SUMMARY REPORT OF ENDANGERED PLANT RESEARCH WITHIN VIRGINIA KEY HAMMOCK AND VIRGINIA KEY PARK (2001-present)

Report prepared for the Virginia Key Trust

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Cover: Top photo, *Ipomoea imperati* (beach morning glory)
Bottom photo, *Okenia hypogaea* (beach peanut)

Plant donations by Fairchild for restoration purposes

Key components to rare plant restoration are protection of remaining wild populations and increasing populations in the wild through re/introductions. Fairchild currently works on conservation research related to 97 native rare South Florida plant species. We have conducted over 40 re/introductions of 14 different species over the past 18 years. We propagate plants from wild collected seed and grow in our greenhouse to eventually be used as material for restoration projects. Below are rare plant species that we have donated to Virginia Key Beach and Virginia Key Coastal Hammock for restoration projects.

Scientific name	common name	status	Location donation
Cyperus pedunculatus	beachstar	state endangered	Virginia Key Park
Dalea carthagenensis	Florida prairie clover	state endangered	Virginia Key Park
Jacquemontia reclinata	beach clustervine	federally endangered	Virginia Key Park
Pavonia paludicola	mangrove mallow	state endangered	Virginia Key Park
Zanthoxylum coriaceum	Biscayne prickly-ash	state endangered	Virginia Key Park
Jacquemontia reclinata	beach clustervine	federally endangered	Virginia Key Coastal Hammock
Zanthoxylum coriaceum	Biscayne prickly-ash	state endangered	Virginia Key Coastal Hammock

Virginia Key rare plants or plants of special interest

Virginia Key is one of the last South Florida barrier islands remaining in a near-natural state. Virginia Key contains a high diversity of plants within habitats such as beach dune, coastal strand, maritime hammock and mangrove tidal swamp. Below is a list of the 21 known plants species of special interest on Virginia Key, which include rare and protected species.

Scientific name	Common name	Status
Cardiospermum microcarpum	balloonvine	locally rare**
Coccothrinax argentata	Florida silver palm	state threatened
*Crossopetalum rhacoma**	maidenberry	state threatened
Croton glandulosus var. *floridanus*	Florida vente conmigo	locally imperiled**
Croton punctatus	beach-tea	locally rare**
Cyperus pedunculatus	beachstar	state endangered
Genipa clusiifolia	sevenyear-apple	locally rare**
Halophila johnsonii	Johnson's seagrass	federally threatened
*Ipomoea imperati**	ocean morning glory	locally rare**
Jacquemontia reclinata	beach clustervine	federally endangered
Okenia hypogaea	beach-peanut	state endangered
Pavonia paludicola	mangrove mallow	state endangered
*Rhabdadenia biflora**	mangrove rubbervine	locally rare**
Reynosia septentrionalis	darlingplum	state threatened
Scaevola plumieri	inkberry	state threatened
Zamia integrifolia	coontie	commercially exploited
Zanthoxylum coriaceum	Biscayne prickly-ash	state endangered
Avicennia germinans	black mangrove	state protected
Laguncularia racemosa	white mangrove	state protected
Rhizophora mangle	red mangrove	state protected
Uniola paniculta	sea oats	state protected

* discovered recently and not on any existing site plant lists
** locally rare and imperiled status designated by the Institute for Regional Conservation: http://regionalconservation.org/

Virginia Key Beach activities

Jacquemontia reclinata outplanting to test survival of large vs. small patch size

Introduction

Metapopulation theory explains that large populations of plants have less of chance of going extinct than smaller populations. Past demography work of *J. reclinata* demonstrated this to be true in wild populations (Pascarella and Wright 2009). We would like to test this within an experimental introduction planting. We would like to use this introduction as an experiment to test the survival and fecundity of introduced plants arranged in two different patch sizes (large vs. small). We expect to find a more self-sustaining population in large patches.

Method

On July 25, 2008 with the help of volunteers and Gary Milano from DERM we planted 165 *J. reclinata* plants within the newly restored dune habitat of Virginia Key Beach. To test if there is a difference in survival according to patch size we installed 41 plants in three large patches and seven plants in six small patches. We installed plants 1.5 meters away from each other to provide sufficient space for subsequent growth. After installation we watered all plants with 1/2 gallon of water. The plants received supplemental water by DERM when needed for the next month. We collected GPS positions of all plants and created maps showing the locations of the plants (Figure 1). Plants were monitored one year after the planting for survival, growth and fruit production.

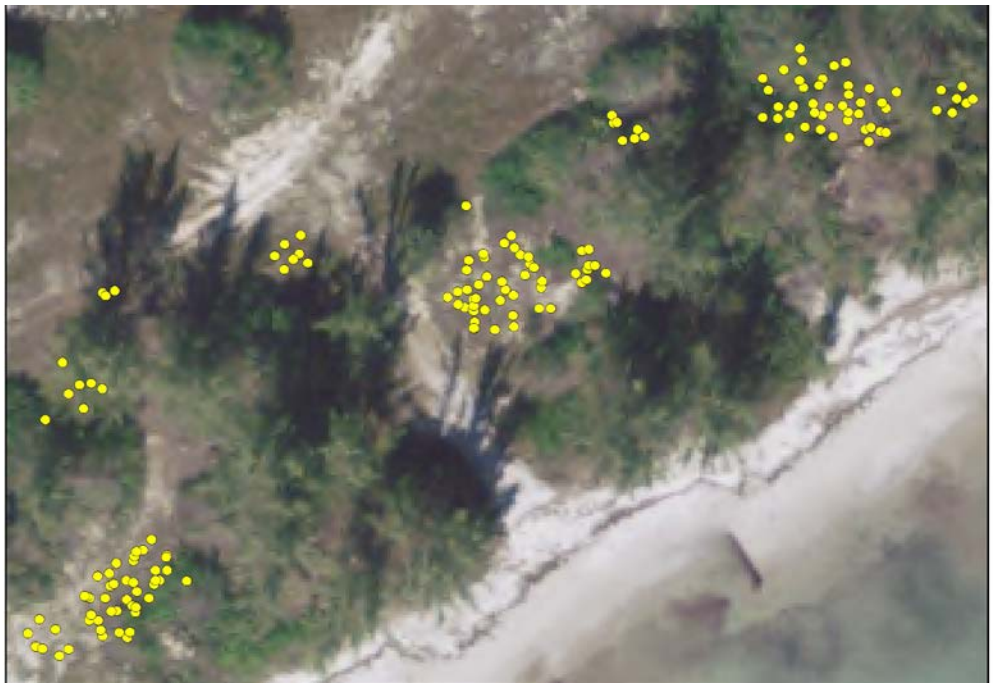
Results

We revisited the outplanting on July 9, 2009 to monitor for survival. We also measured growth and counted fruits to determine fecundity. In total, 149 of the 165 (90%) plants are still alive. 93% of the plants in small patches have survived and 89% of the plants in large plants are still alive. We have yet to analyze the data for growth and fruit production.

Discussion

It still too early to determine if patch size has any effect on survival, preliminary data show that it may not. We will return after six months to monitor survival.

Figure 1. Map showing location of *J. reclinata* outplanting at Virginia Key Park



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Recent discovery of rare plant

In December 2008, during a return visit to survey the *J. reclinata* outplanting we observed *Ipomoea imperati* (ocean morning glory). *I. imperati,* a locally rare vine was observed in the restored dune area of Virginia Key Beach. Population clusters of *I. imperati* were found in two separate locations (Figure 1). Due to the growth pattern of this plant it was difficult to estimate the population size. Until this discovery and another recent observation on Miami Beach the only other known location in Miami-Dade County was at Cape Florida. A voucher specimen was collected for documentation and will be kept as a herbarium specimen in Fairchild's Herbarium. The Institute for Regional Conservation (IRC) was informed of the discovery and will update their Floristic Inventory of South Florida.

Figure 1. Location of newly discovered populations of *Ipomoea imperati* at Virginia Key Beach

Future introduction of *Dalea carthagenensis* var. *floridana* (Florida prairie clover)

In 2002, Fairchild rediscovered *Dalea carthagenensis* var. *floridana* (Florida prairie clover) in Crandon Park (Figure 1). It was thought to be extirpated from all coastal sites and has not been seen on Key Biscayne in over 35 years (Gann et al. 2002). Because there are only two other known populations in Miami-Dade County and increase of population locations is needed for this species to persist. The restored dune habitat of Virginia Key Beach is ideal habitat for an introduction of *D. carthagenensis* var. *floridana*. We have begun discussions with Gary Milano to include *D. carthagenensis* var. *floridana* in the next dune plantings at Virginia Key Beach.

Figure 1. Flowering *Dalea carthagenensis* var. *floridana* at Crandon Park

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Virginia Key Coastal Hammock activities

Cyperus pedunculatus (R. Br.) J. Kern.

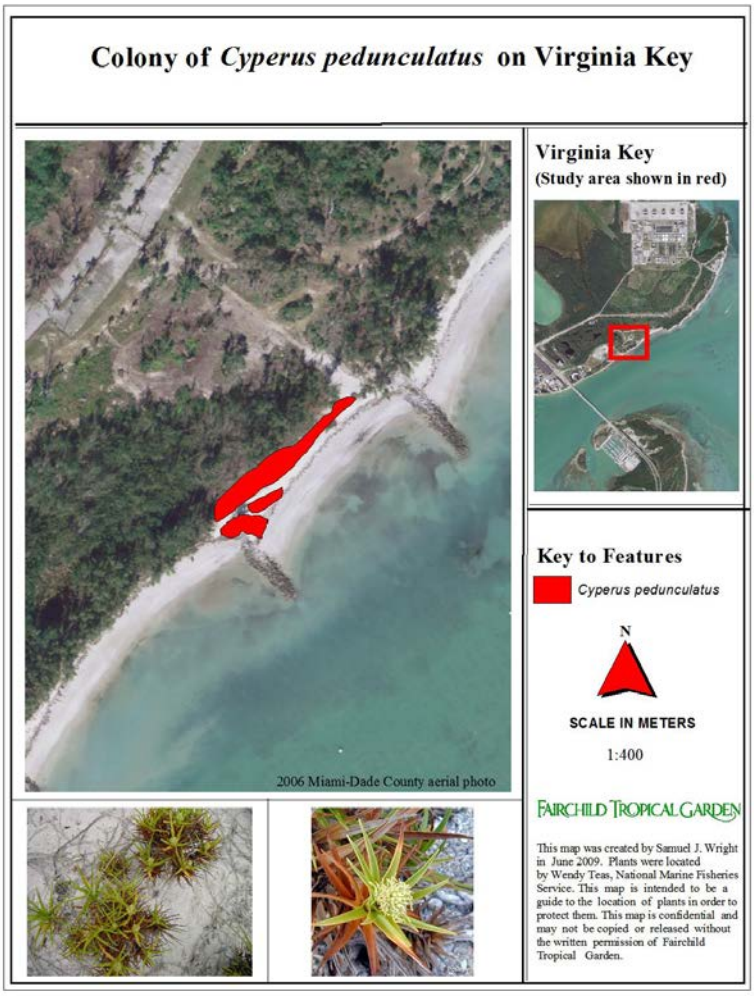
Cyperus pedunculatus (beach star) is a state endangered (FDACS) sedge that occurs along the Southeast Florida coastal dune habitat. *C. pedunculatus* is found predominantly seaward of the foredune in the pioneer zone, but can occur between primary and secondary dunes. Major threats include coastal development, beach erosion, foot traffic, beach raking, and driving on the beach by lifeguards, police, maintenance crews, etc. (Possley et al. 2003). Fairchild documents the occurrence of *C. pedunculatus* at 26 publicly owned coastal sites from Miami-Dade County to southern Martin County (Possley et al. 2002 and Wright unpublished data)

Previously undocumented population

In July 2003 during a coastal survey at Virginia Key, Fairchild intern Allison Rosenberg discovered a previously undocumented population of *Cyperus pedunculatus* (beach star). Beach star has never before been documented on Virginia Key. A voucher specimen was collected (Fernandez present) for documentation and will be kept as a herbarium specimen in Fairchild's Herbarium. The Institute for Regional Conservation (IRC) was informed of the discovery and will update their Floristic Inventory of South Florida. GPS points documenting the location of the new population were also collected. We created an aerial map with the GPS locations and made available to the City of Miami. Juan Fernandez was informed of the discovery who in turn informed the beach manager (Figure 1).

C. pedunculatus has since been observed at Virginia Key Park within the recently restored dune habitat. The restored dune habitat was once dominated by *Casuarina equisetifolia* (Australian pines), *Scaveola sericea* (beach naupaka) and *Schinus terebinthifolius* (Brazilian pepper).

Figure 1. Map showing location of previously undocumented population of *Cyperus pedunculatus*



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Jacquemontia reclinata House

Jacquemontia reclinata (beach clustervine) is a perennial vine endemic to the South Florida coastal dune ecosystem. Natural threats include plant competition, low recruitment rate, and large-scale natural disturbances (e.g., hurricanes). Anthropogenic disturbance, fire suppression, and fragmentation of habitat have further restricted its range and contributed, in part, to its status as federally endangered (USFWS 1996, Lane et al. 2001). Current estimates indicate approximately 800 wild individuals on eight small, protected sites ranging from Miami-Dade County to northern Palm Beach. Primary habitat includes coastal strand and open maritime hammock, areas that historically experienced hurricanes and fire (Austin 1977, USFWS 1996, Wright 2003).

Seed germination study

Introduction

To our knowledge no reintroduction efforts associated with *Jacquemontia reclinata* have ever used seed as material for reintroduction. This experiment tested whether the species can successfully colonize an area using seeds rather than whole plants. Few *J. reclinata* seedlings or young plants are ever observed in the wild (Wright and Fidelibus 2004). However seeds have been shown to germinate within one week after sowing in the greenhouse on a mist bench (Roncal et al. 2006). It is believed that periods of high amounts of rainfall are needed for seeds to germinate. On July 10, 2003 we established seed germination plots to test the hypothesis that *J. reclinata* seeds require periodic cycles of soil inundation for seeds to germinate in the wild. The experiment will also act as a outplanting if in fact seeds germinate successfully.

Study site

In selecting Virginia Key as a study site we strictly followed the protocol of only re/introducing plant material in areas of present or historic range. It has been documented that *J. reclinata* formerly existed on Virginia Key (USFWS 1996). Virginia Key was also selected for this study because according to a 2002 coastal survey (Wright and Thornton *in prep.*), Virginia Key Hammock Park ranked 2nd highest among 32 potential *J. reclinata* restoration sites.

Methods

We randomly selected twenty-four bare sand areas in the coastal dune habitat along a 50-meter transect parallel to the beach (Figure 1). Within each bare sand area a 10 x 25cm PVC open bottom cylinder was installed into the sand (Figure 2). Into each PVC cylinder we sowed eleven locally collected seeds (from Crandon Park) and top dressed with 0.5 cm of on-site sand. We watered 12 randomly selected plots daily from July 10, 2003 until August 7, 2003 with 30 ounces of water, weekly until September 11, 2003 and ceased watering thereafter. We monitored seed germination daily from July 10 – Aug 7, 2003, weekly until October 9, 2003, monthly until June 25, 2004 and yearly thereafter. We also documented germination of non-target species and removed seedlings once identified. During April 2005 we removed all plots that did not have *J. reclinata* germination and left the remaining germinated plants. We used SPSS (SPSS 10.0, 2002) to compare total germination between watered and non-watered plots.

Results

We monitored the plots for germination for one hundred and thirty-five weeks (~2.6 years). First germination occurred after 6 days. To date, we have observed only five *J. reclinata* germinants in four of the 12 watered plots and no *J. reclinata* germination in unwatered plots. Total germination for *J. reclinata* was significantly higher in

watered plots than in non-watered plots (Mann-Whitney = 48, p = 0.03). After forty-three weeks all five *J. reclinata* seedlings have survived, however we observed mortality in one seedling during the 50th week.

We also observed non-target species germinating within the plots. Note that during the entire study the non-watered plots had more non-target species germination than the watered plots due in most part to *Bidens alba* var. *radiata* (Table 1). However for the first eight weeks that the plots were watered, there was no significant difference found between watered and non-watered plots in total germination of non-target species (Mann-Whitney = 48, p = 0.148).

Discussion

Jacquemontia reclinata seeds did not germinate in the field with natural precipitation. Because coastal sites receive spotty rainfall, this may contribute to the lack of germination we observed in this study and in the natural populations. Surprisingly, the natural rainfall was sufficient for germination of many other natives (Table 1). Clearly, more research is needed on *J. reclinata* germination in the wild. Using *J. reclinata* seeds for future reintroduction projects would require supplemental watering and the use of many seeds. Even with watering, the percent germination (3.8 %) was not impressive. However, 4 of the 5 (80%) seedlings have survived since germination.

J. reclinata produces seed all year (Austin 1991), but conditions may not be right for germination all year round. We did not observe germination after the seventh week, which would suggest that *J. reclinata* might have a small window during the year when conditions are ideal for germination. It is essential to understand how the dry and rainy seasons affect germination and survival. Seed germination studies could be replicated at different times of the year to test seasonality on germination.

Figure 1. Map of *Jacquemontia reclinata* seed germination plots at Virginia Key

Figure 2. Germinated *J. reclinata* seedling growing out open bottom PVC cylinder plot

Table 1. Total germination after 74 weeks for *J. reclinata* and non-target species within watered and non-watered plots of seed germination experiment at Virginia Key Hammock.

Species	Watered plots	Non-watered plots	Total
Jacquemontia reclinata	5	0	5
Bidens alba var. *radiata*	45	107	152
Catharanthus roseus	15	9	24
Unknown herb	12	11	23
Unknown graminoid	8	9	17
Galactia volubilus	3	4	7
Okenia hypogaea	2	0	2
Uniola paniculata	2	0	2
Croton glandulosus	2	0	2
Chamaesyce ssp.	0	2	2
Cnidoscolus stimulosus	1	0	1
Helianthus debilus ssp. *debilus*	1	0	1
Dactyloctenium aegyptium	0	1	1
Poinsettia cyathophora	0	1	1
Total	**96**	**144**	**240**

Experimental Introduction of *Jacquemontia reclinata*: How does breeding history influence field survival and fitness?

Virginia Key Hammock

Introduction

The recovery of *Jacquemontia reclinata* not only relies on the protection of remaining populations, but will also require establishment of self-sustaining populations through reintroductions to suitable habitat within its historical range. From 2004-2006 we re/introduced *J. reclinata* to 4 sites within its historical range to test how breeding history could influence survival and fitness. Along with Virginia Key we also selected Haulover Beach, Delray Beach, and North Shore Open Space Park because of their high ranking determined during a 2003 Fairchild coastal survey of suitable habitat (Wright *in prep*).. We conducted these re/introductions to increase the number of populations of *J. reclinata* and to test how breeding history affects survival and fitness of plants. The following description contains only the Virginia Key planting.

Methods

The plant material we used for this introduction was derived from hand-pollination experiments of Pinto-Torres (Pinto-Torres and Koptur *in prep*). The four pollination treatments represented in the introduction were the following: Crandon Park sibling (Sib; crossed with sibling), Crandon Park far neighbor (FN; crossed with offspring of a wild parent from a different patch > 20m away), and two between- site crosses (crossed with pollen from the other site: Crandon Park x South Beach and South Beach x Crandon).

On April 7th 2005, Fairchild staff assisted by Palmetto High School students outplanted 171 *J. reclinata* plants in a coastal strand/dune area currently under restoration at Virginia Key Hammock.
As a part of The Fairchild Challenge, our annual, environmental-education outreach program, the students learned about conservation issues and were instructed how to install, measure, water, and map the *J. reclinata* plants (Figure 1). The planting area is located in an open coastal strand area behind the dunes. The area was once dominated by exotics such as *Casuarina equisetifolia* (Australian pine) and *Schinus terebinthifolius* (Brazilian pepper), which have now been removed. Plants were haphazardly planted throughout the entire area that was suitable and available for planting. Although plants were planted haphazardly within the area, careful consideration was used to make sure treatments were evenly distributed throughout.

To quantify size of *J. reclinata* at planting, we counted numbers of stems using circular rings constructed of a flexible polyurethane tube of three different diameters: 10cm, 50cm, and 100cm. We centered the ring over the plant and counted any stems that touched the ring and repeated the procedure for the other diameters (Figure 2). To quantify health and growth of each plant, we re-measured remaining plants after one year.

At the time of the planting we watered each plant with 1 quart of water. City of Miami staff watered plants when needed for the next two months and then ceased once the rainy season started. To assist with relocation of the plants for return surveys, we collected GPS points and created maps showing plant locations (Figure 3). We also installed a 45cm long x 1.27cm PVC pipe into the ground next to each plant to assist with relocation. We monitored the plants quarterly for the first year and annually thereafter.

Results and Discussion

We first surveyed the experiment on June 1st, 2005 for survival and documented 27 mortalities. We cannot explain why there was a large amount of mortality in the first two months. However, the material for this planting was the last of a batch of plants used for the two previous plantings. Plants may have already been of decreased initial health due to staying in nursery conditions longer than the other plants. In July we also observed that some plants were brown and wilting. It appears that some plants received off-target herbicidal spray from maintenance crews treating *Dactyloctenium aegyptium* (Durban crowfoot grass). This incident was brought to the attention of City of Miami staff and they have agreed to no longer spray in the area.

Three of the four major hurricanes that passed through South Florida in 2005 had very little impact on Site 102. However, Hurricane Wilma caused major damage to Site 102 in the form of downed trees and salt spray. We surveyed the site two weeks after Wilma on November 11th, 2005 documenting 114 of the 171 (67% survival) plants as alive.

We last surveyed the plants on April 14, 2008 and documented survival and measured growth of remaining plants. We observed that 75 of 171 (44%) plants are still alive. It is still too early to determine the effects of pollination treatments from this experiment, however preliminary data show that the between site crosses have the highest survival rates (Table 1).We assume that off-target herbicidal spraying and stress caused by wind and salt spray from Hurricane Wilma contributed to mortality of the plants regardless of genetic stock. We have observed vigorous growth and some flowering on remaining plants and we will continue to monitor.

Adaptive management of site
Dactyloctenium aegyptium (Durban crowfoot grass) is known to be very invasive and aggressive within open disturbed areas. It is usually one of the first species to appear during clearing activities during restoration projects. To combat the occurrence of *D. aegyptium* most land managers use an herbicide application usually Roundup. However, about three months after planting we observed the herbicide to have a negative effect on the outplanted *J. reclinata* in the form of brown and wilted plants. City of Miami staff agreed to stop spraying within the planted area. Within 2 years the *D. aegyptium* has been outcompeted by native grasses and wildflowers and the outplanted area is now very diverse in native groundcover.

During the time of the study we also observed the increased canopy cover of the native hardwood trees in the outplanted area. Coastal strand is naturally an open sunny habitat with a very sparse tree canopy that allows a high diversity of grass and wildlflower species. If the canopy continues to close the *J. reclinata* and the other sun-dependent species will eventually get shaded out and die. In 2008, City of Miami staff selectively removed some of the hardwood trees from the outplanted area. The remaining plants seemed to have benefitted from the canopy openings with increased growth and fruit production

Figure 1. Palmetto High School students planting *Jacquemontia reclinata*

Figure 2. Fairchild biologist demonstrating stem counting technique using rings

Figure 3. Map of outplanted *J. reclinata* plants at Virginia Key

Table 1. Survival after three years of *J. reclinata* according to breeding treatment

Treatment	Color	Total Planted	Survived	%
Crandon -FN	Yellow	52	17	32.7%
Crandon -Sib	Green	22	1	4.5%
Crandon x South Beach -BS	Pink	63	38	60.3%
South Beach x Crandon -BS	Orange	34	19	55.9%
		171	75	43.9%

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Lantana depressa var. floridana

Genetics study

The critically imperiled *Lantana depressa var. floridana* (Florida shrubverbena) is a shrub that occurs in five South Florida sites. The major threat to the Florida shrubverbena includes hybridization with the exotic *Lantana camara.* It is feared that many wild plants are a hybrid between the two Lantana species and the genetic purity of the native Lantana is being lost (Gann et. al 2002). Six cuttings were collected (Fernandez present) from what still is believed to be a pure Florida shrubverbena (verified by Woodmansee) along the Virginia Key Hammock Interpretative Trail. The cuttings were propagated back at the Fairchild greenhouse and used for a genetic study.

Okenia hypogaea Schltdl. & Cham

Okenia hypogaea (beach peanut) is a state endangered (FDACS) annual prostrate herb that occurs along Southeast Florida's coastal dune ecosystem. It is found within the dune community predominantly from the upper pioneer zone to just over the leeward side of the primary dunes, but can also occur within openings of the coastal strand. Habitat destruction resulting from coastal development is the primary threat to *O. hypogaea* (Ward 1979, Iverson 2004). Other threats include recreational sports (Iverson 2004), beach erosion, trampling, and beach raking (Possley et al. 2003). Fairchild has now documented the occurrence of *O. hypogaea* at 19 publicly owned coastal sites from Miami-Dade County to southern Martin County (Possley 2002 and Wright 2003).

Monitoring and mapping activities

Fairchild began mapping *Okenia hypogaea* (beach peanut) at Virginia Key in early 2002 (Possley 2002). With the help of Juan Fernandez we have been able to locate and map 3 population clusters of *O. hypogaea*. Aerial maps of the clusters have been provided back to Mr. Fernandez in order to aid with protection and maintenance of the species. We no longer map *O. hypogaea* at Virginia Key. Due to the ephemeral nature of *O. hypogaea* from each year and season, population numbers vary. At this present time the majority of the populations appear to be stable. From our surveys we suggest that the limiting factor for *O. hypogaea* establishment is available habitat. For example, nearby Cape Florida that does not conduct beach-raking practices has seen an increase in the natural recruitment of seven rare dune and pioneer species, including *O. hypogaea.*

Previously undocumented population

In 2003, Wendy Teas, Sea Turtle Stranding Coordinator for the National Marine Fisheries Service, discovered a previously undocumented population of *O. hypogaea* on the northern end of Virginia Key during sea turtle nest

surveys. The almost hot pink stem and leaf venation coloration of this population is unique and rarely ever seen (Figure 1). The population was found along a highly disturbed beach growing on top of spoil debris underneath *Casuarina equisetifolia* (Australian pines) and adjacent to *Scaveola sericea* (beach naupaka). A voucher specimen was collected in the presence of park naturalist, Juan Fernandez and will be kept as a herbarium specimen in Fairchild's Herbarium. We created an aerial map of the population location and made available to the City of Miami (Figure 2).

Figure 1. Pink stems and veination of *O. hypogaea* found on Virginia Key

Figure 2. Map of *O. hypogaea* in northern section of Virginia Key

Okenia hypogaea Germination in Response to Arson Fire

Introduction

On November 14, 2003 a suspected arson fire occurred at Virginia Key. Fairchild staff visited the site 3 days after the fire on November 17th. According to local fire and police officials the fire was started at the lifeguard stand, which was burned to the ground. The fire jumped from the lifeguard stand to the coastal dune habitat. In total, the fire burned approximately 3000 m^2 of dune vegetation. Several observations indicated that the fire was low intensity. For example, PVC pipe installed at the site for a separate experiment was not melted or burned; it was only lightly charred. Also fruit capsules of *Ipomoea pes-caprae* ssp. *brasiliensis* (railroad vine) were charred, yet had intact seeds inside (Miller, Wright, and Fernandez, pers. obs.).

Fairchild staff again visited the site 11 days after the fire on November 25, 2003. Within the burned area, we observed thousands of seedlings of *O. hypogaea,* where plants had not been directly observed for the last 5 years (Fernandez pers. comm.). The closest patch of *O. hypogaea* observed previously at the site was approximately 6 m from the "arson patch." What was unusual about this germination event was the time of year in which it occurred; the majority of *O. hypogaea* populations germinate from March to June (Iverson 2004). It is unknown what effect the fire has had on the germination timing of these seedlings. We hypothesized that the fruits in the seed bank had remained viable for at least 5 years and the fire triggered germination out-of-season. We decided to take advantage of this rare event to conduct a demography study and census the new population and monitor the germinated seedlings for survival and flowering.

Methods

On January 8, 2004, we established 1 m^2 quadrats within the 16m X 10 m patch of *O. hypogaea* seedlings. In a grid pattern, we hammered 20 cm long PVC pipe. We counted total plants growing within each quadrat, noting size, total number of leaves, number of flowers and elongating peduncles. We measured plants again on March 9, 2004.

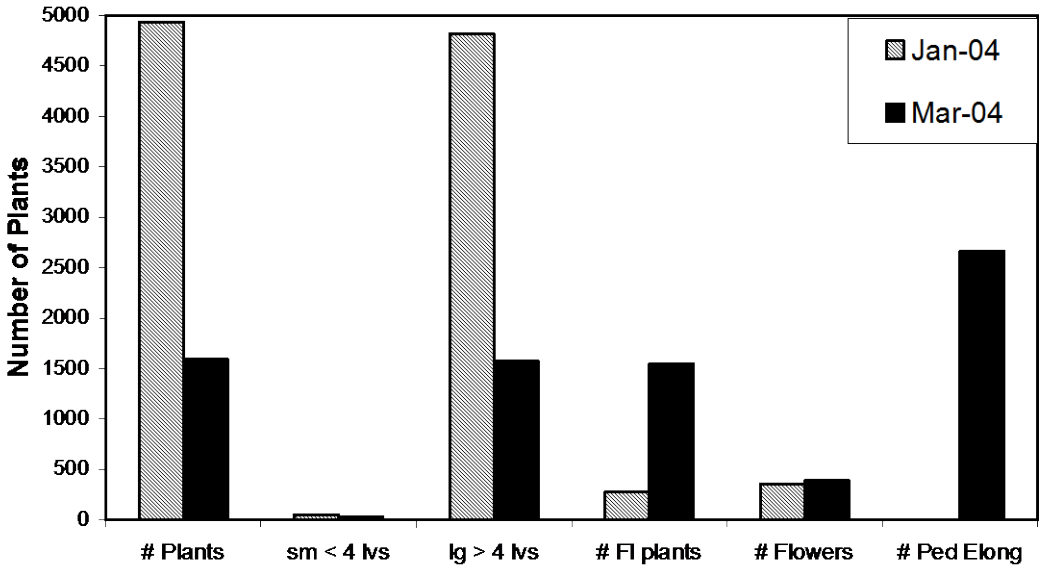
Results

O. hypogaea is a fast-growing annual. Seven weeks after we had first observed the seedlings in 2-leaf stage, the majority of plants in the population had already grown beyond the 4-leaf seedling stage and several had begun to flower. We observed a total of 4936 plants; 1% were seedlings, 93% were non-reproductive juveniles, and 6% were reproductive adults (Figure. 1). Sixteen weeks later, most of the plants were producing fruits (elongating peduncles). We observed a total of 1602 plants; 1 % were seedlings, 1 % were non-reproductive juveniles, and 98% were reproductive adults. We observed 2662 elongating peduncles. Thus, the original 4936 plants produced approximately 2662 fruits. We recognize that not all elongating peduncles would produce viable fruits, but to date we have no data to indicate what percentage of good fruit are produced by a plant.

Discussion

O. hypogaea rapidly responds to optimal germination conditions. Apparently the arson fire stimulated germination from the seed bank, where seeds had been dormant for at least 5 years. Following germination, plants rapidly grow to reproductive maturity. At this present time no *O. hypogaea* plants have been observed in this area for at least 2 years. Fruits will remain dormant in the seed bank until the next disturbance effect (e.g. fire, storms, and hurricanes).

Figure. 1. Number of *O. hypogaea* plants, flowers and elongating peduncles. Codes indicated are # Plants = total number of plants/ census; sm < 4 lvs = small plants with < 4 leaves; lg > 4 lvs = large plants with > 4 leaves; # Fl plants = the total number of flowering plants; # Flowers = the total number of flowers; # ped elong = the total number of elongating peduncles.



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Zanthoxylum coriaceum A. Rich.

Zanthoxylum coriaceum (Biscayne prickly ash) is a state endangered small to medium size tree. Primary habitat is maritime hardwood hammock, which is vulnerable to urbanization. The past and present major threat to *Z. coriaceum* is habitat destruction (Gann et al. 2002). Maritime hammock, which occurs on the most stable coastal ground, has been and still is attractive to coastal road and building construction.

Fairchild documents the occurrence of *Z. coriaceum* at six (3 wild) publicly owned coastal sites in Miami-Dade and Broward Counties (Possley 2002 and Wright 2003). In total there are 77 wild specimens occurring at three South Florida public natural areas. Virginia Key Hammock with 44 trees contains the largest remaining wild population in the United States

Mapping and monitoring activities

Juan Fernandez has been monitoring the *Z. coriaceum* trees at Virginia Key since 1998, surveying for survival, growth and fecundity. Fairchild began assisting Juan with the annual monitoring of the trees in early 2001 (Fellows et al. 2001). All known plants are now documented, tagged and mapped (Figure 1). Using plants germinated from on-site stock, ~ 30 trees have been introduced back into Virginia Key. Those are also mapped and monitored on a regular basis. Although Virginia Key contains the largest remaining wild population of *Z. coriaceum*, the stand of trees occurs mostly in a concentrated area of the hammock. In recent years a few trees were discovered away from this concentrated area:

Trees occurring outside the designated Virginia Key Coastal Hammock

2003
On October 3rd, 2003 City of Miami employee Felipe Alonso discovered a previously undocumented tree in a mangrove associated area northeast of the Coastal Hammock parking lot. The tree measured almost 8ft in height. Park naturalist Juan Fernandez immediately contacted Fairchild. We visited the site soon thereafter to take photos and collect GPS points. During an April 22nd, 2004 survey we determined that the new plant was a male. Fairchild reported the new observation to the Florida Natural Areas Inventory (http://www.fnai.org).

2004
While conducting an exotic removal project next to the Coastal Hammock parking lot, City of Miami personnel revealed a very large (10ft tall) female *Z. coriaceum* tree. The plant was hidden within a thick stand of *Casuarina equisetifolia* (Australian pine) and *Schinus terebinthifolius* (Brazilian pepper). Concerned of over sun exposure to the plant, the City of Miami has since ceased the removal of the non-native canopy over the plant. In the past, removal of canopy over shaded trees has led to trees dying (Fernandez pers. comm.). The non-native canopy will act as a surrogate canopy until planted native vegetation attains the height needed to shade the tree. Fairchild collected GPS points for the newly discovered tree and has updated the Virginia Key population map.

Virginia Key originated plants used for outplantings

The *Z. coriaceum* trees at Virginia Key are very healthy and productive. All wild female trees are now known to flower every year (Fernandez unpub. data). Some of the outplanted trees are also now flowering. Trees at Virginia Key have been extremely helpful in increasing population numbers through re/introductions at other sites. *Z. coriaceum* trees germinated from Virginia Key stock have now been planted out into 6 other sites: Cape Florida, Crandon Park, Flagler Island, Sandspur Island, North Shore Open Space Park and Hugh Taylor Birch. A recent visit to Sandspur Island showed that all the trees were still alive even though they were plant 11 years ago. We documented approximately 70 seedlings of various sizes showing that the Virginia Key generated trees are very productive on Sandspur Island.

Figure 1. Map showing location of *Zanthoxylum coriaceum* trees, yellow dots identify wild trees and red identfies outplanted trees

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