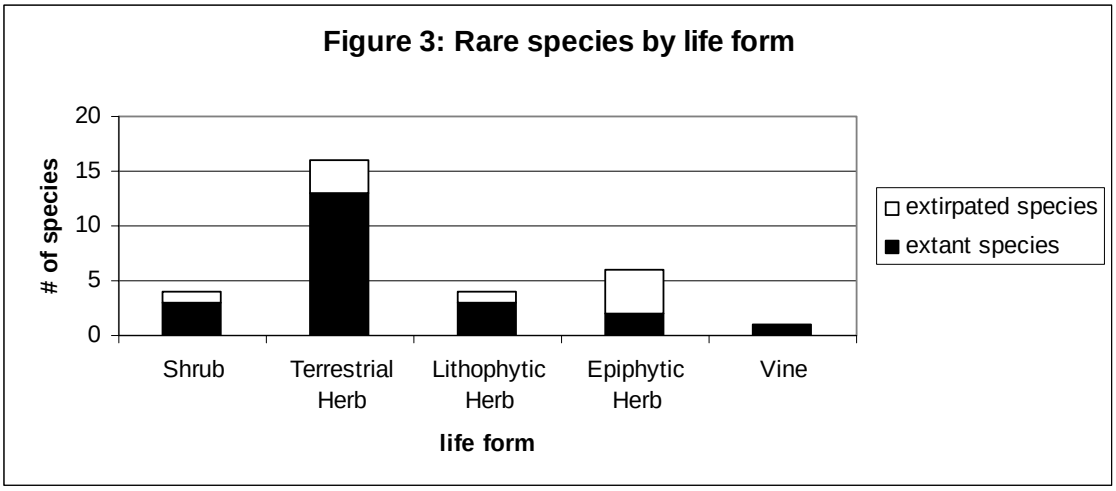


Figure 2. All occurrences as of Year 2 for the Long Pine Key area.
Green circles represent a rare plant station.

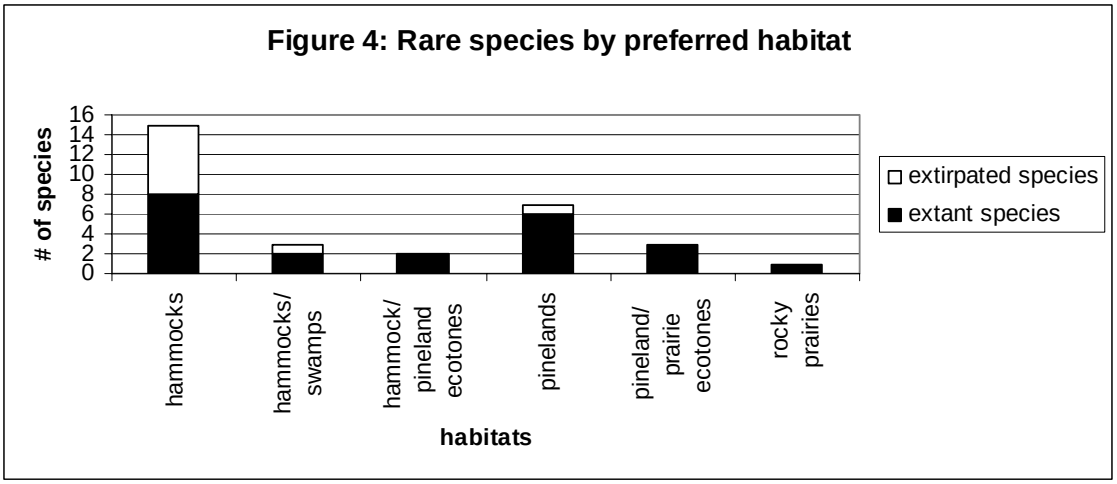


Hammock species represent half of the species in this study and all but two of the species thought to be extirpated on Long Pine Key (Figure 4). One non-hammock extirpated species is *Dalea carthagenensis* var. *floridana*, a species documented only two times in Everglades National Park (Gann et al. 2002) – both of these populations may have been waif populations established on road fill or disturbed soil. The other species, *Schizaea pennula*, is a fern more typically associated with swamps (e.g. Everglades tree islands) and sandy pinelands was reported only once for Royal Palm Hammock in the Long Pine Key area of Everglades National Park (Small 1938).

[1] *Hypelate trifoliata* can become a tree in the interior of hammocks, but is more often a shrub on Long Pine Key.

Table 3. Rare plants by typical habitat, life form and taxonomic group

Taxon	Typical Habitat	Life Form	Taxonomic Group	Long Pine Key Status after Year 2
Adiantum melanoleucum	Hammocks	Lithophytic Herb	Pteridophyte	Present
Anemia wrightii	Hammock/Prairie Ecotone	Lithophyte	Pteridophyte	Present
Basiphyllaea corallicola	Pinelands	Terrestrial Herb	Orchidaceae	Present
Bourreria cassinifolia	Pinelands	Shrub	Dicot	Present
Brassia caudata	Hammocks	Epiphytic Herb	Orchidaceae	Presumed Extirpated
Croton lobatus	Hammock/Pineland Ecotone	Terrestrial Herb	Dicot	Present
Dalea carthagenensis var. *floridana*	Pinelands	Shrub	Dicot	Presumed Extirpated
Desmodium lineatum	Pinelands	Terrestrial Herb	Dicot	Present
Digitaria pauciflora	Pineland/Prairie Ecotone	Terrestrial Herb	Other Monocot	Present
Eltroplectris calcarata	Hammocks	Terrestrial Herb	Orchidaceae	Present
Galeandra beyrichii	Hammocks	Terrestrial Herb	Orchidaceae	Present
Govenia utriculata	Hammocks	Terrestrial Herb	Orchidaceae	Presumed Extirpated
Helenium flexuosum	Pineland/Prairie Ecotone	Terrestrial Herb	Dicot	Present
Hypelate trifoliata	Hammock/Pineland Ecotone	Shrub	Dicot	Present
Lomariopsis kunzeana	Hammocks	Lithophytic Herb	Pteridophyte	Present
Macradenia lutescens	Hammocks	Epiphytic Herb	Orchidaceae	Presumed Extirpated
Oncidium ensatum	Hammocks	Epiphytic Herb	Orchidaceae	Present
Oncidium undulatum	Hammocks	Epiphytic Herb	Orchidaceae	Presumed Extirpated
Passiflora sexflora	Hammocks	Vine	Dicot	Present
Pecluma plumula	Hammocks	Epiphytic Herb	Pteridophyte	Present
Ponthieva brittoniae	Pinelands	Terrestrial Herb	Orchidaceae	Present
Prescotia oligantha	Hammocks	Terrestrial Herb	Orchidaceae	Presumed Extirpated
Schizaea pennula	Hammock/Swamp	Terrestrial Herb	Pteridophyte	Presumed Extirpated
Sideroxylon reclinatum subsp. *austrofloridense*	Pineland/Prairie Ecotone	Shrub	Dicot	Present
Spiranthes costaricensis	Hammocks	Terrestrial Herb	Orchidaceae	Present
Spiranthes torta	Pinelands	Terrestrial Herb	Orchidaceae	Present
Sporobolus compositus var. *clandestinus*	Pinelands	Terrestrial Herb	Other Monocot	Present
Thelypteris reticulata	Hammock/Swamp	Terrestrial Herb	Pteridophyte	Present
Thelypteris serrata	Hammock/Swamp	Terrestrial Herb	Pteridophyte	Present
Tillandsia fasciculata var. *clavispica*	Hammocks	Epiphytic Herb	Other Monocot	Presumed Extirpated
Trichomanes punctatum subsp. *floridanum*	Hammocks	Lithophytic Herb	Pteridophyte	Presumed Extirpated



Hammock species in this study are all herbs with the exception of one vine which is typically herbaceous but sometimes woody (*Passiflora sexflora*)[2]. 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 species 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 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*. Of the extant hammock plants, all are orchids or ferns except for the vine *Passiflora sexflora*. 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. All extant hammock species are considered to be species that may be affected by CERP and therefore are identified for long-term population monitoring.

A second group of nine plants are associated with pinelands and hammock/pineland ecotones. These species represent about one-third of the species in the study and their fate seems to be tied more closely to fire than to collecting or hydrology. Life forms include terrestrial herbs and shrubs and a variety of taxonomic groups are represented. As discussed above, only one species within this group is apparently extirpated – *Dalea carthagenensis* var. *floridana*. The only species to be rediscovered on Long Pine Key, *Ponthieva brittoniae*, also belongs here. Surveys during this study indicate that most of the species in this group are more abundant than previously thought. However *Ponthieva brittoniae*, which grows in association with small sinkholes, and *Spiranthes torta*, which more typically grows in marl prairies outside of Everglades National park, may be

[2] 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 the study.

sensitive to changes in hydrology and are identified as species warranting long-term population monitoring.

The remaining seven species are associated with more typically wetland habitats and all are identified as species warranting long-term population monitoring. Three of these are associated with low elevation pinelands and pineland/marl prairie ecotones that flood each summer: *Digitaria pauciflora*, *Helenium flexuosum*[3] 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 taxonomic 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 was 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 most 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 has 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 know 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.

Recommendations for species that may be affected by CERP and therefore warranting long-term population monitoring are summarized in Table 4. For all species with an estimated population of 10 or fewer individuals, annual counts of all individuals are recommended. For all other species, annual counts of individuals in habitat plots or transects and an abundance estimate in all known locations is recommended. 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. Annual counts of individuals of target rare plant species was initiated in the dry season '05.

[3] *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, which may channel water during rain events.

Table 4. Species identified for long-term population monitoring		
Species	**Habitat**	**Protocol**
Adiantum melanoleucum	Hammocks	1) Annual counts of all individuals
Anemia wrightii	Hammock/Prairie Ecotone	1) Annual count of individuals in habitat plots north and south of main park road
Digitaria pauciflora	Pineland/Prairie Ecotone	1) Annual counts of individuals in habitat transects north and south of main park road; 2) Annual abundance estimates in all known locations
Eltroplectris calcarata	Hammocks	1) Annual counts of individuals in habitat plots; 2) annual abundance estimates in all known locations
Galeandra beyrichii	Hammocks	1) Annual counts of all individuals
Helenium flexuosum	Pineland/Prairie Ecotone	1) Annual counts of individuals in habitat transects north and south of main park road; 2) Annual abundance estimates in all known locations
Lomariopsis kunzeana	Hammocks	1) Annual counts of all individuals
Oncidium ensatum	Hammocks	1) Annual counts of individuals in habitat plots; 2) annual abundance estimates in all known locations
Passiflora sexflora	Hammocks	1) Annual counts of all individuals
Pecluma plumula	Hammocks	1) Annual counts of individuals in habitat plots; 2) annual abundance estimates in all known locations
Ponthieva brittoniae	Pinelands	1) Annual counts of individuals in habitat plots; 2) annual abundance estimates in all known locations
Sideroxylon reclinatum subsp. *austrofloridense*	Pineland/Prairie Ecotone	1) Annual counts of individuals in habitat transects north and south of main park road; 2) Annual abundance estimates in all known locations
Spiranthes costaricensis	Hammocks	1) Annual counts of individuals in habitat plots; 2) annual abundance estimates in all known locations
Spiranthes torta	Pinelands	1) Annual counts of all individuals
Thelypteris reticulata	Hammock/Swamp	1) Annual counts of individuals in habitat plots; 2) annual abundance estimates in all known locations
Thelypteris serrata	Hammock/Swamp	1) Annual counts of individuals in habitat plots; 2) annual abundance estimates in all known locations

Research Objectives for Year 3.

Based on results through the end of Year 2, the following research objectives for Year 3 have been identified for Goal 1:

Task 1 – Surveying, mapping, and monitoring of critically imperiled plants.

- Conduct surveys of four remaining known rare plant locations: Atoll Hammock, Avery Hammock, Bootlegger Hammock and Hammock #120.
- Conduct follow-up surveys for *Bourreria cassinifolia, Digitaria pauciflora*, *Eltroplectris calcarata*, *Galeandra beyrichii* and *Helenium flexuosum*.
- Survey remaining potential locations for *Basiphyllaea corallicola*, *Digitaria pauciflora*, *Helenium flexuosum* and *Sideroxylon reclinatum* subsp. *austrofloridense*.

- Continue new surveys for other species as time allows, especially in Pine Block C, D, G and I.
- Establish baseline abundance estimates for each target species at end of Year 3.
- Conduct long-term population monitoring of species as recommended in Table 4.

Task 2: surveying for historical and extirpated species

- Conduct follow-up and new surveys in additional locations for all species as time allows.

Goal 2) Contribute to the understanding of environmental requirements of rare and imperiled species (Task 3: Establishment of long-term monitoring plots for key rare plant habitats)

Year 1 Methods and Results. Task 3 in the original scope of work established that long-term monitoring plots will be established in key rare plant habitats in the Long Pine Key area: rockland hammocks, rockland hammocks solution holes, pine rocklands, and pine rockland-marl prairie ecotones. Plots for all habitats will be situated both north and south of the main park road. Changes in population status will be 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 will be compared, using appropriate statistical techniques. Additional environmental variables measured will 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 will be inventoried to help define the habitat and to select promising introduction sites.

During Year 1, habitat plots were installed for the following species: *Adiantum melanoleucum*, *Anemia wrightii, Basiphyllaea corallicola, Desmodium lineatum, Eltroplectris calcarata, Lomariopsis kunzeana, Oncidium ensatum, Passiflora sexflora, Pecluma plumula*, and *Ponthieva brittoniae* (Table 5). Where possible, locations for plots were selected in order to represent observed variability in community composition within the habitat of each species. In some cases, target species were so rare that plots were established around the only known extant individuals.

Five meter radius 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 Trimble 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 in each above-ground class (<1%, 1-5%, 6-25%, 26-50%, 51-75%, 76-100%). In the case of solution holes, the total percent coverage of solution holes was estimated for the entire plot. The estimated percent cover of the total area of solution holes for each species was then recorded.

Year 2 Objectives. In the proposal for Year 2, the following general research objectives were identified:

Task 3 – Plots established during Year 1 will be monitored during the wet and dry seasons. Plant community composition will be resurveyed and environmental data will be collected as described in Task 3 of the original scope of work.

In the Year 1 annual report the following specific research objectives for Year 2 were identified:

Task 3: establishment of monitoring plots

- Re-monitor all vegetation plots during wet and dry seasons.
- Conduct initial data analysis to determine if patterns in vegetation correspond to rare plant locations.
- Install additional plots if warranted by initial data analysis.
- Install humidity data loggers to collect solution hole humidity measurements in select plots.

Collect and analyze soil samples to determine soil texture, nutrient status, organic content and water-holding capacity.

Year 2 Methods and Results: Habitat Plots. In Year 2, wet season '04 and dry season '05 monitoring of vegetation in all habitat plots established in Year 1 was completed and wet season '05 monitoring was initiated. A cursory review of plot design and data indicated the need to add additional long-term monitoring plots in Year 2. Additional habitat plots were installed for *Adiantum melanoleucum*, *Bourreria cassinifolia, Galeandra beyrichii, Helenium flexuosum, Hypelate trifoliata,* and *Spiranthes costaricensis* within EVER (Table 5). Additional plots were established in hammocks along the Miami rock ridge outside of EVER to supplement data on six species which are extirpated from the Long Pine Key (LPK) area or known from only one or two locations within LPK: *Adiantum melanoleucum*, *Galeandra beyrichii, Lomariopsis kunzeana, Passiflora sexflora, Spiranthes torta,* and *Trichomanes punctatum* subsp. *floridanum*. One plot was placed in a coastal berm near Flamingo in EVER to provide habitat data for *Oncidium undulatum*, which is extirpated on Long Pine Key and outside of EVER. Control plots on Long Pine Key were 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 habitat 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 target species was known.

Table 5. Habitat plots by species and habitat				
Species	**# of plots**	**Year established**	**Specific Habitat**	**Orientation from main park road**
Adiantum melanoleucum	1	Year 1	Rockland hammock sinkhole	South
Adiantum melanoleucum	1	Year 2	Rockland hammock sinkhole	Outside EVER
Adiantum melanoleucum	1	Year 2	Rockland hammock sinkhole	South
Anemia wrightii	1	Year 1	Rocky prairie	North
Anemia wrightii	2	Year 1	Rocky prairie	South
Basiphyllaea corallicola	3	Year 1	Pineland	South
Bourreria cassinifolia	3	Year 2	Pineland	South
Desmodium lineatum	3	Year 1	Pineland (Redland soil pockets)	South
Eltroplectris calcarata	3	Year 1	Rockland hammock	South
Galeandra beyrichii	1	Year 2	Rockland hammock	Outside EVER
Galeandra beyrichii	1	Year 2	Rockland hammock	South
Helenium flexuosum	3	Year 2	Pineland (low elevation)	North
Helenium flexuosum	3	Year 2	Pineland (near prairie ecotone)	South
Hypelate trifoliata	3	Year 2	Pineland	South
Hypelate trifoliata	3	Year 2	Rocklannd hammock edge	South
Lomariopsis kunzeana	2	Year 1	Rockland hammock sinkhole	South
Lomariopsis kunzeana	1	Year 2	Rockland hammock sinkhole	Outside EVER
Oncidium ensatum	2	Year 1	Rockland hammock (near edge)	South
Oncidium ensatum	2	Year 1 (1), Year 2 (1)	Rockland hammock (near edge)	North
Oncidium undulatum	1	Year 2	Coastal berm	Cape Sable area
Passiflora sexflora	1	Year 1	Rockland hammock (gap)	South
Passiflora sexflora	2	Year 2	Rockland hammock (gap)	Outside EVER
Pecluma plumula	1	Year 1	Prairie hammock	West of main park road near Mahogany Hammoc
Pecluma plumula	2	Year 1	Rockland hammock	North
Ponthieva brittoniae	3	Year 1	Pineland	South
Spiranthes costaricensis	1	Year 2	Rockland hammock	South
Spiranthes torta	1	Year 2	Marl prairie	Outside EVER
Trichomanes punctatum subsp. *floridanum.*	1	Year 2	Rockland hammock sinkhole	Outside EVER

Methods used were the same as for habitat plots installed in Year 1. In addition, dbh (diameter at breast height) measurements of 10 trees randomly selected trees in each plot were initiated in the wet season '05. Additional habitat plots are planned in Year 3 for *Anemia wrightii* (2 north of main park road, 1 south of main park road), *Croton lobatus* (1 inside EVER), *Galeandra beyrichii* (1 outside of EVER), *Oncidium undulatum* (2 in Cape Sable area), *Spiranthes costaricensis* (2 inside EVER), *Spiranthes torta* (1 inside EVER, 1 outside EVER), *Sporobolus compositus* var. *clandestinus* (1 inside EVER), *Trichomanes punctatum* subsp. *floridanum* (2 outside EVER), *Thelypteris reticulata* (3 inside EVER) and *Thelypteris serrata* (1 inside EVER).

Habitat plots can be divided into two types: 1) plots that can be used to track long-term trends in rare plant populations and habitats on Long Pine Key, including effects from CERP, and 2) plots that are useful for habitat characterization of rare species. Habitat plots outside of Long Pine Key, plots in highly disturbed areas, and control plots are used to characterize habitats of target species and help select augmentation and reintroductions sites. Habitat plots in key rare plant habitats to be used for long-term monitoring of rare plant populations and habitats are summarized in Table 6.

Table 6. Long-term monitoring plots on Long Pine Key

Habitat	# plots	Orientation to main park road	Study species
Hammock	10	South	*Eltroplectris calcarata, Galeandra beyrichii, Spiranthes costaricensis*
Hammock	2	North	*Pecluma plumula*
Hammock solution hole	4	South	*Adiantum melanoleucum, Lomariopsis kunzeana*
Hammock (near edge)	2	South	*Oncidium ensatum*
Hammock (near edge)	2	North	*Oncidium ensatum*
Hammock (edge)	3	South	*Hypelate trifoliata*
Hammock (gaps)	1	South	*Passiflora sexflora*
Pineland	12	South	*Basiphyllaea corallicola, Bourreria cassinifolia, Ponthieva brittoniae, Hypelate trifoliata.*
Pineland (Redland soil pockets)	3	South	*Desmodium lineatum*
Pineland (near prairie ecotone)	3	South	*Helenium flexuosum*
Pineland (low elevation)	3	North	*Helenium flexuosum*
Hammock/prairie ecotone	2	South	*Anemia wrightii*
Hammock/prairie ecotone	1	North	*Anemia wrightii*

Even given that the Long Pine Key area north of main park road is small in comparison to the area to the south, relatively few target rare plant species have been found: *Anemia wrightii*, *Digitaria pauciflora*, *Oncidium ensatum*, *Helenium flexuosum*, *Pecluma plumula* and *Sideroxylon reclinatum* subsp. *austrofloridense*. *Pecluma plumula* is not found south of main park road, while all of the other species have populations both north and south of main park road. Only *D. pauciflora* and *S. reclinatum* subsp. *austrofloridense* are abundant both north and south of main park road. Because of

the relationship of these latter two species to an apparent elevational gradient along the pineland/marl prairie ecotone, a different monitoring method has been developed for these species as described in Year 2 Methods and Results: Habitat Transects below. No higher elevation target pineland species or hammock solution hole species have been found north of main park road. The hammock species *Oncidium 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 *Oncidium ensatum* have been installed in the north, paired with two plots south of main park road. *Helenium 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. *Anemia 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.

Some additional habitat plots are planned to complete the minimum needed for the long-term monitoring of rare plant habitats in the Long Pine Key area of EVER: *Anemia wrightii* (2 north of main park road, 1 south of main park road), *Croton lobatus* (1 inside EVER), *Spiranthes costaricensis* (2 inside EVER), *Spiranthes torta* (1 inside EVER). Preliminary associations of dominant vegetation to habitat types are summarized in tables 7 and 8.

Year 2 Methods and Results: Habitat 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 *Sideoxylon reclination* subsp. *austrofloridense*. Both of these species grow along an elevational gradient that extends from within the marl prairie community up and into the pineland. In Year 2, the installation of belt transects for these two species was initiated. Six 50 m transects for each species 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. Data was collected in the dry season of '05 and initiated for the wet season of '05.

Each transect was divided into fifty 1x1 m quadrats. For *D. pauciflora* and *S. reclinatum* subsp. *austrofloridense*, an estimate of percent cover was made for each quadrat. The number of plants of each target species rooted in the plot and the number of plants of each target species rooted outside of the plot was also made. Dominant species (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.

During dry season '05, a total of 32 dominant species were found along the *D. pauciflora* transects and 28 dominant species along the *S. 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. Preliminary analyses based on dry-season '05 data indicate a relationship between each target species and the dominant species with which they are associated. *D. pauciflora* appears to be positively correlated with *Muhlenbergia capillaris*, *Myrica cerifera*, *Schizachyrium rhizomatum* and *S. reclinatum* subsp. *austrofloridense* and negatively correlated with *Cladium jamaicense*. *Sideroxylon reclinatum* subsp. *austrofloridense* appears to be positively correlated with *Byrsonima lucida*, *Muhlenbergia capillaris*, *Myrica cerifera*, *Sabal palmetto*, and *Serenoa repens* and negatively correlated with *Cladium jamaicense*, *Guettarda scabra*, *Persea palustris*, *Schizachyrium rhizomatum* and *Sideroxylon salicifolium*.

Abundance of both *D. pauciflora* and *S. reclinatum* subsp. *austrofloridense* was found to be clustered toward the middle of each transect as previously hypothesized. Preliminary data showed a significant relationship between *D. pauciflora* and location along the transect, but such a correlation for *S. reclinatum* subsp. *austrofloridense* was not found. *D. pauciflora* was found between m 0 and m 48 and *S. reclinatum* subsp. *austrofloridense* was found between m 0 and m 49. Based on

Table 7. Dominant plants of rare plant habitat plots in the Long Pine Key area of EVER (through dry season '05)

Habitat	# plots	Orientation to main park road	Associated dominant species (more than 25% of any layer in any plot)
Hammock	10	South	Canopy: *Gymnanthes lucida, Lysiloma latisiliquum, Ocotea coriacea, Quercus virginiana, Sideroxylon foetidissimum, Sideroxylon salicifolium.* Shrub: *Eugenia axillaris, Gymnanthes lucida.* Herb: *Ocotea coriacea.*
Hammock	2	North	Canopy: *Coccoloba diversifolia, Lysiolma latisiliquum, Quercus virginiana, Sideroxyon salicifolium, Simarouba glauca.* Shrub: *Psychotria nervosa.* Herb: *Psychotria nervosa.*
Hammock solution hole	4	South	Canopy: *Coccoloba diversifolia, Exothea paniculata, Ficus aurea, Ocotea coriacea, Lysiloma latisiliquum, Sideroxylon foetidissimum.* Shrub: *Ocotea coriacea.* Herb: *Ocotea coriacea.* Solution Hole: *Adiantum tenerum.*
Hammock (near edge)	2	South	Canopy: *Quercus virginian*a, Sideroxylon salicifolium.
Hammock (near edge)	2	North	Canopy: *Ocotea coriacea, Quercus virginiana, Sideroxyon salicifolium.* Shrub: *Ocotea coriacea, Rapanea punctata.*
Hammock (edge)	3	South	Canopy: *Lysiloma latisiliquum, Quercus virginiana.*
Hammock (gaps)	1	South	Canopy: *Coccoloba diversifolia, Prunus myrtifolia, Simarouba glauca.*
Pineland	9	South	Canopy: *Pinus elliottii* var. *densa.* Herb. *Angadenia berteroi, Andropogon ternarius, Pteridium aquilinum* var. *caudatum, Schizachyrium rhizomatum, Sorghastrum secundum.* Solution Hole: *Anemia adiantifolia, Cladium jamaicense, Guettarda scabra, Ilex cassine, Psidium longipes.*
Pineland (near or in solution holes)	3	South	Canopy: *Pinus elliottii* var. *densa.* Herb: *Andropogon ternarius, Lysiloma latisiliquum, Myrica cerifera, Schizachyrium gracile.* Solution Hole: *Cladium jamaicense, Pteris bahamensis, Sabal palmetto.*
Pineland (Redland soil pockets)	3	South	Herb: *Andropogon ternarius, Schizachyrium sanguineum.*
Pineland/prairie ecotone	3	South	Herb: *Muhlenbergia capillaris, Schizachyrium rhizomatum.* Solution Hole: *Serenoa repens.*
Pineland/prairie ecotone	3	North	Herb: *Muhlenbergia capillaris, Schizachyrium sanguineum.* Solution: *Proserpinaca palustris.*
Hammock/prairie ecotone	2	South	Shrub: M*yrica cerifera.*
Hammock/prairie ecotone	1	North	Canopy: *Sideroxylon salicifolium.* Shrub: *Chrysobalanus icaco, Metopium toxiferum, Myrica cerifer*a. Herb*: Cladium jamaicense.* Solution Hole: *Cladium jamaicense.*

Table 8. Associated dominant species (more than 25% of any layer in any habitat plot) by major habitat type								
	Hammocks (south)	Hammocks (north)	Hammock solution holes (south)	Hammock/ prairie ecotone (south)	Hammock/ prairie ecotone (north)	Pineland (south)	Pineland /prairie ecotone (south)	Pineland /prairie ecotone (north)
Canopy Layer								
Coccoloba diversifolia	x	x	x					
Exothea paniculata			x					
Ficus aurea			x					
Gymnanthes lucida	x							
Lysiolma latisiliquum	x	x	x					
Ocotea coriacea	x	x	x					
Pinus elliottii var. *densa*						x		
Prunus myrtifolia	x							
Quercus virginiana	x	x						
Sideroxylon foetidissimum	x		x					
Sideroxylon salicifolium	x	x			x			
Simarouba glauca	x	x						
Shrub Layer								
Chrysobalanus icaco					x			
Eugenia axillaris	x							
Gymnanthes lucida	x							
Metopium toxiferum					x			
Myrica cerifera				x	x			
Ocotea coriacea		x	x					
Psychotria nervosa		x						
Rapanea punctata		x						
Herb Layer								
Angadenia berteroi						x		
Andropogon ternarius						x		
Cladium jamaicense					x			
Lysiloma latisiliquum						x		
Muhlenbergia capillaris							x	x
Myrica cerifera						x		
Ocotea coriacea	x							
Psychotria nervosa		x						
Pteridium aquilinum var. *caudatum*						x		
Schizachyrium gracile						x		
Schizachyrium rhizomatum						x	x	
Schizachyrium sanguineum						x		x
Sorghastrum secundum						x		
Solution Hole Layer								
Adiantum tenerum			x					
Anemia adiantifolia						x		

Table 8. Associated dominant species (more than 25% of any layer in any habitat plot) by major habitat type (continued)								
	Hammocks (south)	**Hammocks (north)**	**Hammock solution holes (south)**	**Hammock/ prairie ecotone (south)**	**Hammock/ prairie ecotone (north)**	**Pineland (south)**	**Pineland /prairie ecotone (south)**	**Pineland /prairie ecotone (north)**
Cladium jamaicense						**x**		
Guettarda scabra						**x**		
Ilex cassine						**x**		
Proserpinaca palustris								**x**
Psidium longipes						**x**		
Pteris bahamensis						**x**		
Sabal palmetto						**x**		
Serenoa repens							**x**	

these preliminary results it has been determined that the transects are too short and they will be lengthened by 25 m on each end in Year 3.

Year 2 Methods and Results: Environmental Data and Data Management. Water level data collection was initiated in the dry season of '05 in both habitat plots and transects. In the wet season of '05, relative humidity, with a thermo-hygrometer pen and substrate type were recorded and canopy cover measurements using hemispherical photos were initiated in habitat plots. In addition, dataloggers (ibuttons) were installed at 6 locations in Osteen Hammock: one *Adiantum melanoleucum* plot, two *Lomariopsis kunzeana* plots, and three control plots. In habitat plots, ibuttons were attached to a PVC pole and placed at the height of the species of concern. In control plots, ibuttons were attached to an adjacent tree with zip ties. Data on relative humidity and temperature will be logged every hour. Additional dataloggers are planned to be placed in solution holes in *Ponthieva brittoniae* plots in Year 3.

A meeting was held to discuss soil collection, methodology, and analysis with Yuncong Li at The Institute of Food and Agricultural Sciences, University of Florida. During the meeting, each habitat and substrate type was discussed and initial recommendations were made.

All data collected through the end of the dry season '05 have been entered into an Access database and provided to EVER as part of this report.

Research Objectives for Year 3.

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

Task 3: establishment of monitoring plots

- Complete re-monitoring of all habitat plots during the wet season '05 and the dry season and wet seasons of '06. Reassess frequency and type of vegetation data collected in habitat plots.

- Add additional habitat plots for *Anemia wrightii* (2 north of main park road, 1 south of main park road), *Croton lobatus* (1 inside EVER), *Galeandra beyrichii* (1 outside of EVER), *Oncidium undulatum* (2 in Cape Sable area), *Spiranthes costaricensis* (2 inside EVER), *Spiranthes torta* (1 inside EVER, 1 outside EVER), *Sporobolus compositus* var. *clandestinus* (1 inside EVER), *Trichomanes punctatum* (2 outside EVER), *Thelypteris reticulata* (3 inside EVER) and *Thelypteris serrata* (1 inside EVER).
- Complete re-monitoring of all habitat transects during the wet season '05 and the dry season and wet season of '06. 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 vegetation 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 in wet season '05 and wet season of '06.

Goal 3) Restore and enhance species diversity of uplands and the Everglades region by reintroduction of plants of extirpated or depleted native species considered as rare or imperiled as a result of direct or indirect actions by man. (Task 4: Augmentation of critically imperiled plants & Task 5: Reintroduction of extirpated plants)

Year 1 Methods and Results. Goal 3 in the original scope of work established that the appropriateness and feasibility of augmenting populations of species in imminent danger of being extirpated from Everglades National Park will be investigated, including the feasibility of augmenting populations of these species in the Long Pine Key area. Opportunities for the reintroduction of plants that have been extirpated from the Long Pine Key area will also investigated. These will include 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 (*Trichomanes punctatum* subsp. *floridanum).* If appropriate and feasible, augmentation and reintroduction trials will be initiated, using measures of plant community habitat and environmental variables to help identify favorable reintroduction sites. NPS compliance review will be obtained as required.

During Year 1, two meetings were held to assess the augmentation and reintroduction needs and to develop management recommendations for all species being studied. During the first meeting with Fairchild Tropical Botanical Garden (FTBG) collaborator Joyce Maschinsky, each study species was discussed and initial recommendations were made. Recommendations developed during the first meeting were re-evaluated in a second meeting with collaborators from Marie Selby Botanical Gardens (MSBG). In addition, IRC and MSBG staff and EVER botanist Craig Smith visited potential augmentation/reintroduction sites and discussed practical issues that may be encountered when initiating augmentations and reintroductions..

Year 2 Objectives. In the proposal for Year 2, the following general research objectives were identified:

Task 4 – Following review by NPS, augmentation trials will begin for species identified as potentially warranting augmentation in Year 1.

Task 5 – A list of extirpated species and sites suitable for reintroduction will be developed by IRC and its collaborators.

In the Year 1 annual report the following specific research objectives for Year 2 were identified:

Task 4: assess augmentation needs

- Collect seeds/spores from EVER and/or other South Florida populations of select species for experimental cultivation at MSBG. This stock will later be used for augmentation in EVER, pending compliance review, or at other sites to develop experimental protocols.
- Finalize list of specific augmentation sites.
- Initiate augmentation trials, pending NPS compliance review.

Task 5: reintroduction of extirpated plants

- Locate suitable germplasm of extirpated species for reintroduction to the Long Pine Key region of EVER.
- Finalize list of potential reintroductions candidates and locations.
- If appropriate and feasible, initiate reintroduction trials, pending NPS compliance review.

Year 2 Methods and Results. During Year 2, several meetings and discussion were held with collaborators from MSBG and FTBG to re-evaluate initial recommendations, discuss methodology, and to coordinate seed/spore collection. The collaboration with FTBG was broadened to include Miami-Dade County's Natural Areas Management group (NAM) to allow for research and germ plasm collection by IRC and FTBG in hammocks in Miami-Dade County outside of EVER. A summary of revised recommendations is covered in Table 9. 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 also 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.

Table 9. Augmentation and Reintroduction Recommendations			
Taxon	**Recommendation**	**Reason**	**Trial Site**
Adiantum melanoleucum	Augment	In imminent danger of extirpation	Hattie Bauer Hammock/Royal Palm Hammock
*Galeandra beyrichii***	Augment	In imminent danger of extirpation	Hattie Bauer Hammock/Royal Palm Hammock
Lomariopsis kunzeana	Augment	In imminant danger of exirpation	Hattie Bauer Hammock/Royal Palm Hammock
Oncidium ensatum	Augment	Population depleted	Hattie Bauer Hammock/Royal Palm Hammock
Passiflora sexflora	Augment	In imminant danger of exirpation	Hattie Bauer Hammock/Royal Palm Hammock
*Pecluma plumula***	Augment	In imminant danger of exirpation	Undecided
Thelypteris reticulata	Augment	In imminant danger of exirpation	Royal Palm Hammock
Thelypteris serrata	Augment	In imminant danger of exirpation	Royal Palm Hammock
Brassia caudata	Reintroduce	Exirpation documented	Royal Palm Hammock
Macradenia lutescens	Reintroduce	Exirpation documented	Royal Palm Hammock
Oncidium undulatum	Reintroduce	Exirpation documented	Royal Palm Hammock
Trichomanes punctatum subsp. *floridanum*	Reintroduce	Exirpation documented	Hattie Bauer Hammock/Royal Palm Hammock
Govenia utriculata	Not Decided	Taxonomic difficulty	
Helenium flexuosum	Not Decided	Habitat in EVER not well understood, but augmentation trials could increase understanding	
Spiranthes torta	Not Decided	Habitat in EVER not well understood	
Sporobolus compositus var. *clandestinus*	Not Decided	Habitat in EVER not well understood	
*Anemia wrightii***	No Action	Population apparently not depleted	
Basiphyllaea corallicola	No Action	Population apparently not depleted	
Bourreria cassinifolia	No Action	Population apparently not depleted	
*Croton lobatus***	No Action	Population apparently not depleted	
Dalea carthagenensis var. floridana	No Action	Perhaps never established in EVER	

Table 9. Augmentation and Reintroduction Recommendations (continued)			
Taxon	**Recommendation**	**Reason**	**Trial Site**
Desmodium lineatum	No Action	Population apparently not depleted	
Digitaria pauciflora	No Action	Abundant	
Eltroplectris calcarata	No Action	Population apparently not depleted	
Hypelate trifoliata	No Action	Population apparently not depleted	
Ponthieva brittoniae	No Action	Population apparently not depleted	
Prescotia oligantha **	No Action	Perhaps introduced in EVER	
Tillandsia fasciculata var. *clavispica*	No Action	Perhaps never well established in EVER	
Schizaea pennula	No Action	Presence reported, never documented	
Sideroxylon reclinatum subsp. *austrofloridense*	No Action	Abundant	
Spiranthes costaricensis	No Action	Population apparently not depleted	
*** denotes updated status*			

Fertile material of *Adiantum melanoleucum, Lomariopsis kunzeana, Passiflora sexflora,* 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.

Cultivation of material by FTBG and MSBG for trial augmentation has begun. All species above have been successfully propagated except for *Oncidium ensatum,* which was only recently collected. In addition, populations of *Oncidium undulatum* in EVER were visited but no fertile material was found. *Passiflora sexflora* from Miami-Dade County is already under cultivation at FTBG.

Possible sources for *Brassia caudata* and *Macradenia lutescens* are being investigated by MSBG staff.

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

Task 4: assess augmentation needs

- Continue collecting germ plasm and cultivating plants recommended for augmentation in Table 9.
- Proceed with augmentation trials in Hattie Bauer Hammock outside EVER.
- Proceed with augmentation trials in Royal Palm Hammock pending NPS compliance review.

Task 5: reintroduction of extirpated plants

- Continue collecting germ plasm and cultivating plants recommended for reintroduction in Table 9, including ***Oncidium undulatum, Brassia caudata,*** and ***Macradenia lutescens***.
- Proceed with reintroduction trials in Hattie Bauer Hammock outside EVER.
- Proceed with reintroduction trials in Royal Palm Hammock pending NPS compliance review.

PUBLICATION HISTORY

Two articles on the rediscovery of *Ponthieva brittoniae* were published during Year 2. Three reprints/copies are included.

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 two has been conducted by Jimi L. Sadle, Emilie Verdon, Steven W. Woodmansee, Stephen Hodges, Eric Fleites, Josh Mahoney, and Steven Green. Augmentation needs are being developed in collaboration with Joyce Maschinski (FTBG), Jennifer Possley (FTBG), Joe Maguire (NAM), Bruce Holst (MSBG), Harry Luther (MSBG) and John Beckner (formerly with MSBG). Tom Philippi (Florida International University) has provided useful advice 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 2 are included with this report in an Access database entitled IRC_LPK_RarePlantResults_Year2. Vegetation plot, control plot, and belt transect data and locations are included as tables in the same Access database. Collection data for propagated plants is provided as an excel spreadsheet. Copies of the original field datasheets are also provided.

HERBARIUM SPECIMENS COLLECTED

The following herbarium specimens were collected for identification or documentation during the first year of this project: **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 phaseoloides*.

The following herbarium specimens were collected for identification or documentation during the second year of this project: **Hodges 118** *Croton lobatus*.

All specimens were deposited at Fairchild Tropical Botanical Garden.

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.

Ewe, S., L. da Silvera Lobo Steinburg, and D. Busch. 1999. Water use patterns in pineland and hammock communities of South Florida. Forest Ecology and Management 118:139-148.

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.

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

Appendix A. Status of rare plant surveys

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, newly proposed	?	potential
Basiphyllaea corallicola	Pine Block D	No, newly proposed	?	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, newly proposed	?	potential
Basiphyllaea corallicola	Pine Block H	No, follow up needed	?	No
Basiphyllaea corallicola	Pine Block I	No, follow up needed	?	No
Basiphyllaea corallicola	Pine Block J	yes, Year 1	Present	No
Bourreria cassinifolia	Bootlegger Hammock	No, surveys needed	?	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	?	No
Bourreria cassinifolia	Pine Block H	yes, Year 1	Present	No
Bourreria cassinifolia	Pine Block J	yes, Year 2	Present	yes, Year 2
Brassia caudata	Deer Hammock	yes, Year 1	Presumed extirpated	No
Brassia caudata	Osteen Hammock	yes, Year 1	Presumed extirpated	No
Brassia caudata	Turkey Hammock	yes, Year 1	Presumed extirpated	No
Brassia caudata	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	No, follow up needed	?	No

Appendix A. Status of rare plant surveys (continued)

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, newly proposed	?	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
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	Hammock #120	No, surveys needed	?	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	?	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	No, newly proposed	?	potential
Helenium flexuosum	Pine Block B	yes, Year 1	Present	No
Helenium flexuosum	Pine Block C	No, follow up needed	?	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	No, newly proposed	?	potential
Helenium flexuosum	Pine Block H	yes, Year 1	Present	yes, Year 1
Helenium flexuosum	Pine Block I	No, newly proposed	?	potential
Helenium flexuosum	Pine Block J	No, newly proposed	?	potential

Appendix A. Status of rare plant surveys (continued)

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	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	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	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	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

Appendix A. Status of rare plant surveys (continued)

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	No, newly proposed	?	potential
Sideroxylon reclinatum subsp. *austrofloridense*	Pine Block C	No, newly proposed	?	potential
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
Spiranthes costaricensis	Atoll Hammock	No, surveys needed	?	No
Spiranthes costaricensis	Avery Hammock	No, surveys needed	?	No
Spiranthes costaricensis	Fairchild Hammock	yes, Year 1	Present	No
Spiranthes costaricensis	Hammock #120	No, surveys needed	?	No
Spiranthes costaricensis	Osteen Hammock	yes, Year 1	Present	No

Appendix A. Status of rare plant surveys (continued)

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. *clandestinus*	Pine Block H	yes, Year 2	Present	No
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 C. Population estimates at end of Year 2

Species	Location	Estimated Abundance
Adiantum melanoleucum	Rattlesnake Hammock	1
Adiantum melanoleucum	Osteen Hammock	2-10
	total estimate	**2-10**
Anemia wrightii	Warren Hammock	11-100
Anemia wrightii	Pfleuger Hammock	11-100
	total estimate	**11-100**
Basiphyllaea corallicola	Pine Block J	2-10
Basiphyllaea corallicola	Pine Block A	2-10
Basiphyllaea corallicola	Pine Block B	2-10
Basiphyllaea corallicola	Pine Block E	2-10
Basiphyllaea corallicola	Pine Block F	2-10
	total estimate	**11-100**
Bourreria cassinifolia	Pine Block J	11-100
Bourreria cassinifolia	Palma Vista Hammock #2	2-10
Bourreria cassinifolia	Pine Block E	11-100
Bourreria cassinifolia	Pine Block H	2-10
	total estimate	**11-100**
Croton lobatus	Mosier Hammock Edge	100-1,000
	total estimate	**100-1,000**
Desmodium lineatum	Pine Block J	100-1,000
Desmodium lineatum	Pine Block H	11-100
Desmodium lineatum	Pine Block I	2-10
	total estimate	**100-1,000**
Digitaria pauciflora	Pinelands west of Pine Block B	11-100
Digitaria pauciflora	Pine Block A	100-1,000
Digitaria pauciflora	Pine Block B	100-1,000
Digitaria pauciflora	Pine Block C	11-100
Digitaria pauciflora	Pine Block D	100-1,000
Digitaria pauciflora	Pine Block E	100-1,000
Digitaria pauciflora	Pine Block F	100-1,000
Digitaria pauciflora	Pine Block G	100-1,000
Digitaria pauciflora	Pine Block H	100-1,000
Digitaria pauciflora	Pine Block I	11-100
Digitaria pauciflora	Pinelands west of Pine Block A	11-100
	total estimate	**1,000-10,000**
Eltroplectris calcarata	Winkley Hammock	11-100
Eltroplectris calcarata	Fairchild Hammock	2-10
Eltroplectris calcarata	Frampton Hammock	2-10

Appendix C. Population Estimates at end of Year 2(continued)

Eltroplectris calcarata	Grimshawe Hammock	2-10
Eltroplectris calcarata	Mosier Hammock	2-10
Eltroplectris calcarata	Osteen Hammock	11-100
Eltroplectris calcarata	Palma Vista Hammock #1	11-100
Eltroplectris calcarata	Palma Vista Hammock #2	11-100
Eltroplectris calcarata	Pilsbry Hammock	11-100
Eltroplectris calcarata	Rattlesnake Hammock	11-100
Eltroplectris calcarata	Redd Hammock	100-1,000
	total estimate	**100-1,000**
Galeandra beyrichii	Royal Palm Hammock	1
Galeandra beyrichii	Mosier Hammock	1
Galeandra beyrichii	Pay-Fee Hammock	1
	total estimate	**2-10**
Helenium flexuosum	Pine Block H	100-1,000
Helenium flexuosum	Pine Block B	100-1,000
Helenium flexuosum	Pine Block D	100-1,000
Helenium flexuosum	Pine Block E	100-1,000
Helenium flexuosum	Pine Block F	11-100
	total estimate	**100-1,000**
Hypelate trifoliata	Unnamed Hammock west of Baker Hammock	2-10
Hypelate trifoliata	Deer Hammock	11-100
Hypelate trifoliata	Pine Block A	2-10
Hypelate trifoliata	Pine Block B	2-10
Hypelate trifoliata	Pine Block F	2-10
Hypelate trifoliata	Torre Hammock	2-10
	total estimate	**11-100**
Lomariopsis kunzeana	Osteen Hammock	2-10
	total estimate	**2-10**
Oncidium ensatum	Wright Hammock	2-10
Oncidium ensatum	Baker Hammock	11-100
Oncidium ensatum	Bequaert Hammock	11-100
Oncidium ensatum	Deer Hammock	2-10
Oncidium ensatum	Frampton Hammock	11-100
Oncidium ensatum	Gifford Hammock	2-10
Oncidium ensatum	Grimshawe Hammock	11-100
Oncidium ensatum	Henderson Hammock	11-100
Oncidium ensatum	Junk Hammock	2-10
Oncidium ensatum	Mystery Hammock	11-100
Oncidium ensatum	Osteen Hammock	11-100
Oncidium ensatum	Palma Vista Hammock #1	2-10
Oncidium ensatum	Palma Vista Hammock #2	11-100
Oncidium ensatum	Rattlesnake Hammock	2-10
Oncidium ensatum	Redd Hammock	2-10

Appendix C. Population Estimates at end of Year 2(continued)

Oncidium ensatum	Robertson Hammock	2-10
Oncidium ensatum	Royal Palm Hammock	2-10
Oncidium ensatum	Simmons Hammock	2-10
Oncidium ensatum	Torre Hammock	11-100
Oncidium ensatum	Turkey Hammock	11-100
Oncidium ensatum	Unnamed Hammock 200m NW of Pineland Trail	2-10
Oncidium ensatum	Unnamed Hammock 550m SW of Pine Glades Lake	2-10
Oncidium ensatum	Wild Lime Hammock	11-100
Oncidium ensatum	Winkley Hammock	2-10
	total estimate	**100-1,000**
Passiflora sexflora	Osteen Hammock	2-10
	total estimate	**2-10**
Pecluma plumula	Dewhurst Hammock	11-100
Pecluma plumula	Cadwalader Hammock	11-100
	total estimate	**11-100**
Ponthieva brittoniae	Pine Block E	101-1,000
Ponthieva brittoniae	Pine Block A	11-100
Ponthieva brittoniae	Pine Block B	11-100
	total estimate	**101-1,000**
Sideroxylon reclinatum subsp. austrofloridense	East of Pine Block J	1,001-10,000
Sideroxylon reclinatum subsp. austrofloridense	North of Long Pine Key	101-1,000
Sideroxylon reclinatum subsp. austrofloridense	Paradise Key	101-1,000
Sideroxylon reclinatum subsp. austrofloridense	Pine Block A	1,001-10,000
Sideroxylon reclinatum subsp. austrofloridense	Pine Block D	1,001-10,000
Sideroxylon reclinatum subsp. austrofloridense	Pine Block E	1,001-10,000
Sideroxylon reclinatum subsp. austrofloridense	Pine Block F	1,001-10,000
Sideroxylon reclinatum subsp. austrofloridense	Pine Block G	1,001-10,000
Sideroxylon reclinatum subsp. austrofloridense	Pine Block H	1,001-10,000
Sideroxylon reclinatum subsp. austrofloridense	Pine Block I	1,001-10,000
Sideroxylon reclinatum subsp. austrofloridense	Pine Block J	1,001-10,000
	total estimate	**10,000-100,000**
Spiranthes costaricensis	Winkley Hammock	11-100
Spiranthes costaricensis	Fairchild Hammock	11-100

Appendix C. Population Estimates at end of Year 2(continued)

Spiranthes costaricensis	Osteen Hammock	11-100
Spiranthes costaricensis	Palma Vista Hammock #2	11-100
Spiranthes costaricensis	Rattlesnake Hammock	11-100
Spiranthes costaricensis	Royal Palm Hammock	11-100
	total estimate	**100-1,000**
Spiranthes torta	Pine Block A	2-10
	total estimate	**2-10**
Sporobolus compositus var. clandestinus	Pine Block H	100-1,000
	total estimate	**100-1,000**
Thelypteris reticulata	Royal Palm Hammock	2-10
Thelypteris reticulata	East Boundary Cypress Dome	2-10
Thelypteris reticulata	Hole-in-the-Donut area	2-10
Thelypteris reticulata	Pine Island area	2-10
	total estimate	**11-100**
Thelypteris serrata	Pine Island area	11-100
	total estimate	**11-100**