


Conservation of South Florida Endangered and Threatened Flora Program
at
Fairchild Tropical Botanic Garden

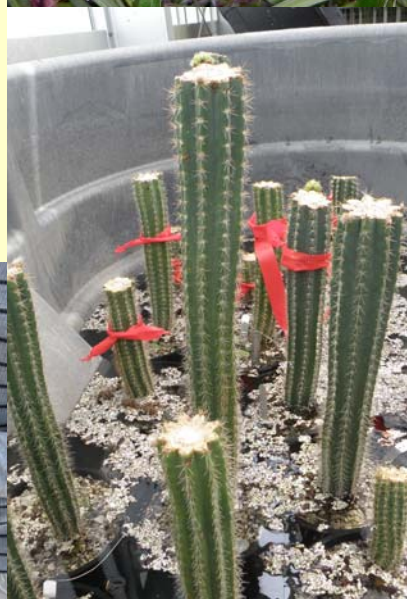
2010-2011

Final Report
Contract #14880



Submitted to the Florida Department of Agriculture and Consumer Services, Division of Plant Industry, Gainesville, FL

July 2011



Conservation of South Florida Endangered and Threatened Flora Program at Fairchild Tropical Botanic Garden: 2010-2011 Program at Fairchild Tropical Botanic Garden

Contract #015982

Final Report Submitted to the Florida Department of Agriculture and Consumer Services, Division of Plant Industry, Gainesville, FL.

July 29, 2011

Submitted by Fairchild Tropical Botanic Garden, 11935 Old Cutler Rd., Miami, FL 33156

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Executive Summary

Joyce Maschinski

Support from the Florida Department of Agriculture and Consumer Services has enabled Fairchild Tropical Botanic Garden to strengthen and expand its conservation program for the recovery and conservation of South Florida endangered and threatened flora. We have been actively engaged in several ongoing activities: monitoring, determining horticultural methods for cultivation and long-term storage, conducting biological and ecological research, assisting land managers with evaluating habitat management and restoration, and reintroducing rare species to increase total numbers of plants in the wild.

Fairchild Tropical Botanic Garden Highlights from
Funding from Florida Department of Agriculture and Consumer Services
2010 – 2011 Program

Species Recovery and Management

- Gathering rare plant population trends guides recovery actions. Some wild populations have increased size. Among these are *Pilosocereus robinii* populations at KL, LKLT, LKGOT, and UMLV. However the majority of natural plant populations in the South Florida urban interface sustain great pressures directly and indirectly from human activity, therefore they live in precarious space where natural ecosystem processes dysfunctional. Coupled with recent natural environmental stressors, especially past hurricanes and recent prolonged drought, several rare plant populations we have been monitoring have lately suffered declines in the number of living plants. Among these are *Amorpha herbacea* var. *crenulata* (p. 13), *Dalea carthagenensis* var. *floridana* (pp. 20-25), *Jacquemontia reclinata* (pp. 35 and 56), *Pilosocereus robinii* (p. 64), *Polygala smallii* (p. 68) and *Zanthoxylum flavum* (p. 85). Working with land managers we have made suggestions and taken actions to improve the probability that these species will persist.

- Some wild populations have increased size due to Fairchild's restoration efforts. With the help of Fairchild Challenge students (p. 12), restoration activities are improving rare plant habitat and seedling recruitment of *Amorpha herbacea* var. *crenulata* in its two largest wild populations. Miami-Dade County restoration activities suggested by Fairchild have significantly improved *Dalea carthagenensis* var. *floridana* population numbers at CDE (p. 20) and RHMP (p. 21).

- Without natural fires some habitats will require repeated treatments. Throughout the year, Fairchild coordinates volunteer efforts to restore rare plant habitats (pp. 12 and 39). Because restoration can increase native vine encroachment, continued monitoring is necessary (pp. 18 and 49).

- Fairchild has taken steps to ensure rare species' persistence through securing ex situ collections. Fairchild made ex situ collections from newly discovered populations of *Jacquemontia reclinata* and from existing *Pilosocereus robinii* (p. 63) populations for long-term ex situ storage, reintroduction, or research (p. 66). As part of our ongoing collaborations with The Center for Plant Conservation and its affiliates, we are working with the National Center for Genetic Resources Preservation to safeguard these species.

- Reintroduced populations have successfully safeguarded *Lantana canescens* in South Florida. The species is now extirpated from the wild, but thriving in two of its reintroduced locations (p. 59). Fairchild continues to monitor introductions of *Amorpha herbacea var. crenulata* (pp. 2-8), *Dalea carthagenensis* var. *floridana* (p. 28), Jacquemontia *reclinata* (pp.

38-46)*, Tephrosia angustissima* var. *corallicola* (p. 70), and *Zanthoxylum coriaceum* (pp. 77). Because they have been done experimentally these reintroductions have contributed to our understanding of rare species' biology and contribute to the species recovery.

- Tracking seedling establishment in the wild allows us to discover secrets of one of the big mysteries of plant life cycles. In natural and reintroduced populations, we are tracking seedlings of several species. New seedlings have been discovered for *Amorpha herbacea* var. *crenulata* (p. 6), *Jacquemontia reclinata* (p. 47), *Lantana canescens* (p. 59), *Tephrosia angustissima* var. *corallicola* (p. 71) and *Zanthoxylum coriaceum* (p. 80) giving encouragement that the populations can stabilize.

- Endangered ferns of South Florida are receiving a helping hand from Fairchild and CREW. Dr. Valerie Pence of Cincinnati Zoo Lindner Center for Conservation and Research of Endangered Wildlife has begun spore cultures of *Asplenium verecundum* (p. 17), *Asplenium x biscaynianum* (p. 16), *Lomariopsis kunzeana*. (p.61) and *Thelypteris patens* (p. 74), and *Thelypteris sclerophylla (*p. 76). Tissue culture is proving to be easy for some species, but challenging for others. Some sporophytes have been returned to Fairchild and we have done trial introductions into protected areas of the garden. We wish to learn from these more benign locations before attempting introductions to the wild. Some species are having difficulty acclimating to the world outside of the test tube, therefore we are very gradually decreasing humidity levels around the ferns we receive.

Conservation Planning

- In response to requests from land managers, Fairchild made recommendations to improve the probability of persistence of wild populations of *J. reclinata* (p 32) and *Z. flavum* (p 85). In addition, we have worked with land managers to implement previous recommendations.

Database and Information Management

- Fairchild continues to build a database that includes GIS maps of rare plant locations, pertinent literature about species and habitats. We share this information with Florida Natural Areas Inventory, U.S. Fish and Wildlife Service, and land managers.

Public Outreach

- Involving volunteers, students, teachers, and land managers in our ongoing conservation activities has helped to expand the effectiveness of our conservation program and has engendered public support. Without many helpful hands our conservation work and habitat restoration would not be possible. As part of our Connect to Protect Network, Fairchild's South Florida Conservation Team led Middle and High School students along with other volunteers to improve health of pine rocklands (p.12), which successfully increased *Amorpha herbacea* var. *crenulata* seedling establishment.

- In spring 2010, Fairchild and Bok Historic Sanctuary co-hosted the Florida Rare Plant Task Force in Miami, FL. Attendees discussed current plant conservation topics in the state. (p. 95).

- Fairchild Conservation Team has disseminated information regarding rare plant conservation to lay and scientific communities in local, regional, national, and international sectors and engendered support for rare plant conservation through participation in community events and public speaking. Recent publications and presentations are cited (page 104).

Ex situ Collections at Fairchild Tropical Botanic Garden

Fairchild maintains an ex situ collection to safeguard species from extinction, to provide plants for reintroduction or augmentation, and for use in studies of rare species' biology. The ex situ collection comprises both live plants and seeds, which we collect with permission from landowners, county, state and federal governments.

In this grant cycle, we made collections of *Jacquemontia reclinata* and *Pilosocereus robinii*, *Tephrosia angustissima* var. *corallicola* (Table 1). This material will be propagated and grown in either the Fairchild nurseries, or stored at the National Center for Genetic Resources Preservation (NCGRP), Ft. Collins, CO to be later used in restoration and reintroduction experiments. Using the Fairchild ex situ collection as a resource to propagate and maintain plant material for reintroduction purposes is an integral part of Fairchild's Conservation of South Florida Endangered and Threatened Plants program.

Table 1. Rare South Florida Taxa collected by FTBG and/or sent to NCGRP. * Denotes plant species included in past FDACS grants but not on current grant cycle.

Species	Site Code	Quantity/ Propagule Type Collected
Jacquemontia reclinata	OP	3046 seeds from 12 parents
Jacquemontia reclinata	FTBG	2501 seeds
Pilosocereus robinii	NKDR, FTBG	2 fruit
Pilosocereus robinii	KTCP, LVK, LKLT, FTBG	Cuttings
Tephrosia angustissima var. *corallicola*	FTBG	350 seeds
**Galactia smallii*	FTBG	239 seeds
**Harrisia fragrans*	FTBG	7374 seeds
**Harrisia simpsonii*	FTBG	1504 seeds
**Linum arenicola*	OCA	50 seeds
**Rhipsalis baccifera*	FTBG	~ 1000 seeds

Amorpha herbacea var*. crenulata*

Joyce Maschinski and Jennifer Possley

Introduction

Amorpha herbacea Walter var. *crenulata* (Rybd.) Isley is an endangered pine rockland shrub endemic to Miami-Dade County. *A. herbacea* var. *crenulata* occurs in pineland communities that were historically associated with seasonally hydrated soils and frequent burning, including wet pinelands, transverse glades and hammock edges. By 1984, 98-99% of these communities in Miami-Dade County had been destroyed, and development continues today. In addition to habitat loss, fire suppression, invasion by exotic plant species and drainage all contribute to the decline in *A. herbacea* var. *crenulata* natural populations (USFWS 1999). The United States Fish and Wildlife Service listed *A. herbacea* var. *crenulata* as federally endangered in 1985 (USFWS 1985). Fairchild staff has been studying and monitoring *A. herbacea* var. *crenulata* since the early 1990's.

Updated of Introduction success of *Amorpha herbacea* var. *crenulata*

To help recovery the federally endangered f *Amorpha herbacea* var. *crenulata* into new locations, Fairchild has conducted introductions on public land, thus increasing the total number of individuals and populations existing in the wild.

LMAR

Historically *A. herbacea* var. *crenulata* grew along the ecotone between pine rockland and transverse glade (Gann et al. 2002), which was seasonally flooded. To assess whether a viable conservation alternative for the species could be achieved by translocation to an area outside the species' known historic distribution range, we introduced plants rescued from private land to a protected area (Site LMAR) with a pine rockland/transverse glade ecotone.

Based on field observations of the soil and flora we defined four zones at Site LMAR: pineland, ecotone, grassy glade and a restored glade. To determine best habitat for reestablishment and long-term sustainability, we transplanted 100 *A. herbacea* var. *crenulata* plants in 2006 (25 into each zone) and 245 plants in 2007 for a total of 345 plants (Table 2-1).

From 2006-2008, the experimental phase of the study, plants survived in all four microsites, but had highest survival in pineland. Plants grew best in microsites with less grass cover and higher P content - the pineland and the restoration glade. Through 2008 we observed consistently higher soil water content with less total vegetation cover in pineland and significantly higher P content in the restoration glade (Roncal et al., in review).

The experimental phase of the study allowed us to assess which microsite(s) supported greatest plant growth and survival of *A. herbacea* var. *crenulata* within two years post-installation. Based upon this information, we implemented an adaptive management phase in which we transplanted 20 plants from the microsite with lowest growth and survival (the grassy glade) to the microsite with the greatest survival (the pineland) in July 2009. We watered transplants immediately after transplanting; thereafter daily natural rainfall occurred for approximately three months. In May 2011, we compared survival and growth of plants moved from the grassy glade to those that remained in place in the four microsites. If this adaptive management action was appropriate, then we expected *A. herbacea* var. *crenulata* survival to improve in comparison to plants left in place.

In 2008, we observed 84% survival for the 2006 and 2007 introductions (Table 2-1), and by 2011 80% of 2006 transplants survived and 61% of 2007 transplants survived. Note that we adjusted

percent survival calculations in 2008 and 2009 from previous estimates by Maschinski et al. (2010), because we discovered that some plants had been dormant and were mistakenly recorded as being dead. A grand total of 66% of the plants have survived at LMAR. Plants had highest survival in pineland (96% and 72% of 2006 and 2007 installations, respectively), while the lowest survival occurred in the grassy glade (22% survival for 2006 outplants and 58% of 2007 outplants). In addition, within the first 30 cm depth, the highest soil moisture we observed at the site occurred in the pineland (Maschinski et al. 2007). It is likely that soil moisture is related to the good survival of plants within this microhabitat. These results confirm our supposition that microhabitat is critical to the success of plant reintroductions.

Moving plants from the grassy glade to the pineland improved their survival. Of the 2006 transplants moved to pineland, 80% survived by 2011, while 100% of the 2007 transplants survived the move. In comparison plants remaining in the grassland had 22% and 58% survival, respectively. This group of plants, however, is not recovering plant canopy growth equal to plants that have been in the pineland for four and five years (Figure 2-1). It is also interesting to note that plants in the restoration glade have achieved the highest plant canopy growth of any group by 2011 (Figure 2-1; Roncal et al., in review).

At LMAR more time will be required to assess whether a sustainable viable population of *A. herbacea* var. *crenulata* has been established, because second generation plants are not yet recruiting. However, it is common for (re)introduced populations to require more than five years for second generation establishment and positive population trajectories (Bell et al. 2003; Maschinski and Haskins *in press*).

Table 2-1. Total plants and percent survival of transplanted *Amorpha herbacea* var. *crenulata* transplanted in 2006 and 2007 at LMAR. *Note that dormant plants detected in 2008 and 2009 are included in live plant counts.

	Experimental Phase			2009	Adaptive Management Phase			
Outplanting in 2006	**Total Planted**	**2008 Total Alive**	**Percent Survival 2008**	**Total Moved or Remaining**	**2009 Total Alive**	**Percent Survival 2009**	**2011 Total Alive**	**Percent Survival 2011**
ecotone	25	20	80		19	76	19	76
pineland	25	24	96		24	96	24	96
grassy glade*	25	17	68	9	2	22	2	22
restoration glade	25	23	92		24	96	23	92
moved to pineland				16	15	94	12	75
TOTAL	100	84	84	25	84	84	80	80
Outplanting in 2007								
ecotone	62	48	77		43	69	30	48
pineland	60	57	95		51	85	43	72
grassy glade*	66	50	76	62	42	68	36	58
restoration glade	57	50	88		43	75	36	63
moved to pineland				4	4	100	4	100
TOTAL	245	205	84	66	168	69	149	61
Combined Outplantings								
ecotone	87	68	78		62	71	49	56
pineland	85	81	95		75	88	67	79
grassy glade*	91	67	74	71	44	62	38	42
restoration glade	82	73	89		67	82	59	72
moved to pineland				20	19	95	16	80
TOTAL	345	289	84	91	252	73	229	66

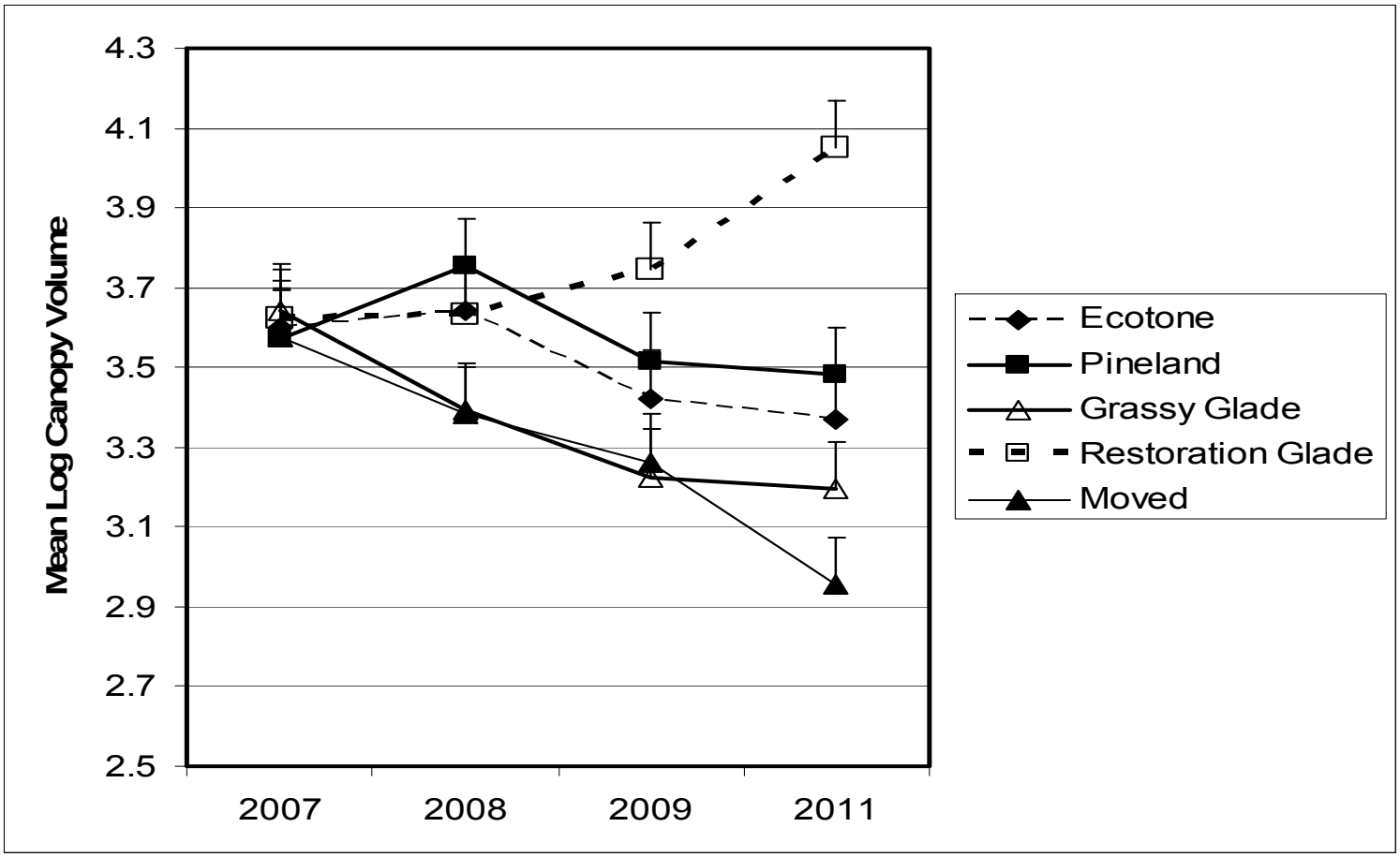

Figure. 2-1. Mean log plant canopy volume from 2007 to 2011 for each microhabitat at translocation site. Twenty plants in the "Moved" group were located in the grassy glade from 2007 to 2009 at which time they were moved to the pineland. Error bars indicate +1 SE.

CDE

Lisa Krueger and Samuel Wright

In August 1995, Fairchild staff introduced 190 *Amorpha* outplants within 7 different plots in the northern pine rockland at Site CDE (Wendelberger 2003). The outplants were most recently monitored on June 21, 2011. Of the original outplants, 67 plants (35.2%) have survived (Figure 2-2); however survival did vary between plots (Figure 2-3). Recently the outplant survival appeared to be fairly stable with 73, 73, and 71 plants alive in 2007, 2008 and 2009 respectively (Figure 2-2), but there was a decline of four plants this year.

No significant fire events occurred in the pineland from 1995 to 2007. However, a prescribed fire in April 2008 burned plots 1- 4, while a wildfire in May 2008 burned plot 7. Also in March 2010 a prescribed fire burned one of the two previously unburned plots. We tracked recruitment in 2003, 2007, and following the fires in 2008, 2009 and 2010. To determine if recruits were establishing, we recorded recruit developmental stage [Stage 1 = recruits <2cm tall with cotyledons (seedling), Stage 2 = recruits 2-10cm tall without cotyledons (seedling), Stage 3 = recruits 10-20cm tall (juvenile), Stage 4 = recruits >20cm tall but not reproductive, Stage 5 = recruits >20cm tall and reproductive (with flowers or fruits)] and identified the nearest adult plant to each recruit.

Recruit numbers in 2008 following the two fires were very high (3735 recruits), thus, burning had a significant impact on recruitment (Figure 2-2). However, recruit numbers decreased significantly in 2009 (302 recruits) and again this year (73 recruits). The decline in recruit numbers may have been due to a lower than average rainfall during the dry season of 2008-2009 and at the beginning of the 2011 wet season. Five of the recruits are at Stage 4 and one is at Stage 5, so we are optimistic that these plants will become reproductive in the future. Now that rainy season is underway we expect to see more recruitment in the burned areas. We will return next spring to monitor the population.

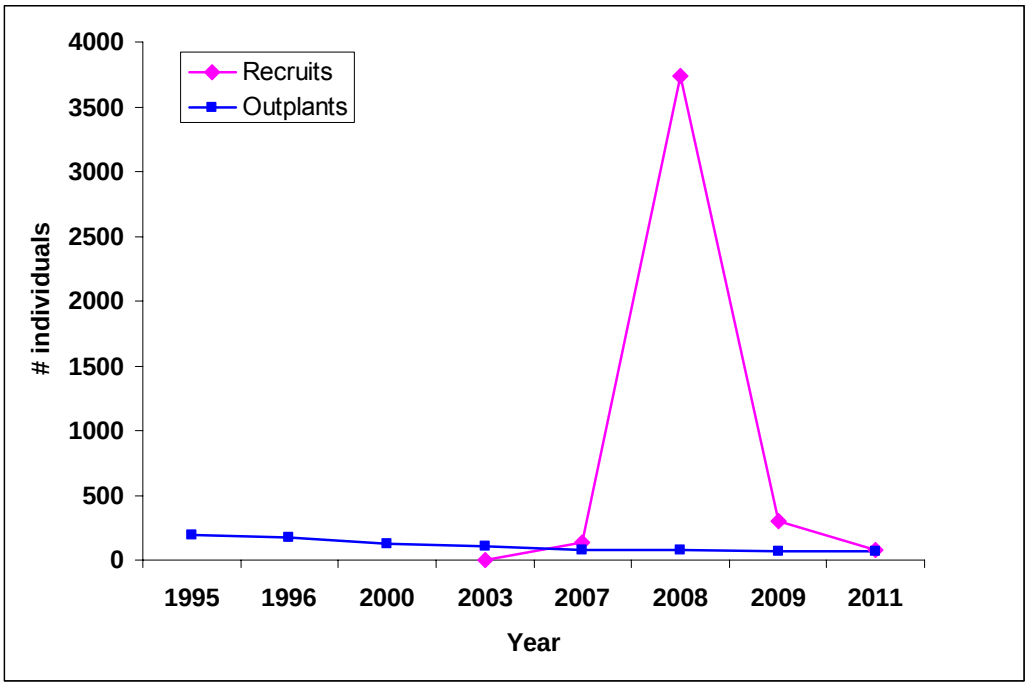

Figure 2-2. Total number of *Amorpha herbacea* var. *crenulata* outplants and recruits alive for 7 different monitoring years ranging from the initial outplanting in 1995 to the present within Site CDE. Sampling of recruits did not occur until 2003.

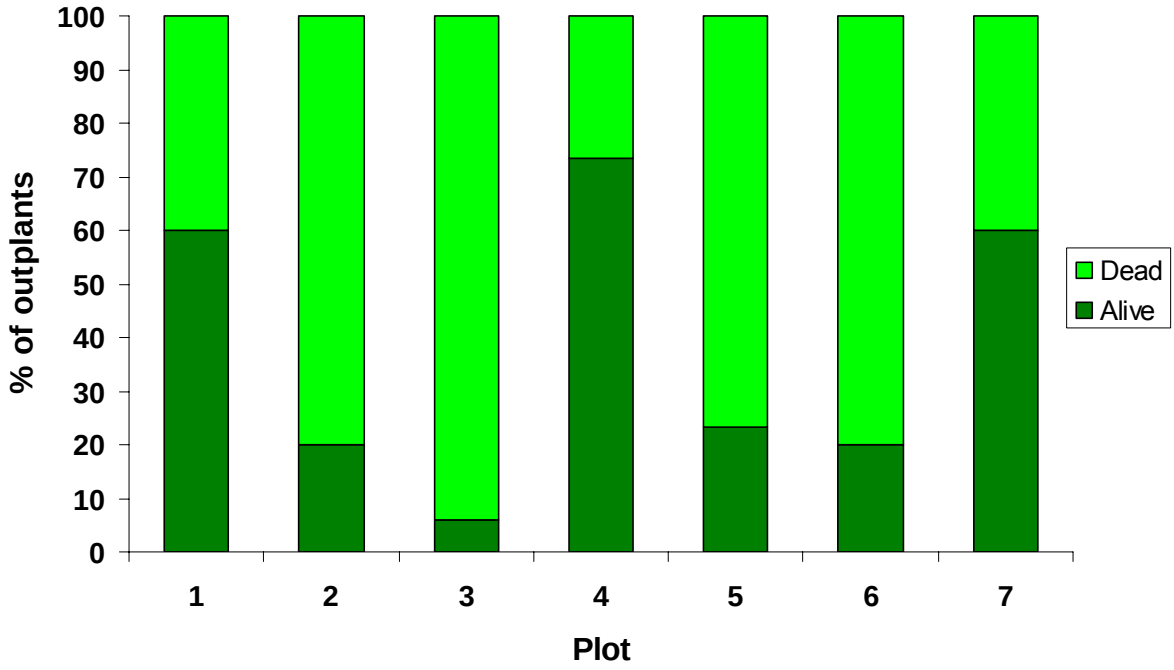

Figure 2-3. Percent of *Amorpha herbacea* var. *crenulata* outplants that were dead and alive in 2011 for the 7 different plots outplanted in 1995 within the pine rockland at Site CD

CDPE

Samuel Wright

In October 2002, Fairchild collaborated with Miami-Dade County Natural Areas Management and Florida Department of Transportation to outplant 128 propagules of *Amorpha herbacea* var. *crenulata* into a restored pine rockland at Site CDPE (Wendelberger 2003). Plants were propagated from seeds, cuttings and whole plants to test whether propagule type influences reintroduction success. After 40 months whole rescued plants demonstrated the highest survival rate (86%) and were considered to be the best translocation material (Wendelberger et al. 2007). A survey in November 2008 showed that the introduced population had declined by 68%. The population has been in steady decline since 2002, which has coincided with hardwood hammock species encroachment (Figure 2-7). Hammock species that are becoming established include: *Ardisia escallonioides* (marlberry), *Chiococca alba* (snowberry) *Myrica cerifera* (*wax myrtle*), *Psychotria nervosa* (wild coffee), *Rhus copallinum* (winged sumac) and *Trema micranthum* (Florida trema). Without intervention through habitat management (fire, mechanical removal, etc.), the canopy will continue to close thereby threatening the future sustainability of the *A. herbacea* var. *crenulata* outplanting.

Soon after the November survey, we met with CDPE land managers to discuss the possibility of removing hardwoods in and around each plot. In January 2009, the land manager hired and instructed contractors to cut and remove any hardwood species over 1 meter high in approximately a 7m x 7m area containing the *A. herbacea* var. *crenulata*. During a June 2009 survey we documented 12 more plants alive than the November 2008 survey. Due to plant dormancy in the winter we most likely overestimated mortality in the last two November surveys. We will monitor the *A. herbacea* var. *crenulata* during the growing season from now on to insure a more accurate count of survival.

On August 14, 2009 we met again with land managers to survey the site and discuss another round of mechanical removal. In September 2009, contracted crews again visited the site and performed the same methods as described above for each plot.

We last surveyed the outplanting on June 29, 2011. Although the population appeared to stabilize over the last two year there was a decline this year by seven plants (47 total). No plants were flowering or producing fruit. We still have yet to observe any seedlings from this outplanting. Last year we reported that the remaining plants appeared extremely healthy perhaps having benefited from the increased sunlight caused by the hardwood reduction (Figure 2-8). However this year the plants are very small and have very little new growth. This is most likely due to competition and shading from adjacent vegetation. We will contact the CDPE land managers to coordinate more mechanical removals.

Figure 2-7. CDPE pineland succeeding to hammock

Figure 2-8. Healthy *Amorpha herbacea* var. *crenulata* from outplanting at CDPE.

Updates on wild populations of *Amorpha herbacea* var. *crenulata*

Today ADB and TROP host the largest remnant wild populations of *Amorpha.* These populations are both in poor health, with little seedling recruitment. CPP contains the smallest known population left in the wild. An update on the health of the wild populations on Miami-Dade County preserves follows.

ADB

Jennifer Possley

In Possley et al. (2010), we reported that the *Amorpha* cluster near the butterfly garden at ADB was in urgent need of protection from mowing, parked cars, and further development. We suggested placing boulders along the perimeter of this circular pine rockland remnant to ADB management, in order to prevent mowing over the plants. Preserve manager Sonya Thompson did exactly that, and those individuals are no longer mowed or driven upon (Figure 2-4).

Figure 2-4. New boulders on the North side of the butterfly garden, April 2010

An additional recommendation in Possley et al. (2010) was to relocate a small cluster of *Amorpha* persisting under thick pine and hardwood canopy (the southwest extent of the population). This action was recommended because long term survival of these individuals was in doubt unless the surrounding canopy could be dramatically thinned—which did not seem logistically feasible. On 22 June 2010, Devon Powell and Jennifer Possley extracted six *Amorpha* from this shaded location. A few plants appeared to be 2-3 intertwined individuals, so in total, we removed nine plants (Figure 2-5). While these plants had large roots, they had very few leaves. Devon potted them up in the nursery and cared for them for 3 months. The plants responded vigorously to the disturbance and/or increased light. On 23 September 2010, Devon and volunteers replanted all of these individuals in a sunnier area at the park, next to other *Amorpha.*

Figure 2-5. Jennifer Possley with a freshly unearthed *Amorpha;* the nine removed individuals growing vigorously at Fairchild's nursery a few weeks later.

Monitoring of the wild *Amorpha* population at ADB was completed in August 2010. We counted 192 woody individuals. In 2009, we reported finding only 133 plants, but we conducted this survey in November, when many of these semi-deciduous plants were difficult to find. Leaving those 2009 data out of the graph below, Fairchild's monitoring of the population since 2003 shows a declining trend (Figure 2-6).

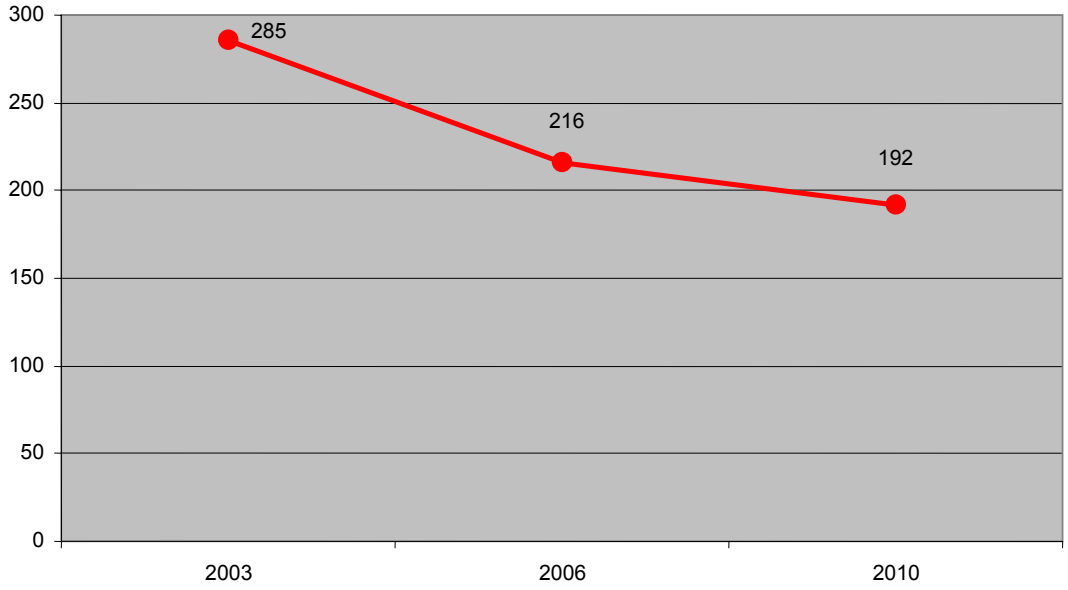

Figure 2-6. Number of woody *Amorpha herbacea* var. *crenulata* at ADB, excluding seedlings.

Litter depth at individual *Amorpha* plants (measurements were taken approximately 10 cm North and South of each plant) averaged 2.3 cm deep (±0.1 Std. Error), while litter depth at *Amorpha* that had nearby seedlings was 1.8 cm (±0.2). While an overall mean litter depth of 2.3 cm is still too high, it is almost as low as the threshold of 2.0 cm recommended by Wendelberger & Maschinski (2009), and 3.2 cm less than the mean litter depth at each *Amorpha* in ADB in 2009. We attribute this difference to the prescribed burn in the northwest portion of the natural area on 26 May 2010. Although it may be too soon, we did not see a surge in seedlings in this area as might be expected after a prescribed burn. We hope that seedling numbers may increase in 2011 and 2012.

Regular prescribed burns are urgently needed throughout this *Amorpha* population if it is going to be self-sustaining. Ideally, burns would be conducted annually for 2-3 years and then at 2-3 year intervals.

TROP

In September 2010, we monitored the wild *Amorpha* population at TROP. We counted a total of 297 individuals; 101 of these were pre-existing tagged individuals and 196 were newly counted seedlings. During the previous complete monitoring in 2008 we reported finding 162 individual plants; 98 of those were pre-existing plants and 63 were newly counted seedlings.

Litter depth at individual *Amorpha* plants in 2010 (measurements were taken approximately 10 cm North and South of each plant) averaged 1.8 cm (±0.1 S.E.), compared with the 2008 average litter depth which was 4.0 cm (±0.3 S.E.).

We attribute the decrease in litter depth and increase in number of seedlings to habitat improvement workdays that we have organized since 2008. On January 22nd 2011, Fairchild and NAM worked with local students (Figure 2-9) as part of the Fairchild Challenge; 40 students spent several hours manually removing non-native, invasive Asian sword fern (*Nephrolepis brownii*) and bracken fern (*Pteridium aquilinum* var. *caudatum*), which is native but grows so densely at TROP that it excludes virtually all other native species. We also returned on two dates in March 2011 with FTBG volunteers to continue removing Asian sword fern. With continued invasive species removal and regular prescribed burns, we hope the *Amorpha* population will continue to grow.

Figure 2-9. Volunteers students that assisted with removal of non-native, invasive Asian sword fern (*Nephrolepis brownii*) and bracken fern (*Pteridium aquilinum* var. *caudatum*).

CPP

FTBG first monitored the *Amorpha* at CPP in 1995 when we mapped and tagged 19 plants. The population has been in a steady decline since then (Table 2-2). In 2009, we retagged and remapped all known plants because previous tags could not be found. Remaining plants are in an area where the canopy has virtually closed and in the absence of fire, hardwood species are succeeding and becoming established in the pineland. Due to this fire exclusion, CPP is not a very healthy pineland; of the 148 documented species at CPP, 54 are not native (Gann et al. 2011). Plants encroaching into the population area include native *Quercus virginiana* (live oak) and non-native invasive plants *Flacourtia indica* (governor's plum) and *Dalbergia sissoo* (Indian rosewood). Other invasive species located in the pineland include native *Trema micranthum* (Florida trema) and non-natives *Albizia lebbeck* (woman tongue), *Neyraudia reynaudiana* (burma reed) *Acacia auriculiformis* (earleaf acacia) *Abrus precatorius* (rosary pea), *Nephrolepis multiflora* (Asian sword fern), and *Nephrolepis cordifolia* (tuberous sword fern).

During a September 2010 visit to the site we removed the thick pine duff layer surrounding the remaining plants. Before removing we measured the duff layer next to the plants (n=5) which averaged 12.4 cm. This is more than 10 times deeper than ideal seed germination and seedling survival conditions reported by Wendelberger and Maschinski (2009). We also cut branches above the plants to allow more light to reach the plants.

We last surveyed the population on June 29, 2011 and documented only three adult plants. We did however observe one seedling. It is possible that the germination of the seedling occurred because of the removal of the duff layer. However, in the 9 months since the duff removal; the pine needles have already accumulated an average of 3.5 cm next to the remaining plants.

It is apparent that the CPP pineland is in need of a prescribed fire. However, due to the surrounding residential area (Figure 2-10) a prescribed burn may not be feasible. As an alternative, mechanical removal of all hardwoods and invasive plants should occur in the immediate vicinity of the population. Also in order to encourage germination the pine duff needs to be raked. Another option could also be to translocate the plants to more suitable habitat.

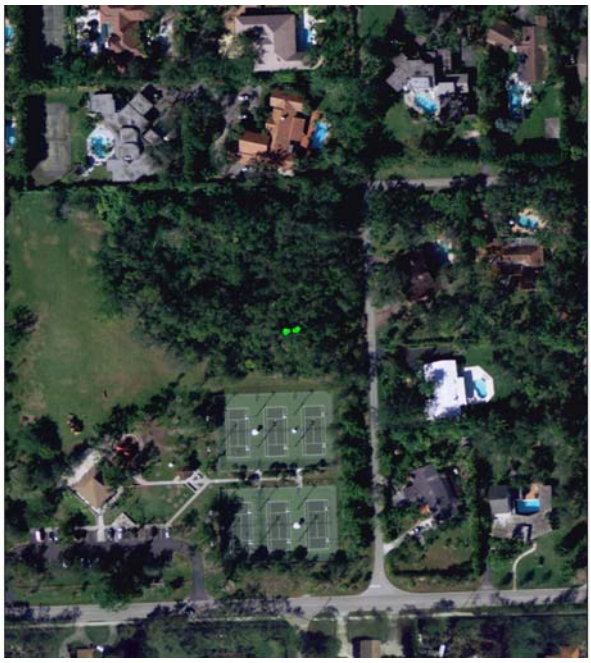

Figure 2-10. Amorpha population at CPP surrounded by housing development

Table 2-2. Population surveys of *A. herbacea* var. *crenulata* at wild and introduced sites (last three)

Site	1991	1992	1993	1995	1996	1997	2000	2001	2002	2003	2005	2006	2007	2008	2009	2010	2011
Wild																	
ADB			193	177			254	270		275		163			133		
TROP			93	61	80	62	85	178		114	125			162			297
MHP	10		8				4		6	4	3	1		1	1	0	
CPP		2		19			10			9		8			7	5	3
RN												1					
Outplanted																	
CDE				190						99		64		72	71		67
CDPE									128	94	85	71		41	53	54	47
LMAR												100	345	266	243		229

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Asplenium x *biscaynianum* (D.C.Eaton) A.A.Eaton

Jennifer Possley

Introduction

Asplenium x *biscaynianum* is an endemic hybrid between two of Florida's endangered ferns, *A*. *dentatum* and *A. verecundum.* The state of Florida does not list it as endangered due to its hybrid status. The Institute for Regional Conservation lists it as critically imperiled. While it has been documented from conservation lands in the past, it is now known only from two private homes in Pinecrest, a suburb of Miami.

Update on wild populations

In February 2010, three Fairchild staff and four volunteers dedicated a morning to removing weeds in the vicinity of *A.* x *biscaynianum* in one of the yards where it persists. We removed 25 large trash bags full of *Epipremnum pinnatum, Tectaria incisa*, *Tradescantia zebrina*, and other aggressive weeds (pics). The other (adjacent) yard that also contains *A.* x *biscaynianum* is managed regularly and weed encroachment is not a major issue. While we have not visited this yard in the past year, we plan to do so in Fall 2011, to coincide with the potential fertile period of *Lomariopsis kunzeana.*

Update on ex situ collections

Fairchild collected spores from *Asplenium* x *biscaynianum* from one of the private properties in June 2005. While fern hybrids are often sterile, CREW achieved germination. However, those individuals were not in fact *A.* x *biscaynianum*, but contaminant fern species. We do not yet know whether any spores from this rare hybrid have actually germinated at CREW, but so far indications are that they will not. It is not uncommon for hybrids to be sterile.

Next Steps

We believe our periodic weeding at one of the homes is important for maintaining this population of *Asplenium* x *biscaynianum*, and we do not believe the homeowner would choose to hire landscapers to do this work. We will continue to offer our services to this homeowner once or twice a year, while at the same time viewing the general health of the *Asplenium* x *biscaynianum* population.

We will continue to wait and see whether true sporophytes develop at CREW. If sporophytes form, we will establish an ex situ collection at Fairchild, conduct pilot reintroductions in Fairchild Garden, and eventually reintroduce plants to sites where *A.* x *biscaynianum* once grew.

Asplenium verecundum Chapm. Ex. Underwood

Jennifer Possley

Introduction

Asplenium verecundum is a small, lacey, limestone-loving fern (Figure 3-1) that is native to Miami-Dade County and a handful of counties in North Florida It is also present in Cuba, where its conservation status is not well known. Three Miami-Dade County preserves (FUH, CASH and CASR) currently contain *A. verecundum,* though the latter two properties are adjacent and could be considered as one occurrence. In addition, *A. verecundum* is present on 2-3 private properties in Miami-Dade County. It is difficult to conduct a thorough census of this species, but we attempt to make population counts every 1-3 years.

In 2005, we collected *Asplenium verecundum* spores from two Miami-Dade County preserves (FUH & CASH) and from a natural population in the yard of a private Miami home. We sent all spores to CREW (Center for Conservation and. Research of Endangered Wildlife), where they germinated within weeks. By 2006, the cultures produced sporophytes. In 2007, Fairchild received the first sporophytes from CREW. As we reported in July 2009, CREW has successfully stored *A. verecundum* spores using cryopreservation methods, and has added this species to their "frozen garden."

Asplenium verecundum is the first fern species for which we attempted any sort of outplanting. As we previously reported, in summer 2009, we planted 13 *A. verecundum* into two locations in Fairchild Garden, with the goals of (1) developing establishment methods to guide a future reintroduction, and (2) to establish a permanent, viable, ex situ population. We placed 3 in the Sunken Garden (within a few feet of a waterfall) and nine on a limestone wall inside the Conservatory. Later, we removed plants that were in poor health (all of the Sunken Garden plants and two in the Conservatory) and brought them back to research terraria to recover.

Update on wild populations

CASH

During a thorough (pre-Hurricane Wilma) survey in 2004, we counted 84 *A. verecundum* sporophytes in CASH. In December 2010 and January 2011, we counted 181 individuals. The populations appeared to be very healthy. In between sampling dates, the NAM crew removed dense areas of non-native trees and vines (*Jasminum* spp., *Schefflera actinophylla, Bischofia javanica, Schinus terebinthifolius*), which enabled us to find several "missing" holes that we had not seen since 2004.

CASR

We conducted a thorough survey of known large solution holes in CASR in December 2010, counting 139 *A. verecundum* sporophytes. This is a marked increase from our December 2010 count of 81 plants. The *A. verecundum* at CASR seems to be thriving. Air potato is very thick in some of the areas where *A. verecundum* grows. While it is not yet smothering any of the ferns, we recommended to land managers that aggressive control be implemented promptly before the ferns are extirpated.

Figure 3-1. An especially robust *Asplenium verecundum* at CASR with close to 20 fronds. 12/29/2010.

FUH

We reported last year that *A. verecundum* may be declining at FUH, and data from our most recent survey supports this. In October 2004 we estimated 135 individuals. In December 2009, we counted 25. And in this most recent December 2010 survey, we counted 20, though on that date we were unable to find the largest sinkhole with the best population of *A. verecundum*, so an estimate of 30 plants is probably more realistic. Reasons for this apparent decline are unclear. It may be tied to recent unusually cold, dry winters. In some areas of the preserve, it is likely due to accumulation of *Schefflera* leaves. Continued removal of *Schefflera* and exotic vines is recommended in order to maximize the area of appropriate habitat for *A. verecundum.*

Update on ex situ collections

As of May 2011, we have 30 robust *A. verecundum* sporophytes in terraria. We have had high survivorship of this species in cultivation. Eight of the 9 plants in Fairchild's Conservatory are alive and should serve as a permanent ex situ collection. One plant died recently. We believe it received too much sunlight and not enough humidity. We now monitor the eight remaining plants more frequently and will try to remove others that may be failing before they die.

Next Steps

Our objectives for *A. verecundum* in 2011-2012 are to:

- Receive more sporophytes from CREW and grow them into larger plants in Fairchild terraria.
- Continue to monitor the pilot introduction of 8 individuals in Fairchild's conservatory.
- In Summer 2012 conduct a reintroduction to a Miami-Dade County preserve (CDE) where *A. verecundum* was collected in the early 1900s but has since been extirpated, provided that hydrologic restoration the historic slough there is complete.

Basiphyllaea corallicola (Small)Ames

Introduction

Basiphyllaea corallicola is a diminutive terrestrial orchid that is listed as endangered by FDACS and critically imperiled by IRC. Its global range includes pine rocklands in South Florida (Miami-Dade and Monroe Counties) and the West Indies (Gann et al. 2002). The only Miami-Dade County preserves that contain *B. corallicola* are CDE and BSP. Fairchild has been monitoring both populations since 2004.

In October 2006, Fairchild collected *B. corallicola* seeds from two individuals at CDE and sent them to CREW. These germinated quickly, enabling CREW to send several dozen plants back to Fairchild in 2007 and 2008. In total, Fairchild has received 86 plants from CREW. At both organizations, plants have failed to thrive in cultivation.

Update on wild populations

CDE

When *B. corallicola* was first discovered at CDE in 1991, Fairchild and Miami-Dade staff counted 47 individuals. During the 2004 census we found only 27 plants. Every year since then, the numbers have dwindled. In fall 2010, we were only able to relocate two plants, neither of which flowered. It is difficult to determine whether this apparent population decline represents actual mortality or dormancy.

BSP

Basiphyllaea corallicola appears to be faring very well at BSP. In fall 2010, we estimated 435 individuals were present in a former pineland that is succeeding to hammock. This is the highest population count we have observed since we began monitoring.

Summary of wild *B. corallicola* population counts

Site	1991		2004	2005	2006	2007	2008	2009	2010
CDE	47		27	10	6	5	3	3	2
BSP			345	Present	present	50-100	150-200	192	435

Update on ex situ collections

Currently, Fairchild has less than 10 *B. corallicola* remaining in cultivation. For the majority of the year, *B. corallicola* exists only as a tiny leafless bulb, making it difficult to determine survivorship. CREW maintains *B. corallicola* lines in culture, but they are also failing to thrive. This may be because we are missing a critical mycorrhizal symbiont.

Next Steps

We will continue monitoring the Miami-Dade County populations annually. Because neither CREW nor Fairchild Tropical Botanic Garden have developed methods for cultivating this species successfully, we do not have plans to collect more in the near future. However, if we find plants at CDE that flower and produce pods, we will collect seeds to send to the NCGRP for storage.

Dalea carthagenensis (Jacq.)J.F.Macbr. var. *floridana* (Rydb.)Barneby

Introduction

The sub-shrub *Dalea carthagenensis* var. *floridana* is a Florida endangered species and a candidate for the USFWS endangered species list. It is endemic to South Florida, and is found only in Miami-Dade and Monroe Counties. The taxon (hereafter "*Dalea*") can be found only in four protected areas: Big Cypress National Preserve and the Miami-Dade County preserves CDE, RHMP and CR. It is also known to be present in three unprotected areas in Miami-Dade (personal communication, K. Bradley, IRC).

Update on pine rockland populations

Jennifer Possley

We have censused *Dalea* at CDE and RHMP once or twice annually since fall 2003. At both locations, the numbers have fluctuated widely. We conduct quick counts of individuals, dividing them into the categories of "woody" and "seedling."

At CDE, total *Dalea* population count hovered around 50 plants from 2003-2007; subsequently, we documented a dramatic increase in seedling establishment (Figure 4-1). We are uncertain how to explain this increase, but we are confident that it was aided by manual hardwood thinning in 2008 and prescribed fire in 2009. During our most recent monitoring in December 2010, we found that recent cold temperatures (mid to low 30s) had left adults partially defoliated and seedlings completely defoliated or dead. At that time, we estimated 320 total individuals (288 woody and 32 seedlings), but those numbers may be low since plants (especially small ones) were difficult to find. We will repeat a survey in summer of 2011 to reassess the population. Adults often resprout from dormant state (Figure 4-2).

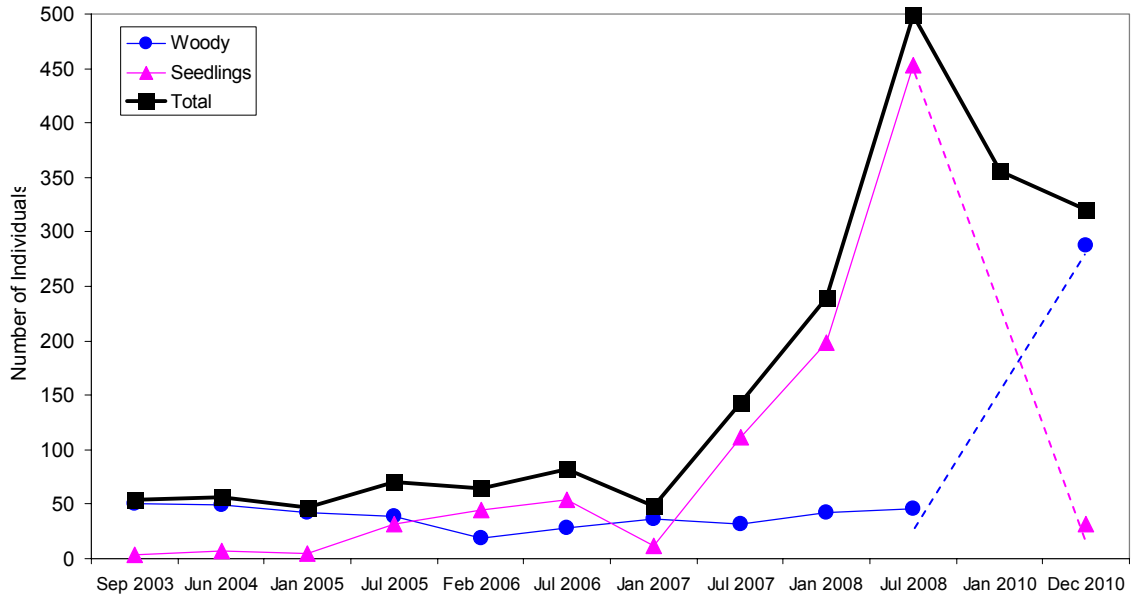

Figure 4-1: Population counts of *Dalea carthagenensis* var. *floridana* at CDE North. We did not distinguish between woody plants and seedlings in January 2010.

Figure 4-2. An established *Dalea carthagenensis* var. *floridana* resprouts from its roots after a prescribed burn at CDE

Until recently we had collected and stored *Dalea* seed from RHMP and CR, but not CDE. In March 2011, we collected seed from 11 individuals and will send it to the NCGRP for storage, so that genetically diverse samples of all Miami-Dade County populations are represented in ex situ seed collections.

The RHMP population of *Dalea* experienced a gradual decline from 2003-2008, with a dramatic recovery in 2009. The recovery began after Miami-Dade County Natural Areas Management crews raked pine straw away from the area where *Dalea* most recently grew. During our most recent monitoring in February 2011, we counted 204 total individuals (100 woody and 104 seedlings) (Figure 4-3).

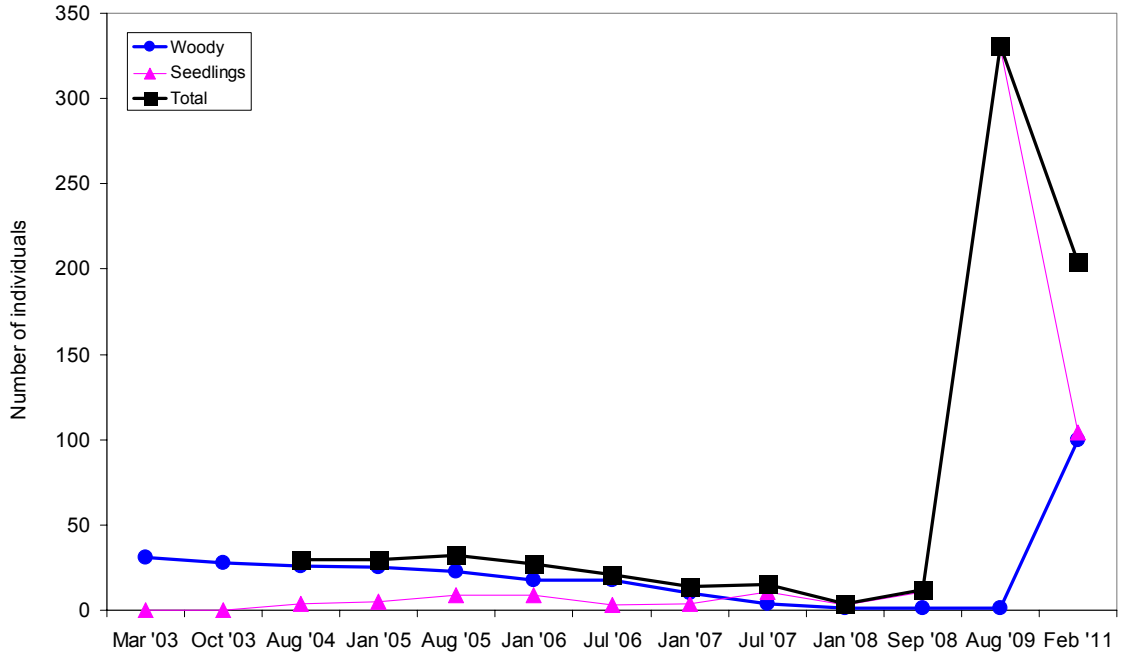

Figure 4-3: Population counts of *Dalea carthagenensis* var. *floridana* at RHM

Update on experimental seed reintroduction

Jennifer Possley

As reported previously, we initiated an experimental reintroduction of 6000 *Dalea* seed at RHMP in summer 2009 (see Maschinski et al. 2010 for complete details). In 2010, we noted 152 *Dalea* that established in our research transects. We intend to conduct 2-year sampling in summer 2011, and will analyze and interpret results after that time.

Next Steps

We will continue annual monitoring of *Dalea* populations in Miami-Dade County preserves, including both wild and reintroduced populations.

Demography Study

Joyce Maschinski and Julie Moore

We compared population growth patterns of the federal candidate species *Dalea carthagenensis* var *floridana* in two pine rockland sites and one coastal strand habitat. Known from five publicly owned sites (Gann and others 2005) and a handful of privately owned sites (Bradley 2005, pers. comm.), the species is under severe threat from fire suppression, invasive exotic species, and human activities that have contributed to an alteration or reduction of its habitat.

Coastal Strand

At Site CR we initiated demographic studies in February 2007 of *D. carthagenensis* var *floridana* growing in coastal strand. The demographic plot measuring 3m x 10m, is stretched randomly through the total population area of 145m^2. Approximately 20% of the population was sampled; in 2007, we estimated total population size to be approximately 1000 plants.

Each year we tagged new individuals, recorded location along the x and y axes of the plot and measured height, perpendicular widths 1 & 2, and the number of inflorescences. We categorized plants into one of three growth stages: 1) seedlings were not woody and had 10 or fewer leaves. Some had cotyledons present. 2) Juveniles were woody plants lacking inflorescences, with > 10 leaves and generally > 15 cm tall. 3) Reproductive adults had inflorescences present.

To examine growth rates of individuals we calculated plant volume (volume = 4/3 (3.14* ht*ht*w1) following Ludwig et al. (1975). For the subset of plants that lived from 2007-2011, we calculated change in average growth and plotted this for plants in each of the three stages in 2007. The number of 2007 plants in each stage that lived until 2011 was 4 seedlings, 18 juveniles, and 14 adults.

We used population viability analysis to examine extinction risk of the CR population. To accomplish this, we used a three stage model (seedlings, juveniles, adults) and calculated proportion of the population transitioning between stages in 2007-2008, 2008-2009, 2009-2010, and 2010-2011. We estimated reproductive values using the following formula: r = sdlgs/inflorescence * 0.97 germ rate *0.5 (viable seeds/inflorescence). We used RAMAS Metapop software to model the population trajectories.

Individual Plant Growth

Plant volume for adults did not significantly change from 2007-2009, while juveniles and seedlings had rapid growth in the first two years. From 2009-2010 plant volume increased for adults and juveniles, but held constant for seedlings. All stages had increased growth between 2010 and 2011 (Figure 5-1). Continuing to track individual growth will give us insight into the average (and extreme) longevity of individuals. Growth rates are likely influenced by climate and seem to affect stages differentially.

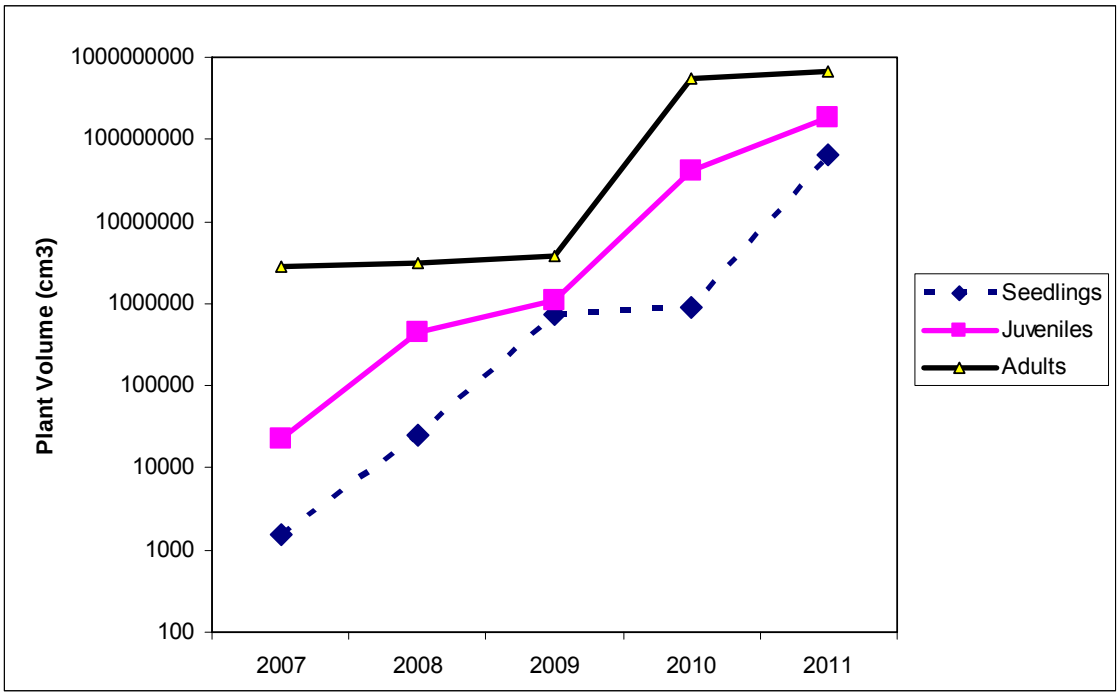

Figure 5-1. Plant volume of *Dalea carthagenensis* var. *floridana* from 2007-2011. Note the sample includes only those plants that lived for all 5 years. Groups are based upon the stage of the individuals in 2007.

Population Growth

The population at CR declined by 33% from 2007 to 2009, but high seedling recruitment stabilized numbers by 2010 (Figure 5-2). Seedling recruitment significantly varied across years. The especially dry winter in 2008-2009 negatively affected seedling establishment by our sampling period in 2009 (Figure 5-3). Because seeds require cold stratification to germinate, the cold winter of 2009-2010 was probably favorable for seed germination. The period from 2010 to 2011 shows another dramatic decline in the population. One hypothesis for this decline is the relatively dry conditions that occurred in late 2010/early 2011. However, there may be other factors at play such as salt-water encroachment and/or mild winter temperatures.

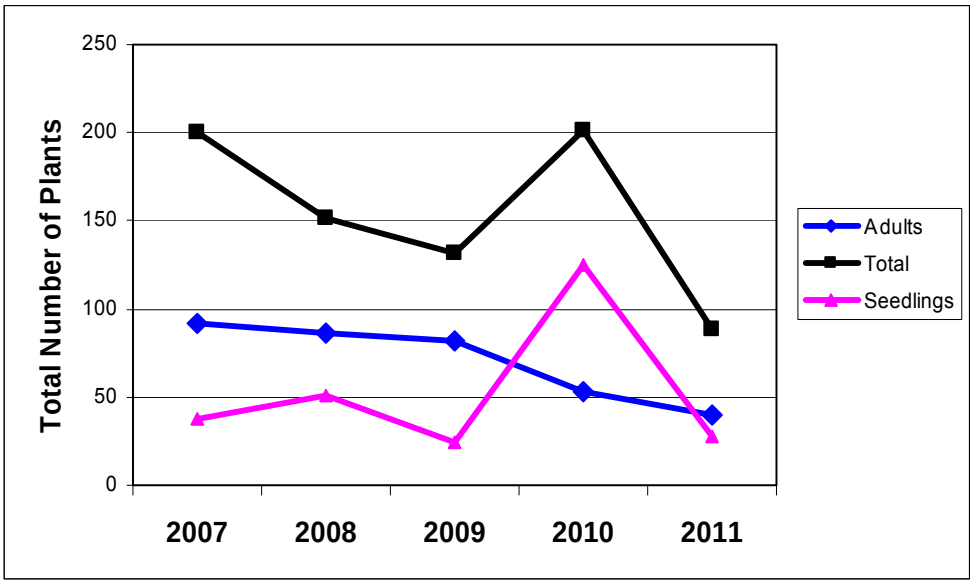

Figure 5-2. Numbers of *Dalea carthagenensis* var *floridana* seedlings, juveniles, and adults alive in demographic plot at CR in 2007- 2011**.**

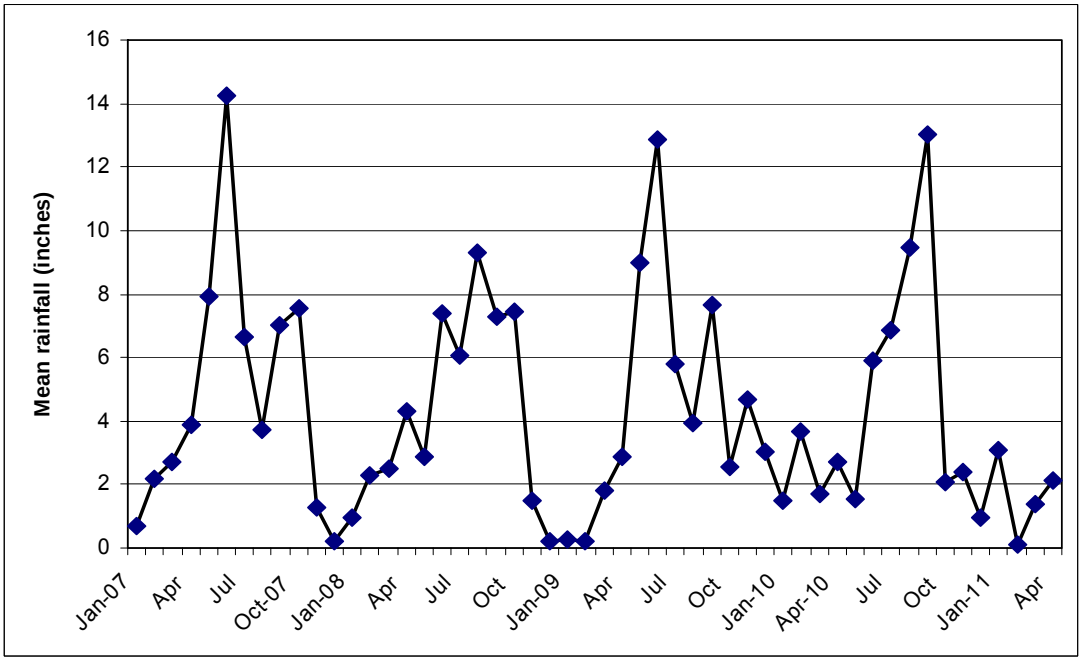

Figure 5-3. Mean monthly rainfall near CR (SFWMD station 26) January 2007 through Apr 2011. Note the prolonged drought from Dec 2008 through Feb 2009.

Transitions between stages in 2007-2008, 2008-2009, 2009-2010, and 2010-2011 reflect the dramatic changes in seedling pulse in the study period (Table 5-1). Preliminary population viability analysis of the CR population indicates that it is slowly declining, but has a relatively low extinction risk within the next 50 years. Lambda was 1.003 for 2007-2008, 0.987 for 2008-2009 for 0.985 for 2009-2010 and 0.973 for 2010-2011, indicating that the population has slightly declined in the last three transition periods (Figures 5-2 & 5-4). The vital rates most critical for sustaining the population were the transition from seedling to adult and adults remaining alive in the population between transition years. We suspect that *D. carthagenensis* var *floridana* is a short lived perennial. Although we have not tested for a seed bank, given the pattern of population growth, we expect that there is a persistent seed bank and that knowledge of the seed bank could be used to improve the precision of the PVA.

Table 5-1. Transition matrices for *Dalea carthagenensis* var *floridana* in 2007-2008, 2008-2009, 2009-2010, and 2010-2011 and the average of the four transition years.

2007-*2008*	**Seedling**	**Juvenile**	**Adult**
Seedling	0	0	1.3
Juvenile	0.37	0.19	0.08
Adult	0.05	0.46	0.57

2009-*2010*	**Seedling**	**Juvenile**	**Adult**
Seedling	0	0	4.33
Juvenile	0.24	0.21	0.14
Adult	0	0.14	0.55

2008-*2009*	**Seedling**	**Juvenile**	**Adult**
Seedling	0	0	0.63
Juvenile	0.32	0.19	0.13
Adult	0.1	0.63	0.66

2010-*2011*	**Seedling**	**Juvenile**	**Adult**
Seedling	0.15	0	0.01
Juvenile	0.01	0.35	0.17
Adult	0	0.26	0.6

Average Matrix **2007**-*2011*

	Seedling	**Juvenile**	**Adult**
Seedling	0.15	0	1.57
Juvenile	0.24	0.24	0.13
Adult	0.04	0.37	0.60

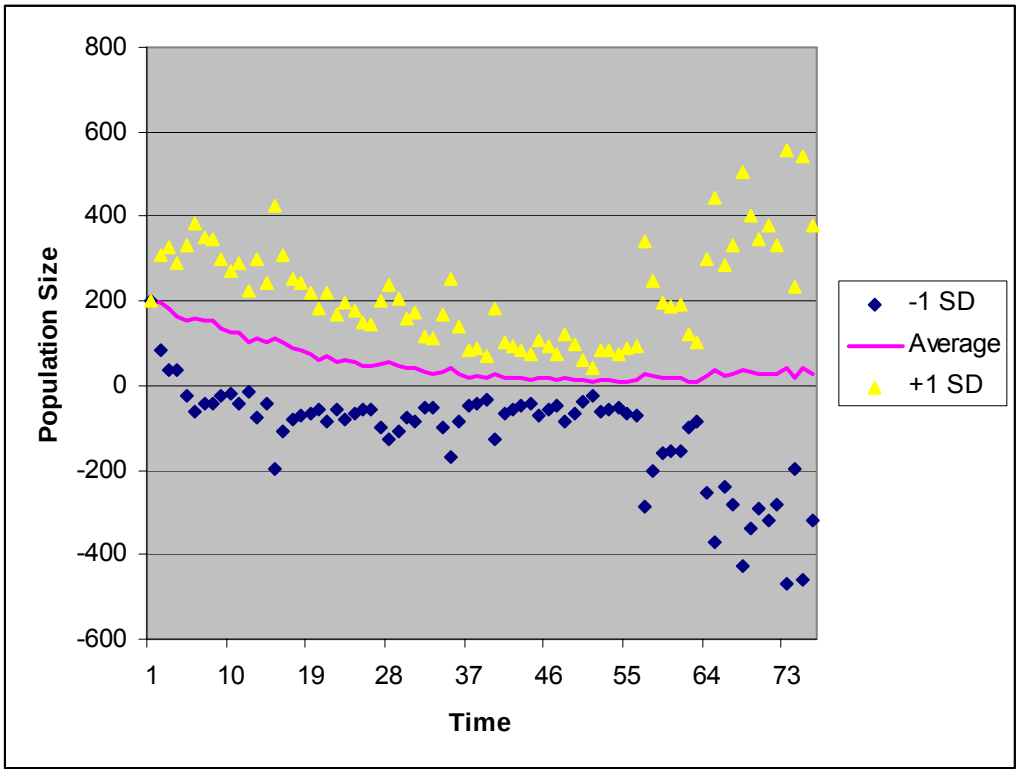

Figure 5-4. Trajectory of population size at CR showing the average, ± 1 Standard Deviation using data from 2007-2011.

Next steps

Population viability analysis indicates that the population in the area where we are sampling is declining, but over our sampling period the population has expanded spatially. We plan to install one or more additional sampling plots to increase the spatial area covered for our study. We will continue collecting seeds of the population for storage at NCGRP.

Outplanting at VKBP

Samuel J. Wright

There is only one known coastal population of *D. carthagenensis* var*. floridana*, which Fairchild discovered in 2003 at CP during a vegetation survey (Wright 2003). Before this observation *D. carthagenensis* var*. floridana* has not been observed at CP in over 35 years (Gann et al. 2002). It was thought to be extirpated from all coastal sites. Establishing additional coastal populations is vital to the overall sustaibability of this species.

During 2007 and 2008 we collected seeds from the CP population. Using these seeds we propagated plants to be used for future outplanting purposes. We donated 25 *D. carthagenensis* var*. floridana* plants to Miami-Dade County's DERM (Department of Environmental Resource Management) to be included into a large dune restoration project at Virginia Key Park on September 26, 2009.

We last surveyed the outplanting on July 21, 2011 and there are currently no plants alive. Although the cause of mortality is unknown, we theorize that this may have been caused by two factors: age of the dune and substrate of the re-nourished beach. The beach has recently been re-nourished with off-site sand that is finer than natural on-site sand, and becomes more compact and hardened than natural beach sand, which may inhibit root expansion and decrease soil aeration. The dune is in very early stages of succession and the surrounding vegetation is not yet established, therefore it is possible that it does not provide protection for the *Dalea plants* from wind and salt spray. Sections of the backside of the dune that have not stabilized are experiencing erosion problems leading to the burial or washing out of plants (Figure 5-5).

For future *D. carthagenensis* var*. floridana* outplantings we will select already established coastal/strand habitats that have natural substrate and also provide protection for the plants.

Figure 5-5. Heavy erosion of backside of dune at VKBP.

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***Jacquemontia reclinata* House**

Surveys of wild populations of *Jacquemontia reclinata*

Samuel J. Wright

Surveys of recently discovered populations

OP
2009
In 2009, we reported a new population of *Jacquemontia reclinata* that was discovered by an amateur botanist in 2007. In 2008, he informed the Florida Natural Areas Inventory (FNAI), and in August 2009 we visited the site and confirmed the presence of *J. reclinata*. Although not ideal habitat for *J. reclinata,* the plants looked extremely healthy and productive. The plants occur in a vacant lot (Figure 6-1), between A1A and a housing development, approximately 300m west of the ocean.

The site was and is heavily disturbed, there is no natural topography and the lot is regularly mowed. Most commonly associated species include *Cenchrus incertus* (sandspur), and non-natives *Stenotaphrum secundatum* (St. Augustine grass) and *Dactyloctenium aegyptium* (Durban crowfoot grass). We notified the Broward County Parks and Recreation Division to make them aware of this new population in Broward County. We also made contact with the property owner and received permission to collect seeds and cuttings. The property owner has also agreed to mow around the plants, which are now flagged.

Figure 6-1. Vacant lot at OP with wild *J. reclinata* population

2010
In March 2010, we documented and mapped 18 *J. reclinata* plants and sent shapefiles of plants to Florida Natural Area Inventory (FNAI) for their records. We collected a voucher specimen, which is currently stored within Fairchild's herbarium. We also collected seeds and cuttings from the population. The seeds were sent to The National Center for Genetic Resources Preservation (NCGRP) in Fort Collins, Colorado for safekeeping. Of the 167 cuttings we collected, 86 are currently alive (52 % survival) and maintained at Fairchild's nursery. The remaining plants appear very healthy (some flowering) and will be translocated as a soon as an appropriate recipient site is found. We are currently in the process of locating a potential reintroduction site.

2011

In April and May 2011, we visited OP to survey the population and collect more seeds. Of the 18 plants we documented last year, 16 plants are still alive, however we did observe 14 more total recruits (seedlings, juveniles and adults). We tagged four of the recruits that are flowering and fruiting, and now consider Site OP to have 20 adult plants. We also collected 3046 seeds from 9 plants. We plan to send the seeds to NCGRP. There are no immediate plans for the development of the site, so in the interim we would like to collect as many seeds as possible. We plan to periodically visit OP to collect more seeds. If available, we will also include more plants during the seed collection to have a better representation of the population.

Using Google Earth's Historic Imagery feature we discovered that as recently as 2003, a condo housing development occupied the footprint and adjacent areas of the current *J. reclinata* population. The aerial photos clearly show that the development covered the location of the population (Figure 6-2). We cannot say for certain if the seed bank remained from a previous population, or was naturally dispersed onto the site. If the plants originated from the seed bank, the seeds have demonstrated the ability to remain viable even after being buried for 10-15 (?) years. Previous studies showed *J. reclinata* seeds can remain viable for at least a year (Pipoly 2006). Seed burial studies for durations greater than 1 year are needed to determine longevity of seed viability. If the seeds have the ability to remain viable for an extended period of time (>10 years) then this is beneficial to the species. It is possible that more plants may be observed at disturbed sites in the future.

Figure 6-2. Aerial photos of Site OP in 2003 showing condo development and in 2011 with current *Jacquemontia reclinata* population.

Next Steps

We have now collected seeds from 17 of the 22 plants that we documented at Site OP and sent them to the NCGRP. We have also collected cuttings from 13 of the 22 plants. Ideally we would like to collect material to represent the whole population, but due to age, size and fruiting seasonality variation this may not be possible. The future of the site remains uncertain, but eventually it will be developed. We will continue to collect material from the site and remain in contact with the land owner. We will also continue to search for an appropriate recipient site for the propagated plants.

JUL

In 2009 we reported a newly discovered population of the *Jacquemontia reclinata* at JUL to FDACS (Wright 2009). We last surveyed the population in June 2011. We were asked by land managers of JUL for a summary report with management recommendations in relation to our observations. The following is the report that we submitted to JUL land managers in June 2011:

Report to JUL Land Managers
Introduction

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 and two private sites ranging from Miami-Dade County to northern Palm. Beach Primary habitat includes coastal strand areas that historically experienced hurricanes and fire (Austin 1977, USFWS 1996).

During an invasive plant survey at JUL State Park on May 12, 2009, Chris Lockhart of the Florida Natural Areas Inventory (FNAI) found a previously undocumented population of *J. reclinata*. FNAI found the plants in an area currently undergoing invasive plant removal (Figure 6-3) and estimated the population to be approximately 15-20 plants. This is a significant find, because there is only one other known population in Broward County on protected public lands, HTB State Park. It is not certain if a few remnant plants occurred before the removal and/or if the seed bank responded to the disturbance. The park is in the process of removing all the *Casuarina equisetifolia* and other non-native invasive plants such as *Colubrina asiatica* (lather leaf), *Schinus terebinthifolius* (Brazilian pepper) and *Scaevola taccada* (beach naupaka). It is possible that more *J. reclinata* plants will emerge as removal efforts continue. The following is a summary of site surveys conducted by Fairchild followed by management recommendations.

Figure 6-3. Restored area where *J. reclinata* was first observed at JUL

Site Visits and Observations
2009

On May 17, 2009 we visited JUL and confirmed the presence of *J. reclinata* in the previously reported location. Also, similar to HTB, the JUL population is located in atypical habitat for *J. reclinata*, found west of a tidal creek. The plants are located in a narrow linear section of a former dune/coastal strand (Figure 6-4). The habitat is in the process of succeeding to hammock and is bordered by mangrove vegetation on both sides (Figure 6-5). We observed the largest cluster of plants growing within an open sunny area where a stand of Australian pines once existed. In an adjacent area, plants occurred in the shade, directly under the non-native trees and were growing in pine needle duff.

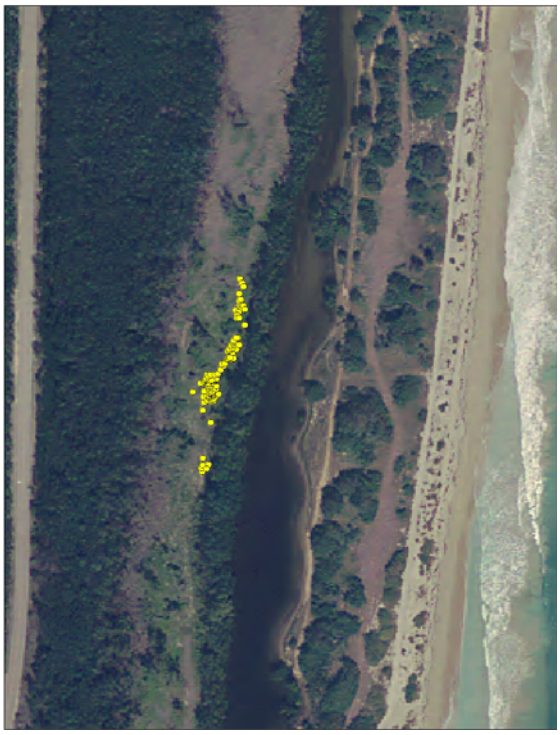

Figure 6-4. Location of *J. reclinata* (yellow dots) in invasive plant removal area of JUL

Figure 6-5. *J. reclinata* (orange flag) located adjacent to a mangrove wetland

We returned in June 2009 to survey the site completely and document the population size accurately. Before starting on the survey we met with an invasive removal crew from the Treasure Coast Cooperative Invasive Species Management Area (TCISMA). The crew was briefed on the discovery and importance of *J. reclinata* and notified of the population location. Fairchild flagged the plants so that invasive removal crews working in the area could visually locate the plants. We found 187 plants making JUL at that time one of the largest remaining wild populations, possibly the second largest. We also collected GPS points at the most southern and northern known plants to document the extent of the population.

2010

On October 5, 2010, we visited the park to assess the status of the population and collect GPS points for the remaining plants. We re-visited all previously flagged plants and used wire to attach numbered ID tags on to 10" metal u-hooks at the base of each plant. The tags will assist with locating plants during future surveys. We also tagged, flagged and collected GPS points for any previously undocumented plants.

Of the 187 plants that we documented in 2009, we observed only 112 alive plants in 2010 (60% survival). It is highly probable that the *J. reclinata* were outcompeted by adjacent vegetation. After the removal of the invasives, native plants such as *Caeselpinia bonduc* (knickerbean) and *Trema micrathum* (Florida trema) agressively moved into the mid-level canopy of the open disturbed areas. *Bidens alba* (Spanish needle) and non-native species such as *Dactyloctenium aegytium* (Durban's crowfoot grass) and *Catharanthus roseum* (periwinkle) dominated the understory (Figure 6-7).

Figure 6-6. *J. reclinata* cluster after invasive removal in 2009
Figure 6-7. Removal area 17 months later showing competing vegetation

2011

Past removal efforts have drastically reduced the number of non-native invasive plant species within JUL. However, as mentioned in the 2010 survey above, opportunistic fast growing native plant species have aggressively moved into newly opened areas particularly *Caeselpinia bonduc* and *Trema micrathum*. On March 21, 2010 we met with Environmental Management and Engineering, who was contracted to remove invasive plants at the park. We showed them the location of the *J. reclinata* and supervised the removal of *T. micrathum* in what was the open sunny area of concentrated *J. reclinata*. The contractor cut all *Trema* within the area and minimally spot treated the stumps with Garlon.

On June 14, 2011 we revisited the *J. reclinata* population to document survival and recruitment. We documented 27 dead plants since last year and two new plants for a total of 87 plants currently occurring at JUL. In the last three years we have observed a declining trend (187, 112 and 87 plants) in the population since we started surveying. Although site conditions were extremely dry due to recent drought conditions the majority of the mortality came from plants that were shaded by *C.bonduc* and *T.micrathum*. We expect rainfall to increase as we advance further into the rainy season, but if conditions do not improve soon, we predict more mortality.

Recommendations

The large decline of 53% in three years of the *J. reclinata* population at JUL is a concern. Protection of *J. reclinata* plants remaining at JUL is crucial as this represents one of two populations in Broward County and is potentially a distinct genetic population..Factors contributing to this population's decline include hammock encroachment, competition, and dry habitat conditions. The future sustainability of the species relies on protection of the remaining plants through habitat management, collection for ex situ long-term seed storage and expansion of the park population into more suitable habitat**.**

It is highly probable that if the location of the *J. reclinata* population was left unmanaged, the species would become extirpated from the park. We cannot say for certain that plants were not present before the invasive removal started, so it is possible that a few plants could remain even after habitat conditions became unsuitable. However, without habitat management the population would depend on chance events such as hurricanes and fires (natural or arson) to improve habitat conditions (decrease canopy, reduce competition, etc.). The following recommendations would assist in conserving *Jacquemontia reclinata* at JUL. Below I describe and review the feasibility of each action.

1) Habitat Management

The *J. reclinata* population is located on former dunes that may have been adjacent to the ocean less than 250 years ago (Raymond 1993), but today the area is separated from the ocean by a tidal creek and the beach (see Figure 2). Environmental stressors (salt spray, wind, sand burial, etc.) that normally would control hammock encroachment into the coastal strand are reduced because the *J. reclinata* population at JUL is located further inland than *J. reclinata* populations at other parks. Reduced salt, wind and sand burial combined with the absence of fire and the layer of mulch spread in the area after invasive removal are contributing to the natural succession to hammock. However, hammock conditions are not conducive to optimal *J. reclinata* growth. To improve conditions for *J. reclinata* and other sun-loving coastal strand species, habitat management would need to include hardwood reduction through mechanical removal, raking and removing mulch, and prescribed fire if possible.

a) ***Mechanical Removal***
Although periodic hardwood reduction within the *J. reclinata* habitat may not be economically or logistically practical in the future, in the short-term (over the next few years) it is essential for the survival of this population. As mentioned above *J. reclinata* has demonstated an inability to compete with aggressive natives such as *C.bonduc* and *T.micrathum*. Management of controlling non-native plants needs to continue, as well as reducing the aggressive natives species. Maintaining open areas of the *J. reclinata* habitat will improve conditions for flowering and fruiting of remaining plants, which will allow for seed collection thereby preserving of site germplasm (see Collect and Store Seed).

b) ***Prescribed Fire***
Of the three habitat zones (dune, strand, hammock) that combine to make the dune ecosystem, coastal strand is the most species diverse in part due to the openess of the habitat. Historically, this openess was maintained in the coastal strand by periodic lightning-caused fires. Fire occurring on 4-5 year cycles was the main factor keeping coastal strand free of hammock vegetation (Austin and others 1977). Sun loving species such as *J. reclinata* thrived in this type of habitat. With the reduction of fire along the coast, hammock encroachment is threatening *J reclinata.*

Although it may not be feasible, it is imperative that fire be re-introduced through prescribed burning to coastal strand habitat not only at JUL but at other coastal parks. The area where *J. reclinata* occurs at JUL is situated between mangrove vegetation and wetland on both sides making it ideal for controlling a presribed burn. Fire breaks would not have to be created. However, even if a fire was approved at JUL it is not certain that a fire would carry that well. Two types of vegetation assist to carry a fire: grasses and palms. The proposed area has little of both. Further discussion should occur to consider the possibility of a prescribed burn at JUL.

2) Collect and Store Seed

In order to preserve the germplasm of *J. reclinata* at JUL, seeds should be collected from the remaining wild plants. As the *J. reclinata* population declines it is now more crucial than ever to collect seeds from as many plants as possible. Habitat management in the form of opening up canopy and reducing competition should improve conditions for flowering and fruiting.

Flowering of *J. reclinata* occurs all year round but peak time to collect seeds occurs from February through May. Only 10% of fruits should be collected at a given time as suggested by guidelines established by the Center for Plant Conservation. At least half of the collected seeds should be send to The National Center for Genetic Resources Preservation (NCGRP) in Fort Collins, Colorado for safekeeping. The rest of the seeds could be used to propagate plants for on-site augmentations. The augmentations would serve two purposes: increase the population size at JUL and transfer the germplasm to more ideal habitat to increase survival of the species at JUL

3) Increase Plant Numbers

In addition to improving habitat conditions for the current population at JUL, priority should also be given to increase the *J. reclinata* population through augmentations. Seeds should be collected from remaining plants and used to propagate plants for an on-site outplanting into suitable habitat within the park. Surveys of the current beach side of JUL should be conducted to determine suitable areas for the outplanting. The potential outplanting sites not only need to be suitable habitat in relation to species composition and light conditions, but also should be areas protected from the public.
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Conduct further research

Although it is not within the scope of our management recommendations, we suggest further research is needed to understand the unique location of population. Suggested research topics are listed below:

a) Research site and geologic history of JUL

At only one other site (HTB) does *J. reclinata* occur in such unique habitat. The JUL population occurs west of a tidal creek while HTB is found west of maritime hammock. Why does a coastal dune/strand plant occur so far west of it's normal habitat on a barrier island? Is it possible that the current beach and tidal creek were not present at one time and the *J. reclinata* habitat was closer to the ocean? Utilizing Romans' map from 1770, Raymond hypothesizes that the beach adjacent to both JUL and HTB existed only as nearshore sandbars in the early 16th century (Raymond 1993). He further states that there are no trees older than 200 years old along this stretch of beach that was described by the Spaniards in 1793 as a tree less beach (newly formed) and then lengthened to be 6 miles long when mapped by Tanner in 1822.

b) Conduct a genetic study to test genetic variation between HTB and JUL

Thornton demonstated that *J. reclinata* at HTB is genetically distinct from seven other *J. reclinata* populations tested (Thornton et al. 2008). The differentiation could be due to ecological, geographic or evolutionary separation of the HTB population from the others (Thornton 2003). The dense hammock vegetation separating HTB from the coast might have prevented its gene flow with other populations (Thornton et al. 2008). It is also possible that both the HTB and JUL populations existed before the present beach location and eventually became separated geographical and genetically from the other populations. A study testing genetic variation between HTB and JUL could prove very informative for selecting source material for potential reintroductions and for understanding the patterns of genetic structure of all populations along the coast.

Conclusion

Although the *J. reclinata* population has experienced heavy decline over the last three years, all is not lost. In the short term, reduction of canopy and competing vegetation needs to be implemented. Increasing sunlight will encourage flowering of existing plants so that seeds can be collected. Once the seeds are collected they can be propagated for outplanting purposes, thereby increasing the sustainability of *J. reclinata at* JUL. Seeds should also be sent to the National Center for Genetic Resources Preservation (NCGRP) in Fort Collins, Colorado for preservation. Also further discussion needs to occur to consider the possibility of a prescribed burn at JUL. We also suggest further research is needed to understand unique habitat of the *Jacquemontia reclinata* population at the park.

Updates on success of *Jacquemontia reclinata* introductions

Samuel J. Wright

Introductions of *J. reclinata* serve several purposes. They increase the number of existing populations (wild and introduced); they provide opportunities to test factors that will influence the success of future reintroductions, such as, habitat and propagule type required for optimal growth and survival; and if successful they reduce the risk of extinction. The following are updates to *J. reclinata* introductions in three South Florida Counties:

Miami-Dade County Introduction Updates: Site NSP (August 2010) and BB (September 2001)

Site NSP
Introduction

According to a 2002 survey of 32 potential *J reclinata* reintroduction sites from Miami-Dade to Martin County, Site NSP ranked in a tie for 4th highest in suitable habitat for a *J. reclinata* reintroduction site (Wright and Thornton 2003). Additionally, the site is geographically and historically significant to the species. In 1930, Moldenke collected a sample of *J. reclinata* on Golden Beach, which occurs about 5 miles north of NSP (Gann et al. 2002). NSP is approximately 10 miles away from the nearest southern population and 15 miles away from the nearest northern population. This distance between populations could aid in the preservation of the species should a hurricane hit the other wild populations. Before any planting could take place, the area had to be prepared by removing the invasive non-native shrub *Scaevola sericea* (beach naupaka). Because of the success (89% survival after two years) we have had at this site from a previous outplanting we felt that we could continue to increase the *J. reclinata* population at NSP.

Methods
Phase 1 Removal

This section of NSP was originally designated for a *J. reclinata* outplanting in 2006. In anticipation of the outplanting we conducted a invasive plant removal using volunteers from Hands on Miami. Before the removal day, *S. taccada* covered a large area of the project location and was by far the most dominant plant species. The NSP project area (1674m^2) contained 730 m^2 (44%) of *S. taccada* before the first removal workday on June 20, 2006. We ended up conducting the outplanting further south on site. We had to concentrate removal efforts in the southern area after planting *J. reclinata*, and we never returned to remove *S. taccada* in the northern section. Without treatment for four years (8/6/10), the *S. taccada* coverage nearly returned to pre-removal levels (Table 6-1).

Table 6-1. Dates showing area coverage of *S. taccada* at NSP

Date	Total Area m^2	Coverage m^2	% covered	Info
4/28/06	1674	730	43.61%	Before removal
6/20/06	1674	101	6.03%	After removal
8/6/10	1674	592	35.36%	Before removal
8/27/10	1674	140	8.36%	After removal
3/31/11	1674	56	3.35%	After removal
4/1/11	1674	33	1.97%	After removal

We returned to the site in August 2010 to prepare the site for an outplanting. To estimate vegetation coverage and plant diversity previous to the removal, we installed seven 10 m long line-intercept transects within the *S. taccada* dominated removal area. We documented all plant species that intercepted the line transect to estimate their coverage within the plots. We also took photo points of each plot in two directional angles before the removal (Figures 6-8 and 6-9). Photos below are an example of the photo points; other plot photos are available upon request.

On August 7, 2010 we supervised volunteers from the Surfrider Foundation and Tempo Hotel to remove *S. taccada* manually. Plant debris was placed in piles next to the side of the dune and later collected by personnel of the City of Miami Beach Sanitation Division. We were able to reduce the *S. taccada* coverage from 35.4% to 8.4%. We returned again three more times in the next year to continue removal efforts (Table 6-1).

Figures 6-8 and 6-9. Before and after photos of a plot within the removal area. Photos taken on August 7, 2010

Phase II Planting

On the same day as the removal we planted 102 *J. reclinata* plants within the newly opened dune. We collected GPS points for each plant and created maps of their locations. We watered each plant with one quart of water immediately after installation. We closely monitored rainfall for the next month using South Florida Water Management District rain stations (The South Florida Water Management District 2010) and we hand watered when needed. Because of a good amount of rainfall (7.53 in.) for the next month we only had to hand water the plants two more times.

Monitoring and Observations

We last surveyed the outplanting on March 30, 2011 and 101 of the 102 (99%) *J. reclinata* plants remain alive. The plants appeared very healthy and seemed to benefit from the high levels of rainfall one month after installation.

Before the *S. taccada* removal the transect plots contained 21 total plant species, 16 of which are native (Figure 6-10). On average *S. taccada* accounted for 87.1 % of total area covered within the plots, a substantial amount considering the next closest native was *Canavalia rosea* (bay bean) with 5.2% of the area covered (Figure x). Removal efforts have greatly reduced the coverage of *S. taccada* within the project area of NSP. We will continue to monitor the regrowth of *S. taccada* and re-treat if necessary. Months after the multiple removal work days, the seedbank has responded with germination of mostly native dune species.

One year after the outplanting we plan to survey the outplanting and census the vegetation plots in August 2011. With the complete removal of *S. taccada* within the vegetation plots we expect to see a large increase in native plant species diversity and coverage. We will continue removal efforts at NSP.

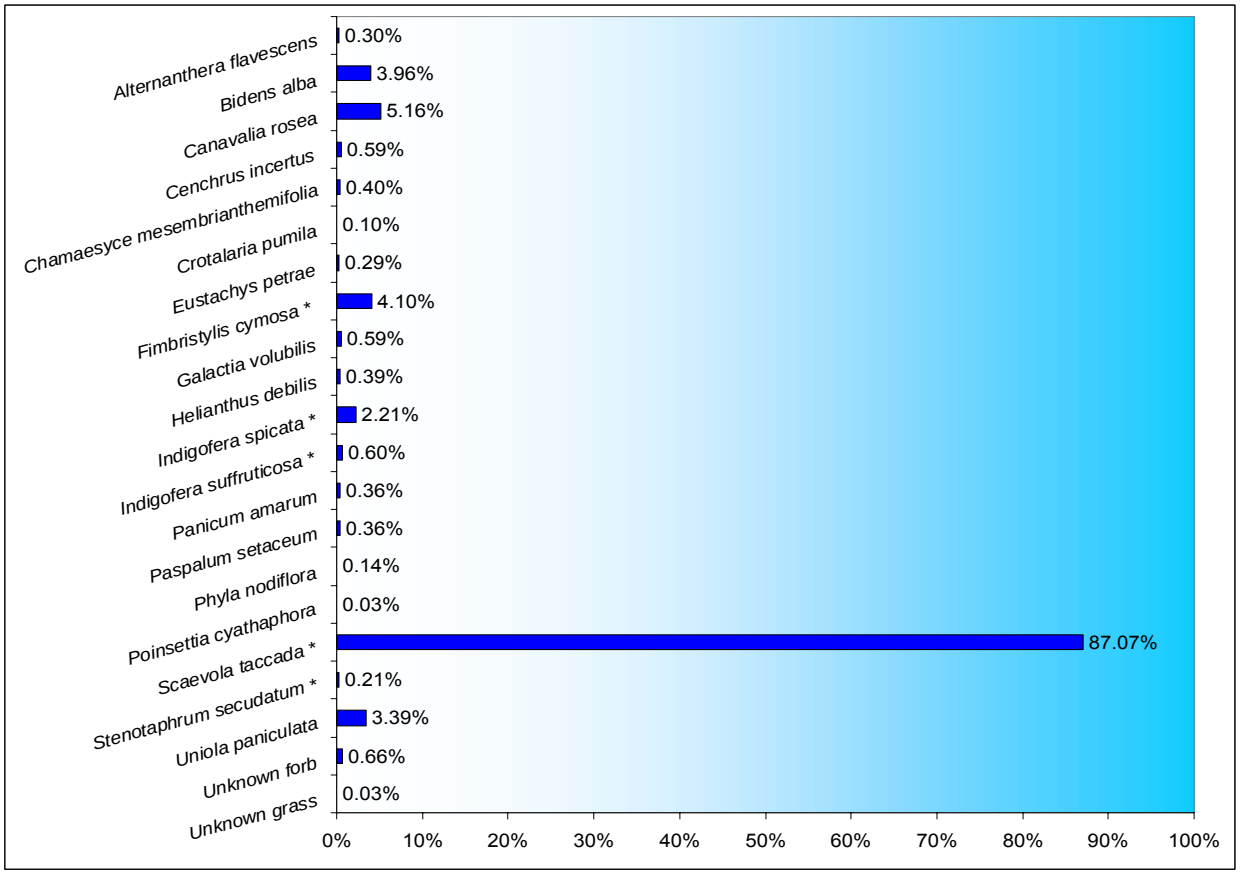

Figure 6-10. Total species found in transect plots before the removal. Percentage showed as average area covered by individual species across all plots. * denotes non-native plant

Site BB

Methods

See Maschinski et al. (2008) page 10 for installation methods. This year we tagged newly observed recruits but we did not GPS and map them.

Results and Discussion

For previously reported results, See Maschinski et al. (2007) page 18, Maschinski et al. (2008) page 10, Maschinski et al. (2009) page 21, and Maschinski et al. (2010) page 39.

We monitored the outplantings on May 17, 2011 and there have been no deaths since the last survey in 2010. After nine years, translocated plants have 40% survival. All plants have now died within the plots furthest from the ocean, possibly due to hammock encroachment by *Coccoloba uvifera* (sea grape). As noted in previous reports, in September 2007, we documented ten *J. reclinata* seedlings at BB - the first recruitment we have observed in any of our outplantings starting in 2001. Some of the recruits now are very large and most are producing fruits. This year we observed a total of 42 recruits; the majority occur outside the outplanted plots. Three recruits have died since the 2010 survey and we observed and tagged six new plants this year. Eighteen recruits occur in-between three separate outplantings: a 1998 DEP planting and two that Fairchild conducted in 2001. Pollinator visits, genetic flow and fecundity may have increased from having plants from the outplantings of various ages and origins in close proximity of each other.

Conclusion

As stated in past reports, plants showed low tolerance to the conditions closest to the ocean (i.e., salt spray, sand burial, tidal surge) and furthest from the ocean (i.e., herbivory, shading). We will continue to monitor this study, but current and past results suggest that future *J. reclinata* reintroductions should occur within a specific distance range (19-45m from mean high tide line) along the coastal dune habitat. The 45m distance also demonstrated the most suitable location for recruitment (Table 2). Although, we recommend a specific distance for *J. reclinata* reintroductions, it should be kept in mind that suitable habitat in relation to distance can vary according to site, topography, and distance from high tide.

Even though it took six years, this study also showed that outplanted *J reclinata* individuals are able to recruit in the wild. Germination rates and seedling fitness seems to have benefited from the design of closely installed plants with various ages and origins. This study also demonstrates that it is not only important to choose suitable habitat for the outplants, but to have suitable adjacent habitat for recruitment and population expansion. We are very encouraged with this outplanting, with more reproductive adult recruits than remaining outplants (38 to 36), the population is trending towards self-compatibility. This remains to be seen, but we will continue to monitor the recruits as well as the adults on a yearly basis.

Broward County Introduction Updates: Site RDB and DB (June 2008, July 2009)

Introduction

J. reclinata is only known to occur at three sites (Sites JUL, HTB, and HB) in Broward County and two of those sites are on protected public land. We reported HB as extirpated last year (Wright 2010a), however a new population location at the site was observed this year. Additional outplanting sites are needed in Broward County although available suitable habitat is very limited. In 2008, we were approached by Kids Ecology Corp, a non-for-profit organization to collaborate on a dune restoration project behind a private oceanfront condominium (Site RDB). The dune restoration project was already underway with the planting of dune stabilizers and builders, such as *Uniola paniculata* (sea oats). We discussed increasing the plant diversity of the dune by including *J. reclinata* and other dune species in an upcoming planting. We also selected a second site (DB) just north of RDB to conduct another Broward County introduction. DB is approximately 1 km south of a recently discovered *J. reclinata* population at JUL (Wright 2009).

Methods

RBD

On June 20, 2008, we planted 57 *J. reclinata* plants at a recently restored dune at RBD. At the time the dunes contained mostly *U. paniculata*. The *J. reclinata* plants were propagated from 20 parental origins and two different wild sites (CR and SB). We were assisted by Kids Ecology Corp, which enlisted about 15-20 teenage volunteers to help the planting. We instructed the volunteers how to install the plants within the newly created secondary dune of RBD. Other species planted included *Argusia gnaphalodes* (sea lavender), *Ernodea littoralis* (beach creeper), *Scaveola plumieri* (inkberry), and *Suriana maritima* (bay cedar). We watered the plants immediately after installation. Water duties thereafter were handled by the condominium maintenance crew through the use of a sprinkler system.

DB

With help of the Department of Parks and Recreation for the City of Hollywood and Kid's Ecology Corp volunteers, we planted 41 *J. reclinata* on July 16, 2009 on the back dune of DB. Broward County treated the site before the planting by removing the non-native invasive *Scaevola taccada* (beach naupaka). In addition to the *J. reclinata*, native dune plants were installed that included *A. gnaphalodes* (sea lavender), *Scaveola plumieri* (inkberry), *Spartina patens* (cordgrass) and *U. paniculata* (sea oats). We watered the plants immediately after installation. We revisited the site two more times after installation to hand water the plants.

Results and Discussion

RDB

We last surveyed the plants for survival on June 14, 2011. Of the 57 *J. reclinata* that were planted in 2008, 52 are still alive (91% survival). We observed one plant that was documented as dead last year. Although most of the remaining plants appeared healthy, some plants are showing stress (dried stems and leaves) related to the dry conditions Broward County is experiencing this rainy season. We documented germinated plants around current and previous locations of *J. reclinata* plants. We observed one flowering adult and 21 seedlings. The outplanting is only three years old and is, by far, the earliest we have ever recorded seedlings recruit. Early germination can be explained by regular watering of the dune by the installed sprinkler system. Excess watering has also contributed to the increased growth of adjacent vegetation, which could eventually outcompete the *J. reclinata*. The condo association has since been told to cease watering.

In 2009, the condo association received permission from FDEP to extend the rope and post fence 3m further east towards the ocean (Figure 6-11). With sand accretion leading to building of the dune and the natural recruitment of native dune species (Figure 6-12), the dune is in the process of becoming a small but functioning habitat. Ecologically significant plant species that have naturally volunteered into the dune include: *Canavalia rosea* (bay bean), *Cyperus pedunculatus* (beach star), *Helianthus debilis* ssp. *debilis* (beach sunflower), *Ipomoea pes-caprae* ssp. *brasiliensis* (railroad vine), and Iva imbricate (beach elder).

In an effort to further increase the plant diversity within the dune, the condo association will conduct a planting soon using habitat-appropriate plants and quantities recommended by FTBG. Due to a high survival rate and germinated seedlings, we are very satisfied with the current outcome of this outplanting. We will continue to monitor the outplanting and seedlings annually.

Figure 6-11. Restored dune before completion of expansion of fence (March 2009)

Figure 6-12. Restored dune at RDB showing sand accretion and *Uniola paniculata* (sea oats) expansion into extended fenced in area (June 2011), previous rope and post fence removed

DB

Last year we reported a difference in survival when comparing one planting section to another (Wright 2010b). We planted material in three clusters that had similar habitat characteristics at the time of planting. Two of the largest clusters are no longer similar in species composition and habitat structure, which was reflected in the survival rate. Both sections were cleared of *Scaevola taccada* and contained mostly open sandy areas. By 2010, Cluster #1 no longer had open sandy areas due to encroachment of native dune plants, dominated mostly by *Helianthus debilis* ssp. *debilis* (beach sunflower). Only 4 of 16 (25%) plants survived in this section. Cluster #2 still retained open sandy pockets and had 14 of 15 (93%) plants surviving.

We last surveyed the plants for survival on July 21, 2011. We documented only 21 of the 41 plants alive (49% survival), down by four from last year. We attribute the low survival rate to a combination of dry site conditions and plant competition. Also, soon after planting, some plants were pulled out. We do not know if this was caused by raccoons or by people. We also mentioned in 2010 that for the remaining plants in Cluster #1 to survive we may have to clear some of the competing vegetation. This is no longer an issue. It appears that recent drought conditions have led to the decline of *H. debilis* ssp. *debilis*. Free from competition the remaining *J. reclinata* have grown quite large and are very healthy. We are encouraged by this recent outcome and will continue to monitor the outplanting annually.

Palm Beach Sites: JDNA Introduction Updates on LOG and CAR augmentations

Introduction

Population sizes at Sites LOG and CAR have drastically declined since the original 2001 population surveys. The 12 *J. reclinata* plants at LOG documented in 2001 have all died. Luckily, since the extirpation at LOG, three plants recruited naturally from the seed bank and are now mature plants that produce fruit each year. By 2006, the plants at CAR have declined by 35% (currently 62% decline). Due to anthropogenic disturbances (trampling, maintenance activities) at LOG and natural disturbances (erosion, encroachment, plant competition) at CAR, we were and still are very concerned with the future sustainability of these two populations.

To preserve the germplasm of both populations, it is critical to protect the remaining plants, collect seeds/cuttings, and propagate plants for future augmentations. Due to the disturbance factors mentioned above, Palm Beach County land managers were concerned with augmenting plants on-site. Therefore Fairchild and Palm Beach County staff selected the adjacent Site JDNA for the augmentation, because the plants would be subjected to fewer disturbances than the other two sites, thereby increasing the probability of survival. We conducted two separate outplantings of *J. reclinata* at JDNA in 2006 and 2007.

Methods

2006 outplanting
In June 2006, with the help of Jupiter High School students, we conducted an outplanting in open scrub/coastal strand habitat at JDNA. We outplanted 32 plants propagated from cuttings collected from LOG and CAR. See Maschinski et al. (2006) for further explanation of collection, propagation, mapping and survey methods.

2007 outplanting
In June 2007, with the help of JDNA land managers, we planted 34 *J. reclinata* plants just north of the June 2006 outplanting (Figure 6-13). See Maschinski et al. (2007) for further explanation of collection, propagation, mapping and survey methods.

Results

2006
We last surveyed the 2006 JDNA outplanting on May 18, 2011. Of the 32 plants that were planted, 14 are still alive (44% survival), a large decline from last year. There was also a very large decline in fruits, from 3602 in 2010 to 287 fruits this year. We also observed the survival of three plants newly documented last year and two new recruits for this year's survey. We tagged the two new plants.

2007
We last surveyed the 2007 JDNA outplanting on July 22, 2011. Of the 34 plants that were planted, 13 are still alive (38% survival), also a large decline from last year. The remaining plants are very small and none were producing fruits.

Discussion

We have observed a major decline (41% survival combined) in the JDNA outplantings, particularly this year. The major factor contributing to the decline in the survival of both outplantings this year could be the extreme drought conditions that Palm Beach County has experienced this winter and spring. Palm Beach County has had record low rainfall from October 2010 until May 2011(The Palm Beach Post 2011). The majority of the remaining plants are small and fruit production is also down. Although a demography study (see page 53) of the 2006 outplanting has demonstrated that plants showed very prolific fruit production in 2009, we observed a dramatic reduction the last two years. The plants produced ~8000 fruits in 2009 and declined to ~3600 in 2010 and 287 fruits this year. Total patch size and area covered has also

decreased. It appears that further expansion of the populations may also be limited due to a nature trail to the east and dense scrub vegetation to the west. There is however additional suitable habitat available to the north and south of the outplantings. These outplantings are the first and only that we have conducted using rooted cuttings of *J. reclinata*. Plants were propagated from seeds and cuttings using LOG and CAR material and cuttings from HB and PBH. The latter two sites are now considered extirpated and the former two are declining, so the survival of the remaining plants is vital to preserving the germplasm of these sites. Last year we collected and sent 1812 seeds from 21 plants of the JDNA outplantings to the National Center for Genetic Resources Preservation for safekeeping. Hopefully, as the rainy season progresses, plants will produce more seeds and we will be able to collect more. We will return at the end of the summer to collect more seeds if available.

Figure 6-13. Map showing locations of 2006(blue) and 2007(yellow) outplantings at JDNA.

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

Samuel J. Wright

Introduction

The recovery of *J. 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. We selected Sites DEL, HPB, NSOSP and VK, because of their high ranking determined during a 2003 Fairchild coastal survey of suitable habitat (Wright *in prep*). We conducted re/introductions to increase the number of populations of *J. reclinata* and to test how breeding history affects survival and fitness of plants.

Breeding history outplantings at Site HPB, DEL, and NSOSP are scheduled to be monitored this summer. Results for Site VK are reported below.

Methods

See Wright (2009), page 26

Past Observations

In 2007, we noticed that the *J. reclinata* branches were spreading into an area regularly mowed by park maintenance staff. We asked the land managers to stop mowing in this area to allow the *J. reclinata* to expand outside the planting area. Also, in order to open up the canopy we supervised the removal and trimming of hardwoods such as *Ficus aurea* (strangler fig) and *Coccoloba diversifolia* (pigeon plum). During a September 2009 survey we observed recruitment for the first time. We observed 16 seedlings recruiting into the open grassy area outside of the planting zones, which is no longer mowed. Since the survival rate of the outplants has been very low, the discovery of seedlings was encouraging news for the future sustainability of the population.

On June 15, 2010 we revisited VK to collect GPS points for new recruits and recruits that we observed in 2009. In total we observed, tagged and collected GPS points for 31 *J. reclinata* plants. We created a map showing the recruited plants and distributed to the land manager. All documented recruits were observed outside the outplanted areas.

Results and Discussion

We last surveyed the plants for survival on July 22, 2011. We observed that 47 of 171 (28%) plants are still alive. Data from 2006-2011 shows that the between site crosses (SBxCR and CRxSB) have the highest survival rates and the sibling (Sib) cross has the lowest survival rates (Figure 6-14).

Of the 31 recruits that we tagged and mapped last year, 29 are still alive. We also documented 55 newly observed recruits this year. We tagged these recruits and recorded distance and bearing measurements to the nearest adult plant location. We did not map this year's recruits. Some of the newly observed plants were very large and were most likely missed in previous surveys. The area we observed the majority of the recruits has always been dominated by weedy, disturbance type plant species. Many of those species died off, possibly affected by the very dry conditions this spring and summer.

Although there has been a large amount of mortality within this outplanting, the remaining plants are very healthy and productive having produced many seedlings that survived to maturity. As shown by the BB outplanting (page 41) this study demonstrates the importance of suitable adjacent habitat for recruit expansion. We will continue to monitor the outplants and recruits on a yearly basis. We also plan to analyze if recruitment is affected by breeding treatment.

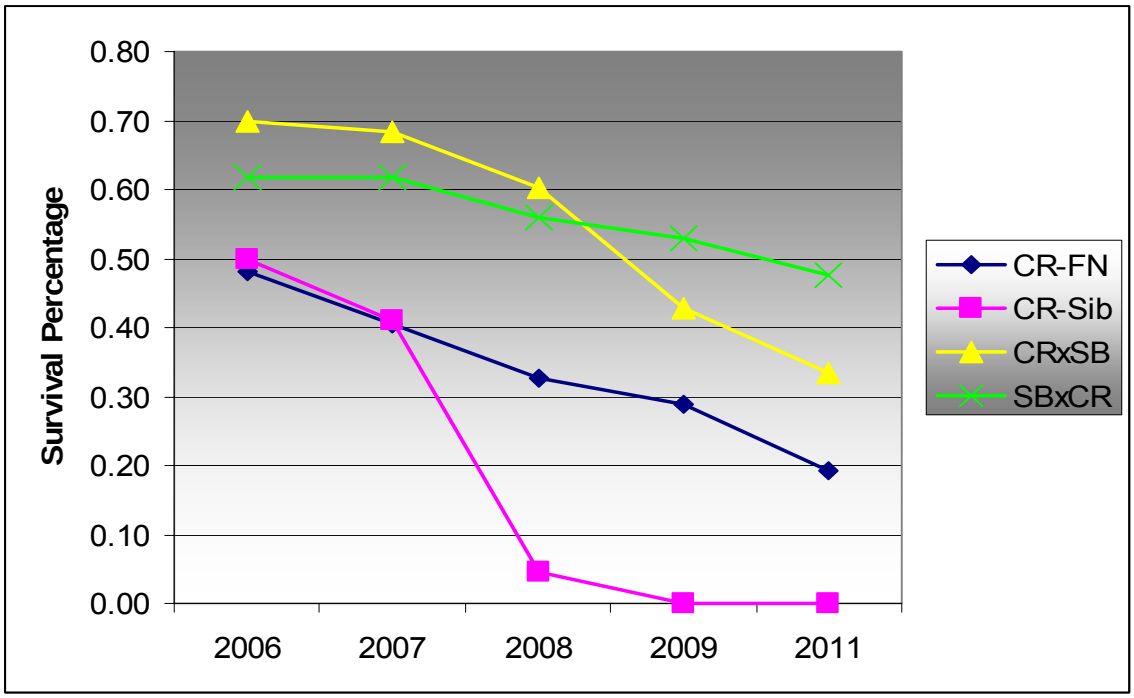

Figure 6-14. Percentage survival (2006-2011) of *J. reclinata* according to breeding treatment at VK

Table 6-2. Overall survival of 2001-2011 *Jacquemontia reclinata* outplantings.

Year	Site #	Planted	# Alive	% Survival	Recruitment Observed	Date last surveyed
2001a	BB	90	36	0.40	Yes	June 16, 2010
2001b	BB	105	47	0.41	Yes	November 3, 2010
2002	RR	18	17	0.94	No	February 1, 2007
2004	HBP	143	96	0.67	Yes	September 29, 2008
2005a	VKCH	171	47	0.28	Yes	July 20, 2011
2005b	DEL	132	74	0.56	No	April 16, 2008
2006a	JDNA	32	14	0.44	Yes	May 18, 2011
2006b	NSP	157	140	0.89	No	March 24, 2008
2007a	JDNA	34	13	0.38	No	July 22, 2011
2007b	HBP	324	225	0.69	No	September 10, 2009
2008a	RDB	57	52	0.91	Yes	June 14, 2011
2008b	VKBP	165	148	0.90	No	July, 2009
2009	DB	41	21	0.49	No	July 21, 2011
2010	NSP	102	101	0.99	No	March 30, 2011
		1571	**1031**	**0.66**		

Habitat restoration and *J. reclinata* population protection through invasive native plant removal

Introduction

Management of non-native invasives within coastal strand habitat is vital to the survival of *J. reclinata* and other imperiled plants species. Florida coastal strand is recognized as the most diverse plant habitat within the coastal dune ecosystem. Open sunny areas of this habitat were historically maintained by fire, hurricanes and freezes. Now that these natural events occur less frequently, some native vines, shrubs and trees have become just as aggressive as non-native plants, thereby producing the same effect of low plant diversity. Over the last 6-7 years at CR we observed *Dalbergia ecastaphyllum* (coinvine) become more and more dominant, shading out sun loving plant species, including the federally endangered *J. reclinata.* The *D. ecastaphyllum* became very dominant within an area that was once a trail that is now blocked off. We observed the *D. ecastaphyllum* expand from its original location toward a large cluster of *J. reclinata*. This has led to the disappearance of *J. reclinata* in shaded areas. For *J. reclinata* to remain in this area the *D. ecastaphyllum* needed to be reduced. *D. ecastaphyllum* is native to this habitat so our goal is not to completely remove it. Our objective is to reduce *D. ecastaphyllum* in order to increase coastal strand species diversity and help the *J. reclinata* to persist in the area.

Methods

In January, 2008, Miami-Dade County's Natural Area Management personnel cut down *D. ecastaphyllum* from a 300 m^2 area of the coastal strand at CR and left the debris in piles. Fairchild staff, volunteers and Biscayne Nature Center naturalists removed piles of the shrub using plants stretchers on two separate days in February and March. We will monitor the regrowth of *D. ecastaphyllum* and suggest retreating if needed. To document the response of the co-occurring vegetation and seed bank to the removal, we randomly placed 20 1x1m plots within the removal area. We constructed a 1x1m sampling grid using ½" PVC pipe. We placed the grid over each plot, identified all vegetation and visually estimated percent cover of every species within the plot. To increase our accuracy in determining area coverage we also constructed a 50x50 cm PVC square that we used to place over the vegetation. The square contained 25, 10, 5 and 1% cover segments. We recorded seedlings of any species that covered < 1% as 0.5%. We will visit and sample plots on a quarterly basis until 2012. We also set up three photo points and took 360 degree photos using a fisheye lens (Figure 6-15).

Observations

We last sampled the plots on April 27, 2011. Although this study is three years old, the photo points do not seem to show much change except for an increase in open sandy areas and a decrease in the duff layer. Native species diversity and percent vegetation cover has increased since the first census (Table 6-3). However, the number of plants species and coverage have fluctuated depending on seasonality. The April 2010 survey recorded the highest amount of species with 45. During the April 2011 survey we observed a total of 41 species, some of which are rare species such as *Fimbristylis caroliniana* (Carolina fimbry) and *J. reclinata*. *Randia aculeata* (indigoberry) is by far the most dominant species within the plots covering 11.2% of the area (Table 5). Non-native *Catharanthus roseus* occurs in 15 plots but only covers 0.58% of the area. *D. ecastaphyllum* has increased since the beginning of the study, although it still does not even cover 0.3 % of the total area (Table 6-4). Due to the increase in coverage (.005 to 1.325%) of *Stenotaphrum secundatum* (St. Augustine grass) we will closely monitor the grass and treat if needed.

The project is only three years old but so far we have achieved our objective of reducing the dominant plant species to increase species diversity while protecting the *J. reclinata* within the vicinity. This project also showed it was possible to restore any area without the use of planting. Species diversity increased through the seed bank and adjacent seed sources. We will revisit in August 2011 to take photos and continue sampling the vegetation.

April 2008

April 2009

April 2010

April 2011

Figure 6-15. Time sequences of photo point in invasive removal area at Site CR. Photos were taken in April 2008-2011.

Table 6-3. Plant coverage comparisons from April 2008 and 2010 surveys.

	4/9/08	4/27/11
# Total plant species	30	42
% Total vegetation coverage	9.88	28.58
% unoccupied area	90.12	71.42
% Dalbergia coverage	0.05	0.25
% Native species coverage	9.69	26.67
% Non-native species coverage	0.19	1.91

Table 6-4. Documented plant species and % cover within plots of removal area.

	April 9, 2008		April 27, 2011	
Species	**% Area Cover**	**# Plots**	**% Area Cover**	**# Plots**
Randia aculeata	6.36	17	11.15	17
Smilax auriculata	0.625	4	2.75	5
Metopium toxiferum	0.15	1	2.4	2
Jacquemontia reclinata	0.3	1	1.85	2
Lantana involucrata	0.25	2	1.65	2
Stenotaphrum secundatum	0.005	1	1.325	6
Cassytha filiformis			1.325	13
Coccoloba uvifera			0.8	2
Alternanthera flavescens	0.01	2	0.605	4
Catharanthus roseus	0.19	11	0.58	15
Pithecellobium keyense	0.7	4	0.575	3
Cnidoscolus stimulosus	0.16	5	0.35	6
Opuntia humifusa	0.025	1	0.35	1
Crotalaria pumila			0.35	1
Verbesina virginica	0.38	3	0.325	2
Dalbergia ecastaphyllum	0.05	1	0.25	1
Eustachys petraea	0.01	2	0.25	1
Vitus rotundifolia	0.08	3	0.225	5
Cenchrus incertus			0.2	2
Lantana depressa var. *depressa*			0.2	1
Helianthus debilis ssp. *debilis*	0.005	1	0.15	1
Physalis walteri	0.01	2	0.135	6
Passiflora suberosa	0.08	3	0.13	5
Licania michauxii	0.15	1	0.1	1
Serenoa repens			0.1	1
Fimbristylis caroliniana	0.085	9	0.075	2
Commelina erecta			0.05	1
Melanthera nivea			0.05	1
Poinsettia cyathaphora	0.02	4	0.035	3
Croton glandulosus	0.015	3	0.035	7
Sabal palmetto	0.005	1	0.025	1
Chiococca parvifolia			0.025	1
Chamaecrista fasciculata			0.025	1
Phyllanthus sp			0.025	1
Rhynchosia minima			0.025	1
Setaria macrosperma			0.025	1
Zamia integrifolia	0.005	1	0.025	1
Polygala grandiflora	0.055	7	0.02	4
Dactyloctenium aegyptium			0.005	1
Galactia volubilus	0.135	15	0.005	1
Galium hispidulum			0.005	1
Echites umbellata	0.005	1		
Ipomoea indica	0.005	1		
Trichostema dichotomum	0.005	1		
Zanthoxylum coriaceum	0.005	1		

Demographic Census of *Jacquemontia reclinata* populations

John Pascarella and Samuel J. Wright

To assess population trends and compare natural to outplanted (restored) populations, we have monitored four natural and three outplanted populations of *J. reclinata.* Specifically, we monitored 19 patches in four natural populations (SBI, LOG, and SB in Palm Beach County and CR in Miami-Dade County between 2000 and 2011. We refer to these as the "Original Natural Cohort." Because some patches were lost, in 2006 we added 10 patches from four natural populations (CAR, LOG, SB, and CR), replacing patches lost at SBI with 1 new patch at CAR. We refer to these as the "2nd Natural Cohort." From 2007-2011, we also monitored three outplanted populations (DEL and JDNA in Palm Beach County and BB in Miami-Dade County).

Methods-Demography Sampling

For sampling methods see Pascarella and Wright (2010), page 53

Results

Patch dynamics

The number of stems in the original cohort, with the exception of 2007, has continuously decreased since 2000. In contrast, the 2nd natural cohort shows a very different pattern, with increasing stem numbers in all but one year (2009). With the exception of one of the population, the restored populations are increasing. Between 2010-2011 transition years, natural populations increased from 165 to 193 stems (+8.5%) and restored populations increased from 105 to 106 stems (+1%).

Similar to stem number, the original natural cohort showed a decline in size most years (the exceptions were 2007 and 2002), while the restored sites mostly increased through the study. The 2nd natural cohort has expanded in size as the number of stems has increased. Between 2010-2011 transition years, natural populations increased from 479 to 580 m^2 (+8.1%), while restored populations decreased from 409 to 405 m^2 (-1.0%). No patches were lost in 2010-2011 and the one patch in a natural population that had previously lost all plants showed recruitment.

Seed production results were mixed in 2011 (Table 6-5), with most sites decreasing. Outplanted population seed production exponentially exceeds that of natural populations. Not only have outplanted plots achieved reproductive success, they have greatly increased total seed production of the species.

Population Data

Natural Populations

LOG

LOG is the smallest remaining natural population with plants contained in a very small and restricted area. Population size has been stable, but very low. The total number of *J. reclinata* stems in 2010-2011 declined by one plant. LOG now has two plants remaining. Area occupied and average cover has fluctuated since 2001, but has declined this year and is the lowest since 2002. Fruit production was nonexistent for several years and then increased in 2008 and 2010, but declined this year (Table 6-5).

The population has remained stable for a number of years; however a decrease in stems, area and fruit production has us concerned for the future of this population. Surprisingly, this population has not gone extinct in spite of its small size, few plants, low reproductive output, and precarious location next to a nature trail and dense scrub vegetation.

CAR

Population size at CAR has remained stable since we started monitoring in 2006. Average cover and patch size increased from 2010. Fruit production however has decreased this year (Table 6-5).

This northernmost population has degraded environmental conditions. Declining population numbers and fruit production suggest environmental conditions are less favorable. This area has undergone considerable regrowth of vegetation following hurricane disturbances earlier this decade. On the coastal side, beach erosion is encroaching into the dunes causing the *Uniola paniculata* (sea oats) to advance further west thereby heavily competing with the remaining *J. reclinata*. On the back side of the dunes, *Coccoloba uvifera* (seagrape) and vines are increasing in density and cover and could limit expansion or movement of the population over time.

SB

In 2000, we installed four patches at SB. Two new patches were added in 2006 when one patch went extinct. Total stem numbers decreased this year by one stem, but total patch size increased. However, average cover (1.23 to 1.05) and fruit production decreased from 6669 fruits to 4948 fruits this year (Table 6-5).

The population at SB has decreased significantly since we first started monitoring in 2001. One patch went extinct in 2006 and has not been recolonized. Other remaining patches show mortality of older plants, some limited recruitment of new plants, and relatively stable size, cover, and fruit production. No new patches have formed on the landscape. We recommend using prescribed fire and/or mechanical removal to reduce encroaching woody vegetation to maintain open dune landscapes.

CR

CR consists of numerous small to medium sized patches. Many new plants were documented in the 2011 census. Total stem number increased from 94 to 124 due to recruitment of new stems across several patches. Total patch size increased from 253 to 348. Cover values and fruit production increased incrementally. This is the 2nd year at CR that there has been as increase in stem number, patch size, cover values and fruit production (Table 6-5).

Recent recruitment and recolonization of an extirpated patch (for the second time!) means that the population is expanding. Similar to other natural populations, maintenance of open patches in the strand habitat will be critical to sustain this population.

Outplanted (restored) populations

JDNA

For the last four years the population at JDNA has been stable, but this year stems declined from 31 to 19. We documented formation of two new stems through buried stems rooting and then breaking off from the original outplant. We tagged these new plants. Total patch size decreased from 90 m^2 to 54 m^2 continuing a declining trend noted in the 2009 census. Average cover decreased minimally from 1.08 to 1.04%. Fruit production declined dramatically for the 3rd straight year (8027 in 2009, 602 fruits in 2010 and 287 this year).

The outplanting is declining in total area occupied, average cover, and fruit production in part due to the extremely dry conditions in Palm Beach this spring and early summer. Future growth of this population is constrained by adjacent land use. The outplanting lies between a nature trail, a vehicle lane to the west of the nature trail, and the dense scrub vegetation west of the outplanting. Additional space for planting is available to the south and north of this outplanting and could be used to further increase the population at JDNA.

BB

This is the second straight year that we observed a substantial increase in plant numbers at BB; 37 in 2009, 46 in 2010 and 53 plants this year. Total patch size also increased, however average coverage decreased. Fruit production has decreased by almost a third from 9075 to 3332 fruits.

This population is very healthy and normally productive. The large decrease in fruit production can be attributed to dry conditions that occurred at the beginning of the rainy season. Recruitment of new stems and fruit production indicate that this outplanting is functioning successfully. There are a number of open dune areas similar to this outplanting that could be used for additional outplanting efforts if so desired at BB.

DEL

The DEL population increased from 28 to 34 plants, the majority of which propagated vegetatively from detached and rooted branches of outplants. Patch size, average cover, and fruit production all increased this year also. The drought conditions Palm Beach County experienced this year did not seem to affect the outplanted *J. reclinata* at DEL. Average plant cover this year reached the highest recorded for any population (both natural and outplanted) during the 10 years of the study (Table 6-5). Total fruit production also reached record high among all populations. Fruit production increased substantially every year, 74101 fruits in 2009, 101,614 in 2010 and 125,289 this year.

The DEL outplanting can be considered successful due to its large size, high average cover, and very high fruit production. DEL was planted with multiple diverse genotypes from different source populations and parentages-it is possible that this genetic admixture or very favorable environmental conditions are responsible for the extremely high fruit production.

Table 6-5. Stem number, total patch size, average cover, and total fruit production of natural and outplanted populations in 2009-2010.

Population	Type				
	Natural	Stem # (2010,20111)	Patch Size (m^2) (2010, 2011)	Average Cover (2010, 2011)	Fruit Prod. (2010, 2011)
CR	Natural	94, 124	253, 348	1.14, 1.16	15481, 16056
SB	Natural	57,55	139, 140	1.23, 1.05	6669, 4948
LOG	Natural	3,2	9, 9	1.02, 1.00	251, 49
CAR	Natural	11, 12	78,83	1.36, 1.42	575, 222
BB	Outplanted	46, 53	87, 89	1.23, 1.13	9075, 3332
DEL	Outplanted	28, 34	232, 262	1.77, 1.90	101614, 125289
JDNA	Outplanted	31, 19	90, 54	1.08, 1.04	3602, 287

Conclusions

The 2010-2011 survey found that conditions were favorable, with most populations in relation to stem number. However, other than CR and DEL, the rest of the populations showed large decreases in fruit production. Patch size increased or remained stable in all populations except JDNA.

Natural Populations

LOG and SB showed population declines while CR increased due to substantial recruitment of new stems. In all sites, especially SB, encroachment of the areas occupied by *J. reclinata* by woody vegetation may threaten long-term persistence. Woody plant removal or prescribed fire may be options to enhance persistence and area in open conditions on the back dune/strand vegetation.

Outplanted Populations

JDNA declined in stem numbers and size while BB and DEL increased in both variables. DEL and increased fruit production substantially while JDNA and BB decreased. At all three locations, there are nearby areas that could be used to further increase the population size through additional outplantings.

Variation in population dynamics among the outplanted and natural populations is likely a function of local environmental conditions (rainfall, sunlight, competition, disturbance) that vary both temporally and spatially. The fact that both BB and CR showed substantial recruitment events may be related to the close proximity of these two sites that should be related to local environmental variables, such as precipitation events.

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Lantana canescens Kunth

Jennifer Possley

Introduction

Lantana canescens is native to Miami-Dade County, the southern tip of Texas, the tropical Americas, and the West Indies (Gann et al. 2002). In Florida it is an extremely rare plant listed as endangered by the state of Florida and critically imperiled by IRC. It is native to the ecotone between pine rockland and rockland hammocks. Today in Miami-Dade County this type of ecotone is extremely rare due to a combination of fragmentation and fire suppression.

Update on Wild Population

Florida's last known remaining wild population of *L. canescens* was located at COB. While our 2003 census showed 44 plants, since then its numbers have plummeted and we were unable to locate any living plants in December 2010. This taxon may now be extirpated from the wild. Yet our actions to propagate and reintroduce *L. canescens* have ensured it will remain in Miami-Dade County for years to come.

Updates on Re/introductions

In 2005 and 2007, we propagated plants from wild *L. canescens* seed and planted 370 individuals in three EEL (Environmental Endangered Land) preserves. We conducted annual monitoring of these outplantings in December 2010. We collected fruit from numerous individuals at each population (22 individuals total). We germinated some seed at Fairchild and sent the rest to the National Center for Genetic Resources Preservation (NCGRP) in Fort Collins, Colorado for long-term storage. An update on survivorship for each planting site is below.

- **COB (2005)**
  We planted 36 individuals in a mulched restoration area adjacent to a road bordering the southern edge of the park in July 2005. By December 2010, all original outplants of this short-lived species had died— yet, hundreds of seedlings recruited from those original 36 plants. Last year, we counted 485 recruits the majority of which are flowering and producing fruit. In December 2010, these plants continue to thrive; we estimated the population size to be approximately the same.

- **COB (2007)**
  These plantings were done in cooperation with a local Boy Scout troop. We planted 6 individuals in a butterfly garden adjacent to the park entry road, and 15 in a mulched restoration area along the East property line. In January 2010 we reported zero survival/recruits in the butterfly garden. However, in December 2010, we found six recruits presumably from the seed bank generated by those outplants. The Eastern planting has been incredibly prolific in terms of seedling production. Previously, we estimated there were around 4000 seedlings here. In December 2010, we estimated the population size to be approximately the same.

- **CASH 33 (2005)**
  We planted 270 individuals along the western edge of this parcel in December 2005. By December 2010, all original outplants had died. Yet hundreds of seedlings have recruited from that original planting. Last year, we counted 444. In December 2010, we estimated the population size to be approximately 250 plants, many of which have few leaves. This population has more shade and more competition than the COB population.

- **Castellow Hammock (2005)**
  We planted 40 individuals along the hammock edge, North of the nature center in July 2005. In December 2010, we determined that all original outplants were dead, but 16 recruits survived. No outplants lived more than four years in the field. Of our three outplanting locations, *L. canescens* has performed the poorest here. We attribute this to lower light levels and higher competition at this site.

As of December 2010, we believe we have documented the decline and disappearance of wild *Lantana canescens* in Florida. Luckily, our actions have prevented this species' complete extirpation, as the outplantings we conducted at COB in 2005-2007 are thriving, with thousands of recruits. In addition, we have stored thousands of seeds at the National Center for Genetic Resources Preservation, ensuring that the Florida germplasm of this species is not lost forever. We will continue monitor the outplanting and their recruits. Periodically, we also plan to continue collecting seeds from the remaining plants.

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Lomariopsis kunzeana (Underwood) Holttum

Jennifer Possley

Introduction

Lomariopsis kunzeana is a very rare fern that is listed as endangered by the state of Florida and critically imperiled by the IRC. It is found only in Miami-Dade County, Cuba and Hispaniola, though we do not know its status in the latter two islands. In South Florida, *L. kunzeana* is found only at COB, MHP, and in the yards of two adjacent private homes in the Pinecrest area. There is also reportedly a single plant in Everglades National Park (Gann et al. 2002).

Through our surveys, we have noted that the majority of South Florida's *L. kunzena* germplasm exists as gametophytes or as very small sporophytes that are morphologically distinct from mature sporophytes. Whereas mature sporophytes have a stiff rachis with distinct, serrate-margined, diamond-shaped pinnae, the sporophytes we call "juvenile" are amorphous, without distinctly different rachis and pinnae (see Figure 7-1).

Figure 7-1. "Juvenile" *L. kunzeana* leaves on the left are 1-2 cm long. "Mature" leaves tend to be at least 7 cm long, with rachis and pinnae strongly differentiated.

Update on wild populations

The total number of sporulating individuals in South Florida is, at most, three, though we have not observed any plants sporulating since 2005, prior to Hurricanes Katrina and Wilma, which significantly impacted the canopy at COB and especially MHP. There are 12 mature sporophytes at COB and 16 at MHP, as well as 3-4 on private property. Juvenile sporopohytes number approximately 700 at COB and 4 at MHP. There are hundreds (perhaps thousands) of gametophytes at COB, but we would guess there are less than 100 at MHP.

Update on ex situ collections

Material we collected in 2006 from sites COB, MHP, and one private home continues to grow very slowly at FTBG, CREW, and Selby Botanical Garden. The majority of material is gametophyte stage, and each organization has a few dozen sporophytes, none of which have fronds more than 2-3 centimeters long.

Next Steps

We will monitor the largest wild plants for sporulation in June 2011. We will continue to wait and see whether more sizeable sporophytes develop at CREW and FTBG. Wild sporophytes can be several decimeters in length. If that occurs, next steps will include establishing an ex situ collection at Fairchild, conducting pilot reintroductions at Fairchild, and eventual augmentation of wild populations.

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Pilosocereus robinii (Lem.) Byles & G.D. Rowley

Joyce Maschinski and Devon Powell

Introduction

Understanding reasons for biodiversity loss is essential for developing conservation and management strategies and is becoming increasingly urgent with climate change. Growing at elevations <1.4 m in the Florida Keys, U.S.A., the endangered Key tree cactus (*Pilosocereus robinii*) recently has experienced precipitous population decline. From 1994 to 2007 eight extant populations lost 81 percent of plants and 84 percent of stems. Concurrently, seven hurricanes with wind velocities >100 mph and storm surges exceeding 2 m occurred. Since 2007, four populations have declined further, and four have had increased numbers of stems. Previous studies suggested that high soil salinity was associated with Key tree cactus mortality in the lower Florida Keys. With increasing threats of sea level rise and storms, the future of Key tree cactus in the Florida Keys may teeter on its ability to tolerate salinity.

Steps Fairchild has taken to ensure the species' persistence include gathering a genetically diverse ex situ collection of seeds and cuttings, continued monitoring of wild populations and conducting a controlled experiment to determine salinity tolerance of the species.

Ex situ collection

Fairchild maintains a collection of 420 cuttings made from six populations in the Florida Keys. There are 60 maternal lines represented in these cuttings. In addition, Fairchild has 211 seedlings from 8 maternal lines and 2 populations.

We have routinely propagated cuttings from plants growing in the FTBG nursery (Figure 8-1). Since May 2010, we have propagated 185 new cuttings from 35 material lines. During annual monitoring in 2010, we collected an additional 10 cuttings from damaged or dying plants.

In October 2010, we received a single fruit from a salvaged plant growing at NKDR headquarters. We brought the single ripe fruit back to the nursery to be germinated using protocols established by FTBG and Desert Botanical Garden. We observed ~90% germination in 1-2 weeks. Unfortunately, all germinates were consumed by snails.

In fall 2010 a plant growing in the nursery produced one ripe fruit. We cleaned the seeds and stored them in ambient conditions at FTBG seed lab. Half the seeds will be germinated in the nursery to increase *ex situ* collections for future reintroductions, and the other half will be stored at the National Center for Genetic Resources Preservation in Fort Collins, CO.

Figure 8-1. Cuttings of *Pilosocereus robinii* before potting

Monitoring wild populations

In January and March 2011, we monitored populations at sites NKDRE and NKDRW, LKLT, LVK, KTCP, and KL. We adjusted our methods for defining an individual stem in 2010 to track growth more accurately within a population. As of 2010 we began tagging all rooted segments whether prostrate or erect that have lengths ≥ 10cm. In 2010 at KTCP we saw significant mortality and did not observe significant clonal regeneration (Table 1). In contrast, at NKDRE there were increased numbers of stems between 2010 and 2011, due to a change in our methodology. At LKLT and UMLVK we observed stem proliferation.

Between 1994 and 2007, six populations had decreased stem counts, while three populations experienced substantial stem proliferation (Table 8-1). By 2011, five populations still had not recovered from losses observed in 2007, however all but KTCP have either increased stem counts or stabilized since the last monitoring period.

Table 8-1. Pilosocereus site characteristics and Stem counts of living healthy *Pilosocereus robinii* observed in 2007-2011 in the Florida Keys and compared to 1994 stem counts reported by Lima and Adams (1996). Note that dying stems are not included in these counts. We display for comparison. Elevation means $\pm$ 1 S.E. are presented. NS = Not Surveyed; *LIDAR data were not available for this site; data is from 1/3 arcsecond NED, accuracy cited as 7-15m; when checked against LIDAR derived elevation data for NKDRW and NKDRE mean difference was –0.71m, max diff=-1.47, min diff=-0.05; N=66; **We did not receive permission to survey on this private property. Note that KL population is *P. bahamensis*, while the others are *P. robinii*.

Site	Area (ha)	Mean elevation (m)	Region	Ownership	Stems 1994	2007	2008	2009	2010	2011	Percent change since 1994	Percent change since 2007	Percent change since 2010	Na (ppm) 2008	Na (ppm) 2011
NKDRW	10.618	0.83 ±0.03	Lower	Public	1960	27	23	14	10	10	-99	-63	0	566	212
NKDRE	2.364	1.14 ±0.04	Lower	Public	240	29	25	19	17	21	-91	-28	24	374	48
LKGOT	0.118	0.15*	Middle	Public	16	78	77	NS	87	NS	444	12		205	33
LKLT	0.327	0.44*	Middle	Public	60	13	13	13	NS	18	-70	38		719	38
LKBP**	-	0.90*	Middle	Private	814	NS	NS	NS	NS	NS	NS	NS		NS	NS
LM	0.184	1.55*	Middle	Private	78	59	57	NS	NS	NS	-27	-3		638	NS
UMCO	0.184	1.07*	Upper	Private	177	85	NS	50	52	43	-76	-49	-17	NS	98
UMLV	0.035	0.63*	Upper	Public	14	25	22	21	28	29	107	16	4	364	104
KL	0.026	0.15*	Upper	Public	75	112	NS	98	NS	308	311	175	214	2432	113

For site KL we track growth differently than we do at other sites. We do not tag each rooted stem individually. Instead we count all stems, branches, flowers, and fruits. At KL, the clone remains stupendous! Over the past three years, there have been many flowers produced, but few fruits are formed. For example, in 2011, we observed over 500 flowers, but did not observe any fruits set (Table 8-2).

Table 8-2. Number of stems, branches, fruits, and flowers at site KL in 3 years.

Site	Stems 2009	Flowers 2009	Fruit 2009	Stems/Branches 2011	Flowers 2011	Fruit 2011
KL	98	610	2	308	500	0

Greenhouse experiment to determine salinity tolerance in *Pilosocereus robinii*
Joyce Maschinski and Devon Powell

Abstract

Abstract Summarizing Greenhouse Experiment (Maschinski and Powell 2011)

With increasing threats of sea level rise and storms, the future of Key tree cactus in the Florida Keys may teeter on its ability to tolerate salinity. To determine the salinity tolerance of Key tree cactus, under controlled greenhouse conditions we tested growth, physiological, and intercellular indications of salt tolerance of two Key tree cactus maternal lines - one growing in cultivation and a second collected from a high mortality site in the lower Keys. We used five salt concentrations: none; 2 mM NaCl equal to salinity at one proposed reintroduction site; 15 mM NaCl equal to salinity detected where plants had low mortality between 1994 and 2007; 40 mM NaCl equal to the threshold for osmotic stress in salt-sensitive plants (Munns and Tester 2008) and comparable to soil salinity associated with high mortality; and 80 mM NaCl equal to twice the sodium concentrations inducing osmotic stress, but below a lethal dose. Tolerance to salinity varied between the maternal lines. Salt sensitive plants from the Lower Keys (Maternal 2) had less stem growth(Figure 8-3), lower root:shoot ratios, lower water use efficiency, lower K: Na ratios and lower recovery rate, and lower survival than a second maternal line (Maternal 1) of unknown origin. Reasons for the differences in salt tolerance between maternal lines may either be genetic or environmental and will require further research. Within the next two decades, the degree to which salinity threatens Key tree cactus may lie in its genetic diversity.

Worldwide rare species restricted to fragmented, low-elevation island habitats, with little or no connection to higher ground will require traditional conservation actions and movement to new locations. For the conservation of Key tree cactus we recommend continued monitoring of all populations and trial reintroductions. Reducing any stresses to existing populations would be beneficial. Specifically, we recommend fencing to protect plants from herbivory. Prior to any reintroduction within historic range or managed relocation outside of range, it will be important to assess soil salinity at a recipient site to determine its suitability for supporting Key tree cactus.

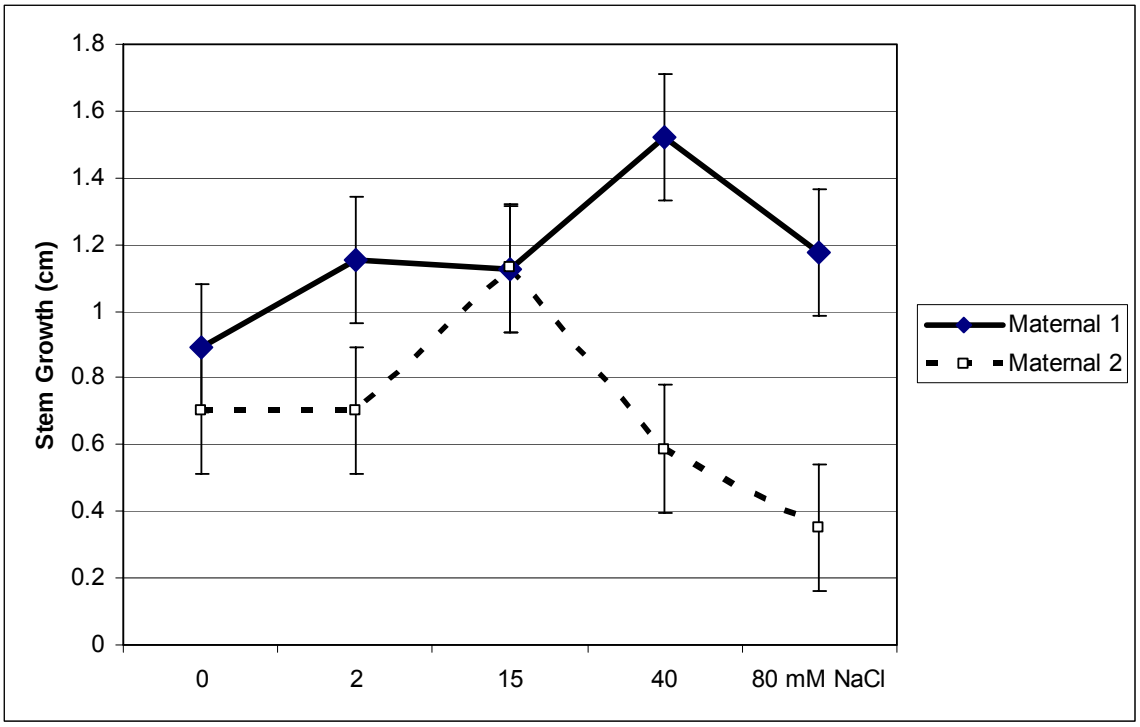

Figure 8-3. Stem growth of two maternal lines of *Pilosocereus robinii* cuttings grown for seven weeks in five salinity treatments and given 0.1% Hoagland's solution weekly.

Next Steps

Currently we are testing whether inundation alone may cause mortality of *P. robinii.* In addition, we will continue to observe cuttings that had been subjected to salinity trials to determine if mortality effects are slow to manifest in the plants. We are also testing soil salinity in wild population habitat and in potential habitat for reintroductions.

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Polygala smallii R.R.Sm. & D.B.Ward

Jennifer Possley

Introduction

Polygala smallii is a federally endangered species found only in southeastern Florida. Its range includes six protected preserves (Gann et al. 2011) and a handful of unprotected properties. In Miami-Dade County, we monitor this species on the County preserves CDE, MMZ and PSP, and on the unprotected sites CG and LFPL. Unlike most of the rare species we work with, *P. smallii* is an ephemeral annual whose population numbers can vary widely over time.

Update on wild populations

In spring 2011 we monitored *P. smallii* populations at CDE, MMZ, PSP and LFPL. Results from those surveys are summarized, along with known results from past surveys (Table 9-1). Surveys in 2000 were conducted by The Institute for Regional Conservation, under subcontract to Fairchild (Fisher 2000). Surveys prior to 2000 were conducted by the Miami-Dade County Dept. of Environmental Resources Management (DERM 1993). All other surveys were conducted by Fairchild, except for the 2010 survey at PSP which was conducted by the Dade Chapter of the Florida Native Plant Society.

As our survey data indicate, population sizes for *P. smallii* can vary widely. The driving force behind such variation is fire and fire suppression. Populations of *P. smallii* experiencing fire suppression decrease. Those that experience a fire can have dramatic increases in population size in the year following the fire. We list site-specific comments relating to population trends below.

- Populations at CDE and LFPL both seemed to be on the verge of disappearing, but fires in the past year caused seeds to germinate from the soil seed bank and both populations that began to increase once more. However, both populations are still so small (19 and 5, respectively), that they are still extremely vulnerable to extirpation.

- The population at MMZ is 97% smaller than when we last monitored in 2008. While we expected to find fewer plants than we did in 2008, we didn't anticipate such a dramatic reduction. We will revisit MMZ toward the end of the 2011 rainy season to re-assess its numbers.

- PSP is a small preserve (8 acres) surrounded by homes and schools. It has not burned in the past decade, and is unlikely to receive regular burns in the future. Recent surveys have found 0 or 1 plant. If PSP does not experience a fire in the next 5 years, we fear the *P. smallii* population may be lost.

In summary the number of *P. smallii* individuals in Miami-Dade County has declined dramatically in the past few years, and this trend is likely to continue unless there is a dramatic increase in the frequency of prescribed fires.

Next Steps

We will continue to monitor CDE, MMZ, PSP and LFPL annually. Each year, we submit a list of urgent management needs to Miami-Dade County, and we stress the crucial need for fire at PSP. The site is on the County's priority burn list, but the conditions required for a prescribed burn there are so rare that it has not yet been possible to conduct one.

Table 9-1. *Polygala smallii* surveys by Fairchild and others in Miami-Dade County.
Cells with no data indicate that there was not a survey conducted for that site during that year. An asterisk (*) indicates that part or all of the population experienced a fire in the year preceding the survey.

Site	1986	1989	1990	1992	1993	2000	2001	2002	2004	2006	2007	2008	2009	2010	2011
CDE	8			0	0	2		5	10	9	1	6	0	1	*19
LFPL				27	28	11			5			1	0		*5
MMZ					36	70						*1036			36
CG					159	781						>10,000			
PSP			75	380	119	15	30		23			10	0	1	0
BK		1		2	9										
ERRV			6	3	0			1							0

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Tephrosia angustissima Shuttlew. ex Chapm. var. *corallicola* (Small) Isley

Microhabitat Preference and Demography of *Tephrosia angustissima* var. *corallicola* in an Experimental Introduction

Joyce Maschinski and Kristie Wendelberger

Introduction

Throughout the world, conservationists have been engaged in restoring native plant communities and endangered plant species to maintain biodiversity and natural capital. Worldwide reintroduction is considered an essential plant conservation tool. Yet, the success rates of rare species introductions are variable (e.g., Falk et al. 1996). With improved techniques more reintroductions are showing successful establishment of populations (Maschinski & Duquesnel 2006, Guerrant and Kaye 2007, Wendelberger et al. 2007). In many instances, lack of knowledge about microsite and niche requirements has been noted as a reason for failure of reintroductions, therefore understanding niche or microsite requirements is a critical research need.

Here we update findings of an experimental introduction of *Tephrosia angustissima* var. *corallicola*. The sole U.S. population is growing in a cultivated lawn with ~ 100 individuals. Herbarium records indicated that the species formerly occurred in Miami-Dade pine rocklands and has populations of unknown status in Cuba. To increase the total individuals in the wild in the U.S and reduce the species' extinction risk, we conducted an experimental introduction to determine which of three microhabitats supports the greatest *T. angustissima* var. *corallicola* transplant survival and population growth.

Methods

We conducted this study at LUD, a pine rockland managed by Miami-Dade Environmentally Endangered Lands Program, which is located 1 km from the extant population. LUD has a diverse fire-dependent pine rockland dominated by patches of *Pinus elliottii* Engelm. var. *densa* Little & Dorman and *Serenoa repens* (W.Bartram) Small (Snyder et al. 1990). The shrub strata consists of over 400 native taxa mostly derived from the West Indies and highly influenced by the proximity to other plant communities such as tropical hardwood hammocks or wetlands (Gann et al. 2002). Under historical conditions, many south Florida pine rocklands experienced fire every 3- 7 years (Snyder et al. 1990). The entire study site experienced prescribed fire in the winter of 2002 and 2003. An additional arson fire burned along a portion of our firebreak microsite in 2009.

In June 2003, we transplanted a total of 141 plants into three microhabitats: 57 plants into open canopy dominated by *Serenoa repens*; 57 plants into a firebreak along the edge of the pine rockland; and 27 into closed canopy dominated by *P. elliottii* var. *densa*. We examined growth and dynamics of *T. angustissima* var. *corallicola* growing in the three microhabitats. For each introduced plant, mapped with Trimble Pro XRS GPS, we measured the length of the longest stem from rootstock to tip and the number of branches. We counted the total numbers of flowers and fruits

In response to significant seedling recruitment, we began monitoring seedlings in February 2004. We located and tagged each seedling within 1m of the parent plant. In 2008, to capture more plants, we expanded our radius of inclusion into the demographic study from 1 m to 4 m radius of the parent plant. We recorded the distance and compass bearing from the parent plant to each seedling, height (cm) to the apical meristem and fruit or flower production each year.

To determine which of the three microhabitats successfully established self-sustaining populations, we categorized each plant into one of four non-overlapping stages based upon plant size and the presence or absence of fruits or flowers. Stages were 1) seedling = < 2 cm w/cotyledons; 2) juvenile = 2-10 cm; 3) non-reproductive adult = no flowers present, > 10 cm or > two branches; 4)

reproductive adult = flowers or fruits present, > 10 cm. We assessed survival reintroduced individuals and second generation seedlings for the transition periods between 2003 and 2011. We developed a stage-based model incorporating percent survival, transitions to larger stages, and reproductive values for plants in four stages.

For purposes of this report, we provide counts for the original transplants and the second generation recruits for the period 2003 -2011.

Results

Survival of *T. angustissima* var. *corallicola* across microhabitats varied across time. In the first three years of the study, greater numbers of transplants survived in the firebreak and *Serenoa* microhabitats than in the pines, yet the greatest percentage survival of plants transplanted to the site occurred in the pines microhabitat in most years (Table 10-1). By September 18, 2009, 77 months after outplanting, only one transplant survived along the firebreak.

Table 10-1. Number of living transplanted adults and second generation recruits from summer 2003 through Spring 2011. A single adult remained in the firebreak by fall 2009, but numerous second generation recruits have established.

	Firebreak - Adults	**Firebreak - 2nd Generation**	**Pines- Adults**	**Pines- 2nd Generation**	***Serenoa*- *Adults***	***Serenoa* - 2nd Generation**
Summer 03	57	0	27	0	57	0
Fall 03	56	25	24	43	34	102
Winter 04	50	206	24	120	34	99
Spring 04	45	793	24	129	32	70
Summer 04	40	1256	24	358	22	240
Fall 04	22	1039	22	320	15	276
Winter 05	17	562	16	247	13	252
Spring 05	16	337	13	194	12	218
Summer 05	15	374	11	117	12	183
Fall 05	12	259	5	68	11	148
Winter 06	10	160	3	30	9	132
Fall 06	5	65	0	14	8	59
Summer 07	2	20	1	14	5	44
Fall 08	1	72	0	10	3	36
Fall 09	1	86	0	7	0	71
Spring 11	0	52	0	1	0	15

Second generation recruitment occurred by fall 2003 in all microsites and contributes immensely to the reintroduced population. By summer 2004 second generation recruitment peaked and was greatest in the firebreak. Seedling recruitment was highest along the firebreak (> 2,230 seedlings total) in most years. By fall 2011, the number of living second generation plants was 52 in the firebreak, 1 in pines, and 15 in *Serenoa*. Within firebreak and *Serenoa* microsites stage classes 2-4 are represented (Table 10-2), but in 2011 the pines microsite had only a single non-reproductive plant. Growth to maturity was most rapid in the Serenoa habitat. It took significantly less time to

flower in the *Serenoa* microsite than the other two microsites ($P < 0.001$). The median time to flower in the *Serenoa* microsite was 1212 days, while in the Firebreak it was 4264 days, and 8,224 days in the Pine.

Table 10-2. The number of transplant progeny in each size class growing within the three microsites in 2009 and 2011. Size classes are as follows: 2 = plants 2-10 cm; 3 = >10 cm, or with > 2 branches (not reproductive); 4 = >10 cm w/ flowers or fruits.

2009	**Size 2**	**Size 3**	**Size 4**	**Total**
Firebreak	20	60	6	86
Pines	1	5	1	7
Serenoa	37	24	10	71
2011				
Firebreak	11	28	13	52
Pines	0	1	0	1
Serenoa	3	8	4	15

Total plants surviving at LUD after 7 years is 52% less than the initial introduced population. Although preliminary population viability analysis for *Serenoa* microsite indicated a positive population trajectory (May 05 – Aug 2005 λ = 1.037; 2007-2008 λ= 1.0126), models for the 2008-2009 and 2009-2011 trajectories in all habitats indicate rapid decline.

Discussion

Because little was known about the microhabitat requirements of *T. angustissima* var. *corallicola,* demographic patterns in the three tested microhabitats offer valuable insights into the species' biology and life history. Reasons for the variation in survival and recruitment may relate to shade tolerance, soil moisture, underlying topography and root growth during establishment, and drought.

Within the first year after planting, introduced adults had highest survival and growth in microhabitats with partial shade and relatively high soil moisture and lowest survival in the microhabitat with high light and low soil moisture. Given the transplants were pint-size, nursery-grown individuals accustomed to adequate water and nutrient supplies it would be expected that those individuals planted into the drier, sunnier habitat (*Serenoa)* would show greater mortality within the first year. However, after 77 months, introduced adults showed similar survival across all three microhabitats regardless of soil moisture or light exposure. Presumably, the majority of the transplants were not able to establish a root system suitable for the harsh conditions found in South Florida pine rocklands or they have short lives under wild – uncultivated conditions.

Fortunately, the transplants were able to disperse abundant seed before they died. Seedlings had highest recruitment in microhabitats with highest soil moisture (Wendelberger and Maschinski 2006). The highest recruitment was in the firebreak, followed by the pines and *Serenoa*. Although initial PVA indicated that the population was projected to grow slowly, recent years project that the population will rapidly decline. The relative dry winter may have adversely affected the population, especially germination and flowering. The vital rate that had the highest sensitivity was non-reproductive adult transitioning to reproductive adult. These findings are a concern and suggest that immediate action should be taken to augment the LUD reintroduced population.

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Thelypteris patens (Sw.) Small ex R.P.St.John

Introduction

Thelypteris patens is found throughout the tropical Americas and Caribbean, in addition to Miami-Dade County, Florida in the United States. It is similar to the common *Thelypteris kunthii* in appearance, though it can grow larger (to approximately 1.5 m) and instead of a creeping rhizome, it forms an erect "trunk." Its Florida population is limited to two Miami-Dade County preserves. At CDE, there is only a single plant. The population at BSP consists of a few dozen individuals.

Propagation updates

Fairchild sent *Thelypteris patens* spores from CDE and BSP to CREW in 2006. Plants germinated and produced sporophytes within the year. From 2006-2010, CREW sent 60 individuals back to Fairchild for our ex situ holdings. While we initially had high mortality in the process of transferring ferns from terraria to ambient conditions, we have improved our technique and mortality has been reduced.

Update on ex-situ collection and wild populations

Currently, Fairchild maintains 25 individual *T. patens,* with about half of those held in our greenhouses and the remainder in indoor glass terraria.

We have conducted a census of the wild populations of *T. patens* since 2003. The table below contains a summary of population counts at CDE and BSP. At CDE, there is only a single plant, which was first discovered in 2000 (Gann et al. 2002).

Site	1993	2000		2003	2004	2005	2006	2007	2008	2009	2010	2011
CDE		2		3	2	2	2	2	2			1
BSP	41			81				71				77

The population of *T. patens* at BSP was first discovered in 1993, by former Fairchild employee Carol Lippincott with Alan Cressler. At that time they counted 41 plants. Possley and colleagues have surveyed the population every 4 years since 2003. We conducted a survey most recently in April 2011. Overall, most *T. patens* looked healthy and robust, and we found what we thought were some "juveniles" that had appeared since our previous census. Major threats to this population are large exotic trees *Bischofia javanica, Schefflera actinophylla,* and *Schinus terebinthifolius* - the first two of those species produce copius leaf litter and young seedlings, which can quickly smother or crowd out understory ferns. Because the trees are so large and provide much of the shade in the immediate area, managers cannot simply clear cut them, or the rare ferns beneath could be harmed. Thus, beginning in 2009, Miami-Dade County Natural Areas Management removed approximately 25% of the exotic tree canopy each year. So far, the *T. patens* does not appear to be adversely affected by this process.

Next Steps

Last year we reported that a next step would be to establish some individuals in high humidity locations within Fairchild Tropical Botanic Garden (likely the conservatory or sunken garden) as a pilot study for eventual wild reintroductions. Due to construction in our conservatory, we have not yet proceeded with this plan. We hope to establish *T. patens* in Fairchild Garden in the next two years.

Reference

Gann, G.D., K.A. Bradley and S.W. Woodmansee. 2002. Rare plants of South Florida: Their history, conservation and restoration. The Institute for Regional Conservation, Miami, FL.

Figure 11-1. A fertile frond of *Thelypteris patens* collected from ex situ holdings at Fairchild. We sow the dehisced spores into closed containers filled with moist soil and wait for germination. Our previous efforts have been rewarded by mold, but we are working to improve our sterilization technique and hope to soon be cultivating young *T. patens* gametophytes.
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Thelypteris sclerophylla (Poepp. ex Spreng.) C.V.Morton

Jennifer Possley

Introduction

Thelypteris sclerophylla is a lithophytic fern native to South Florida and the Caribbean. The state of Florida lists it as endangered. Its distribution in South Florida is limited to just two Miami-Dade County Parks: HRD and FUH. The total number of individuals in South Florida is not likely to exceed 150 plants.

In 2005 and 2007, Fairchild collected spores of Florida endangered *T. sclerophylla* from HRD. The spores were sent to CREW for propagation. In late 2008, the 2007 accessions began to produce sporophytes at CREW.

Update

In 2009 and 2010, we received two shipments of *T. sclerophylla* from CREW, originating from spores from 7 individuals from HRD. We have had excellent (100%) survival of all 38 individuals. Currently we are working to gradually transition these ferns from terraria to our greenhouses (Figure 12-1).

Figure 12-1. Plastic bags used to transition *Thelypteris sclerophylla* (and other ferns) from terraria to greenhouse.

Next Steps

We hope to receive more *T. sclerophylla* from CREW in the next year to bolster our collections. As greenhouse individuals approach full size with fronds 40-50 cm long, some will be incorporated into a display at the main garden. If the FTBG planting proves successful, we may conduct in situ augmentations.

Zanthoxylum coriaceum A. Rich.

Zanthoxylum coriaceum (Biscayne prickly ash) is a state endangered (Coile and Garland 2003) small to medium size tree. Its primary habitat is maritime hardwood hammock, which is vulnerable to urbanization - a past and present major threat (Gann et al. 2002). The discovery of new trees and the observance of numerous wild seedlings at Site CR over the past three years demonstrate that suitable habitat also occurs in coastal strand habitat (see page 80).

In total, there are approximately 76 wild specimens occurring at three South Florida public natural areas. Fairchild has documented the occurrence of *Z. coriaceum* at nine (three wild naturally occurring populations and six outplanted populations) coastal sites in Miami-Dade and Broward Counties (Possley 2002, Wright 2003, Wright 2010). The following is a summary of monitoring results for three (one wild) populations.

Outplanting updates

Due to habitat fragmentation and development along South Florida's coast, suitable coastal hammock habitat for *Z. coriaceum* is extremely limited. Of the trees left in the wild (3 populations), 99% occur at two sites within one mile of each other. The close proximity of the two populations leaves *Z. coriaceum* vulnerable to possible extinction via one large stochastic event, such as a hurricane or large storm. Fairchild recognizes the need to increase population numbers and sizes in the wild through outplantings.

Site BB

Samuel J. Wright and Elizabeth Golden

Site BB occurs within the natural range of *Z. coriaceum*, just 3 miles south of a wild population at CR. BB also contains similar coastal strand and hammock habitat to CR thereby making it a potentially good recipient site for *Z. coriaceum* outplantings. In 1992, an outplanting was conducted prior to Hurricane Andrew at BB, and the three plants that survived the storm were transplanted to the park's nursery to make way for a new path. These plants were later planted into the Atlantic Hammock in 1997, at the crest of the high dune and currently only two remain alive. Between 1999 and 2003, 63 *Z. coriaceum* grown from CR stock and donated by FTBG were planted at BB (Table 13-1).

Table 13-1. Table showing dates, quantities and location of *Z. coriaceum* plantings at BB

Date	Quantity	Area
July 1999	31	Lighthouse Compound Seawall Hammock
May and June 2001	18	Seawall Hammock Atlantic Hammock
September and October 2003	14	Lighthouse Compound Seawall Hammock Atlantic Hammock

As of January 2011, 40 plants remain; 18 are males, 19 are females (of which 12 have produced fruit at least once), and one is of unknown gender. Their heights vary between 73 cm and 425 cm, with most between 250 cm and 350 cm. All but the shortest most recently planted trees have flowered several times and some have produced seedlings.

In May 2001, the first seedling was observed under a female plant. Through the years seedlings have experienced herbivory from rabbits, occasionally biting off new stems (Possley 2002, Golden and Duquesnel unpub. data). Mortality in adults has also occurred due to storm surge and battering from the storms of summer 2005 and resulted in the loss of 14 transplants. During the January 2011 survey, seven adult plants were seen to have seedlings below or near them (less than 2 m from the trunk); one of these had 17 seedlings and one had more than 40. In addition, nine recruited plants measuring from <5 cm to 95 cm were found in the Seawall Hammock at distances ranging 2 m to 21 m from the nearest adult plant (Figure 13-1). Seedlings located far from the nearest adult may have been dispersed by high hurricane winds that have passed through BB in 1992, 2001 and 2005. This dispersal distance is in contrast to short distance dispersal of seeds at CR where the majority of seedlings are located within only a few meters of the parent plant (See pages 82 and 84.

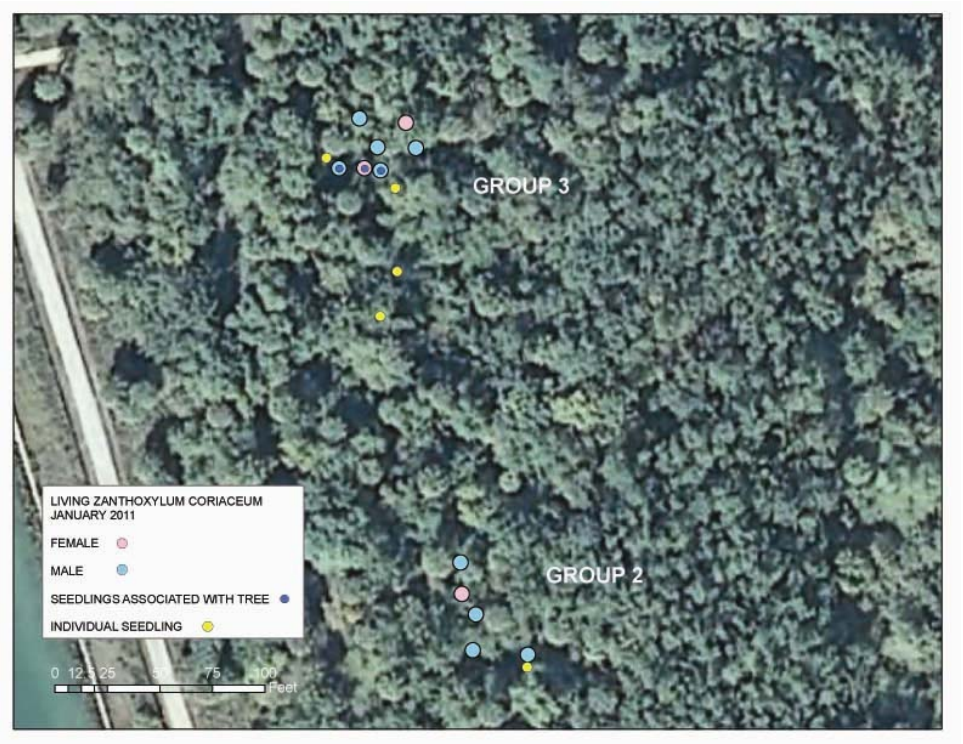

Figure 13-1. Aerial map showing location of male, female and seedlings of *Zanthoxylum coriaceum*. Map created by Elizabeth Golden of Site BB

Site *NSP*

Samuel J. Wright

Introduction

We selected NSP as a suitable location to re/introduce *Z. coriaceum* for several reasons. The park has an intact fragment of healthy maritime hammock habitat. Also the area is historically significant to the species. *Z. coriaceum* was known to exist in the vicinity of NSP. Small and Mosier collected a specimen (5819, US) of *Z. coriaceum* in 1919 at a site about 4-5 miles north of the southern tip of Miami Beach (Gann et al. 2002). NSP is about 5 miles north of the southern tip of Miami Beach. Additionally, NSP is approximately 11 miles north of the two largest remaining wild populations and 24 miles south of the small population. This location and distance from the wild populations could aid in the preservation of the species should a hurricane hit the two large wild populations.

Methods

For methods see Maschinski et al. (2006), page 122.

Results and Discussion

We last monitored the outplanting on July 7, 2011. The planting is now 66 months old and only five plants remain alive (16% survival). Although mortality is very high, no trees have died in the last three annual surveys. Some trees appear very healthy (new growth and fruiting). Three of the remaining plants are female and two have grown substantially (currently 2.5 meters tall). One of the females is fruiting prolifically and has for the last three years. We have not observed any seedlings under the fruiting female. Seed germination may be suppressed by a thick layer of *Coccoloba uvifera* (sea grape) leaves.

Factors that have contributed to the decline of this outplanted population include theft, vandalism damage, possible root rot, and trunk damage cause by landscape maintenance workers. Park staff has been made aware of the issues concerning the unnatural deaths of the plants. We held a meeting in April 2007 with staff to discuss management options to save the remaining plants. In order to protect the remaining trees fencing was installed around the hammock. Although there has been a large decline since the outplanting, the population seems to have stabilized since the installation of the fence. Increased protection has not only occurred with the fencing, but also by signs designating the hammock as a ‘Conservation Area’.

Next Steps

The remaining *Z. coriaceum* trees are very healthy with two of the females producing fruit. However the present thick duff layer is not conducive to seed germination. We recommend raking and removing seagrape leaves underneath the fruiting females to improve conditions for seed germination. Outplanting survival at NSP is low, but we have observed stabilization in the population over the last few years due in large part to the fencing installed around the hammock. NSP is the last remaining intact coastal hammock on Miami Beach and is our only option for outplantings on the island. However, before another outplanting can take place at NPS, the “Conservation Area” would need to adopt management strategies more suitable for a natural area. Currently vegetation (native or non-native) is being removed by unsupervised volunteers thereby reducing the native species diversity within the hammock. We will continue to monitor the remaining *Z. coriaceum* trees for survival, flowering, height, and presence of seedlings once a year.

Site survey and demography study of wild and outplanted *Zanthoxylum coriaceum* populations at Site CR

Samuel J. Wright

Wild population
Introduction

On December 14, 2001 Fairchild staff conducted our first survey at CR to assess the *Zanthoxylum coriaceum* population numbers. We counted and mapped 21 naturally occurring wild individuals. The site has been revisited annually since March 2004 to observe population numbers, growth, fecundity and recruitment. We discovered six previously undocumented trees during the 2004 survey, and five more in 2007. In March 2008, after removing invasive plants in the coastal strand habitat at CR, we discovered another two (1 male, 1 female) formerly undocumented adult *Z. coriaceum* trees.

Methods

During the spring of the past seven years we have assessed survival, growth (height) and recruitment of *Z. coriaceum* trees. To find trees we previously used ArcView and now use ArcMap derived maps that were originally created in 2002 and updated accordingly with the discovery of new plants. We also documented the occurrence, year-to-year survival and growth of seedlings. When found, we tagged seedlings with numbered ID tags, but we did not record GPS points of seedling locations. For the past three years we measured distance and bearing location of seedlings to nearest female tree. We define seedlings as new plants that are <1 year old. We define recruits as plants that are 1+ year old in addition to seedlings. All recruits and seedlings received numbered tags.

Results and Discussion

We last surveyed the population in May 2011. We observed 2 deaths since the 2010 survey, and recorded last year that the two trees were in poor condition. We documented, tagged and mapped three previously unknown trees (2 female, 1 unknown). Site CR currently has 32 (16 female, 9 male and 7 unknown) documented wild *Z. coriaceum* trees (Figure 13-2). As mentioned previously (Wright 2007), from 2004-2007 we documented that seedling recruitment in the wild population was only one-fourth of recruitment in comparison to the outplanted population. We theorized that the close proximity of the male and female trees due to the planting design (Possley 2002) of the outplanting may have increased pollinator visits and benefited pollen transfer and fertilization. However, in 2008 the wild population recruited 212 seedlings; double the observed seedlings from the outplanted trees (Figure 13-3). This disparity in seedlings present in past surveys may be related to the timing of maturity for the wild plants rather than the planting design of the introduced plants.

We have documented over 377 recruits and seedlings in the last six years underneath eight wild female trees (Figure13-3). This year, 51 of the 124 recruits recorded in 2010 survived and we documented 12 new seedlings. In the past we attributed the loss of many recruits to a very dry winter. However, last year CR experienced a very wet winter and this year a very dry winter again. Even during this annual fluctuation in winter rainfall, we observed virtually an equal amount of survival over the past three surveys (42%, 44% and 41%), thus recruit survival may not be dependent on rainfall. *Z. coriaceum* displays limited short distance seed dispersal. Recording the seedling distance from its parent showed that all seedlings occurred within 3m of the mother plant, with 90% of the seedlings located within 2m of the base of the tree (Figure 13-4). We will continue to monitor the adults and recruits for survival annually. We will also send the GPS points to the Florida Natural Area Inventory (FNAI) so the occurrences can be documented within their database.

Figure 13-2. Population of *Z. coriaceum* at CR. Trees discovered in last few years designated by red dots. Previously known plants are designated by yellow dots.

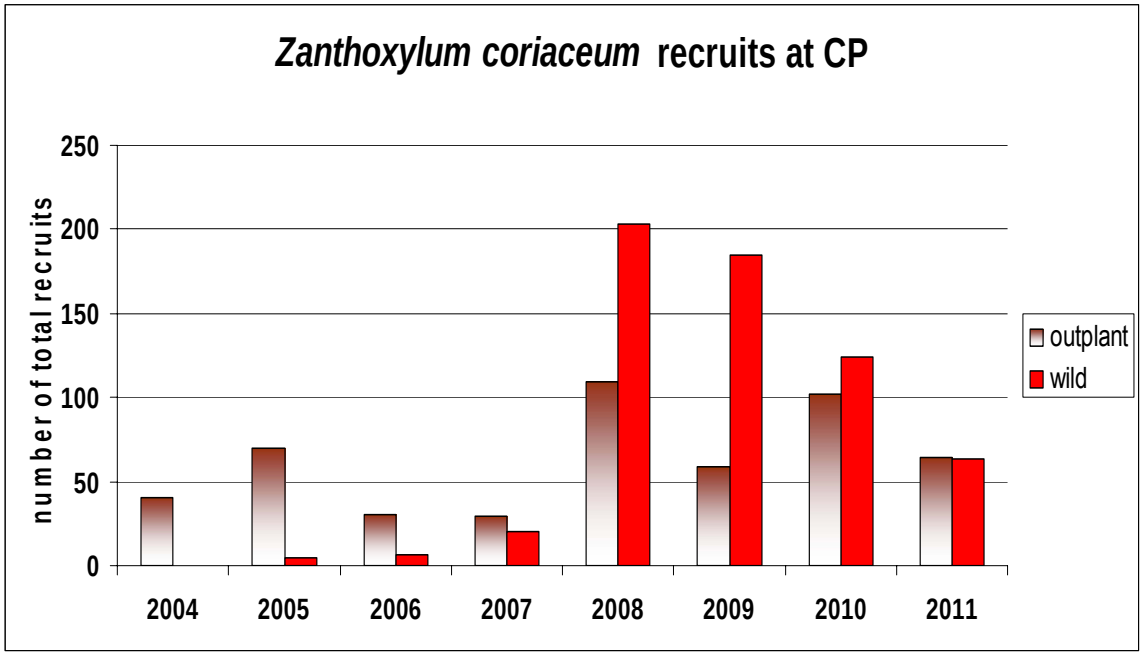

Figure 13-3. Total number of *Zanthoxylum coriaceum* recruits underneath outplanted and wild trees at CR found during 2004-2011 surveys.

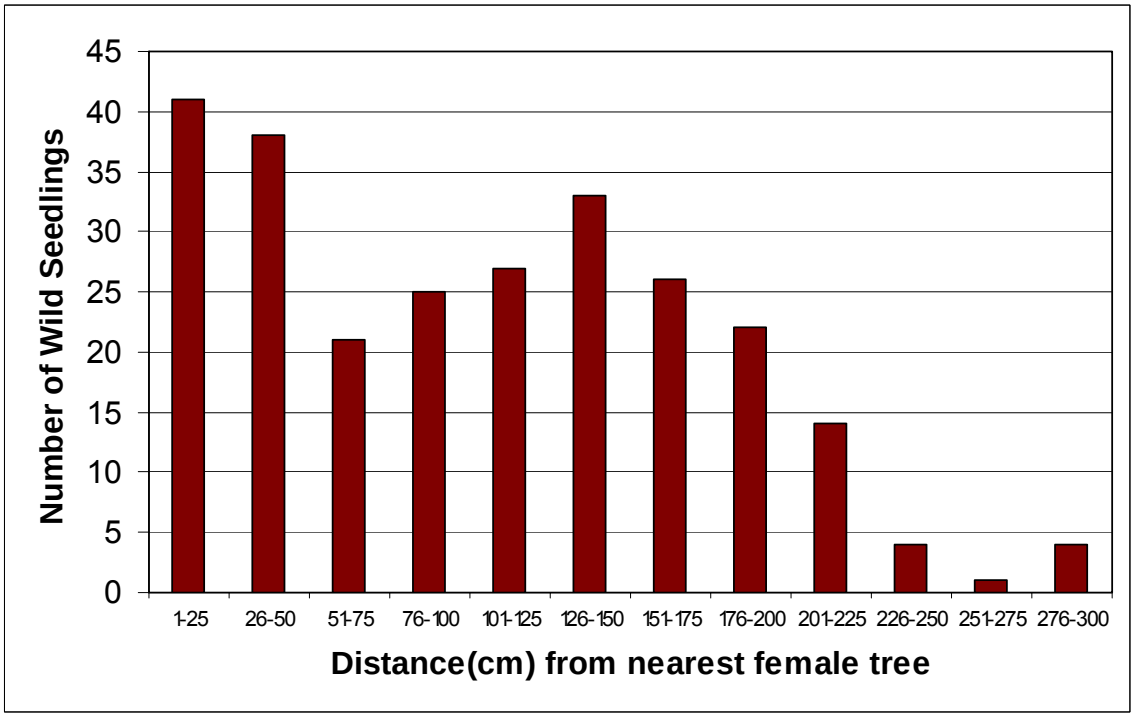

Figure 13-4. Distance (cm) of recruits (n=256) from base of nearest wild female *Z. coriaceum* tree. Distance data not taken during the first few years of the study.

Outplanted population

Introduction

In September 1998, Miami-Dade County's Department of Environmental Resource Management and Fairchild collaborated on an outplanting of *Zanthoxylum coriaceum* at CR. The outplanting purpose was to increase the number of individuals at CR, which already contains a wild population of *Z. coriaceum*. In an effort to increase pollen exchange between plants, the outplanting design consisted of individuals planted in three clusters, each with two males and one female. In total 30 trees were planted in two separate areas of CR: southern (21 plants) and northern (9 plants).

Methods

See methods in Maschinski et al. (2006), page 120. We documented the growth and survival of tagged recruits and tagged new seedlings. For the past three years we measured distance and bearing of recruits and seedlings to nearest female tree. We define seedlings as new plants that are <1 year old. We define recruits as plants that are 1+ year old in addition to seedlings. All recruits and seedlings received numbered tags.

Results

Results for 2004-2007 surveys are reported in Maschinski et al. (2006), page 121.

We last surveyed the population in May 2011. All plants are still alive from the 2009 census. In total there are 24 of 30 trees alive from the outplanting. We have documented over 260 total recruits and seedlings the last seven years underneath 12 wild female trees. Of the 102 total seedlings that we documented in 2010, 55 remain alive. We documented and tagged 9 new seedlings underneath three female trees. Recording of seedling distance showed that all new plants occurred within 3m of the mother plant, with 90% of the seedlings located within 1.5m of the base of the tree (Figure 13-5).

Discussion

This introduction is now almost 13 years old and 80% of transplants have survived (24 of 30 alive), although it took six years to observe our first seedling, female trees have been very productive with 260 seedlings documented in the past seven annual surveys. Germination of seedlings may be dependent upon fluctuating winter rainfall levels. A dry 2009 winter produced only four new seedlings while a wet 2010 winter this year produced 68 new seedlings and dry winter this year produced nine new seedlings.

We are encouraged by the success of this introduction, but it's still too early to determine if the introduction is self-sustaining. We will continue to monitor annually the survival of transplants and seedlings. We will also continue to document distance measurements of seedlings in order to better understand dispersal mechanisms.

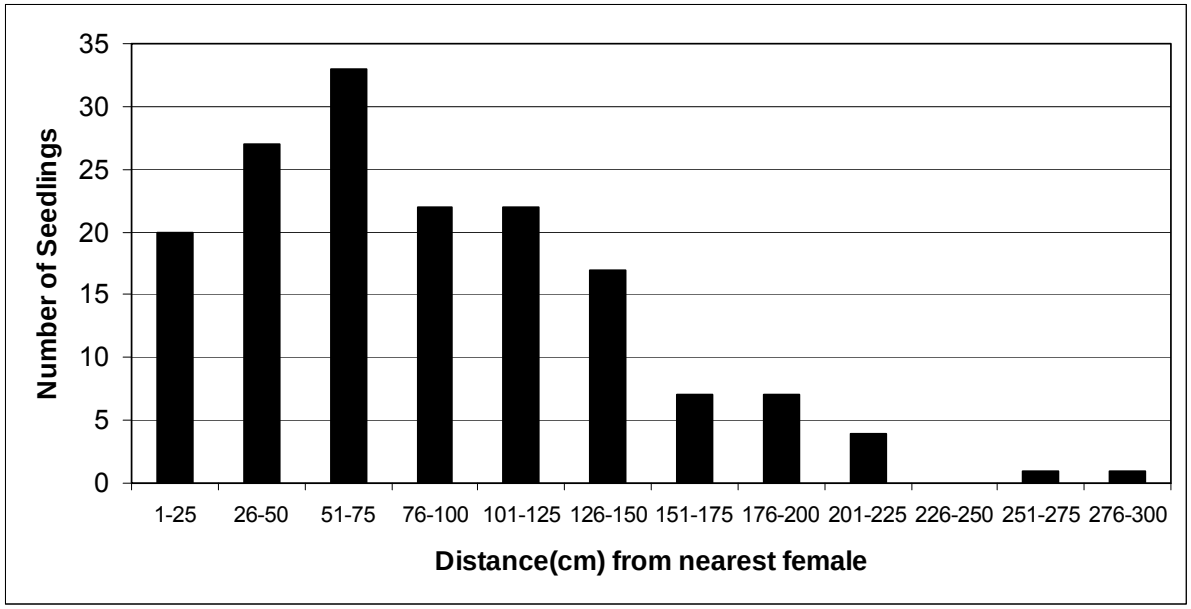

Figure 13-5. Distance (cm) of seedlings (n=161) from base of nearest outplanted female *Z. coriaceum* tree. Distance data was not taken the first few years of the study.

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Zanthoxylum flavum Vahl.

Samuel J. Wright

Last year we reported a survey of the *Zanthoxylum flavum* population at KWNWR to FDACS (Maschinski et al. 2010). We were asked by the USFWS managers at KWNWR for a summary report with management recommendations in relation to what we observed. The following is the report that we submitted to USFWS in September 2010:

Summary Report for Survey of *Zanthoxylum flavum* (yellow-wood) at KWNWR

Introduction

Zanthoxylum flavum (yellow-wood) is a state endangered (Coile 2003) medium sized tree located in only three lower Florida Keys sites (KWNWR, BHSP, and KWGC). Two of the three populations occur on protected public lands and the unprotected private land is a golf course. The three wild populations range from one to approximately 75 individuals. Primary habitat for *Z. flavum* includes maritime hardwood hammock (Long and Lakela 1971) and coastal berms (Coile 2000), which are vulnerable to urbanization especially in the Keys. Other threats include non-native plant invasions (Gann et al. 2002) and hurricanes (pers. observation).

With only 1-2 individuals present at the other two wild populations, the KWNWR is the largest remaining wild stand of *Z. flavum* in the United States. A full survey of the population has not occurred since 1998, in which 75 trees were documented, tagged and mapped by Janice Duquesnel of DEP. The effects of past hurricanes (particularly Georges in 1998 and Wilma in 2005) on the *Z. flavum* trees were unknown and a full survey and assessment was imperative to gauge the health of the population.

Methods

Before visiting the island we created maps showing the location of the trees observed and mapped by Janice Duquesnel in 1998. We visited KWNWR on May 27th 2010 and again on July 3rd 2010 to assess the status of the population. Using the map and previously collected GPS points we re-visited all tagged/mapped trees, and documented survival, growth and productivity. We measured (in cm.) to the top of the highest green leaf for each live tree as a factor of height. We documented trees without green leaves as dead. Upon arriving at GPS coordinates with no visible tree we surveyed within a 10m diameter of the GPS point. If still no tree was observed, we then documented the tree as dead. We also surveyed for seedlings and previously undocumented trees. We measured and collected GPS points for newly observed plants. We incorporated the new plants into the site map. We also placed numbered ID tags around the base of the trunks of new trees using wire.

Results and Obervations

KWNWR was heavily damaged by Hurricane Wilma (Wilmers pers. comm.) with many dead and downed trees (Figure 14-1) making it difficult to traverse the island. The difficulty of hiking through the downed debris and the limited time on the island due to tidal conditions made a second visit to the island necessary.

We observed only 24 live trees of the previously documented 75 trees (Figure 14-2), demonstrating 32% survival since 1998. At least four of the female trees were flowering, therefore future recruitment is still possible. Approximately 1/3 of the remaining trees did not appear healthy; they had yellowing and browning leaves. We did, however, find three previously undocumented trees (all > 3m tall). It is apparent that the hurricanes had a negative effect on the *Z. flavum* population. During our visits, the island was very dry with temperatures over 90° F. This may have also contributed to the stressed appearance of the trees.

Figure 14-1. Five years after Hurricane Wilma, the canopy at KWNWR still shows damage from the storm.

We observed exposed substrate and virtually no leaf litter underneath dead and dying trees. This implies that decaying leaf matter may have been increased through opening of the canopy or that little leaf litter has accumulated in the past few years. In contrast, under healthy trees we observed a thick duff layer typical of undisturbed hammocks. Site elevation and distance from the foredune may have played a factor in contributing to the survival of some trees. Survivorship appeared to be positively correlated with elevation and distance from shore. A study could be conducted to quantify if these factors along the gradient are in fact related to tree survival. Once these fastors are better understood this information could be useful for future translocations.

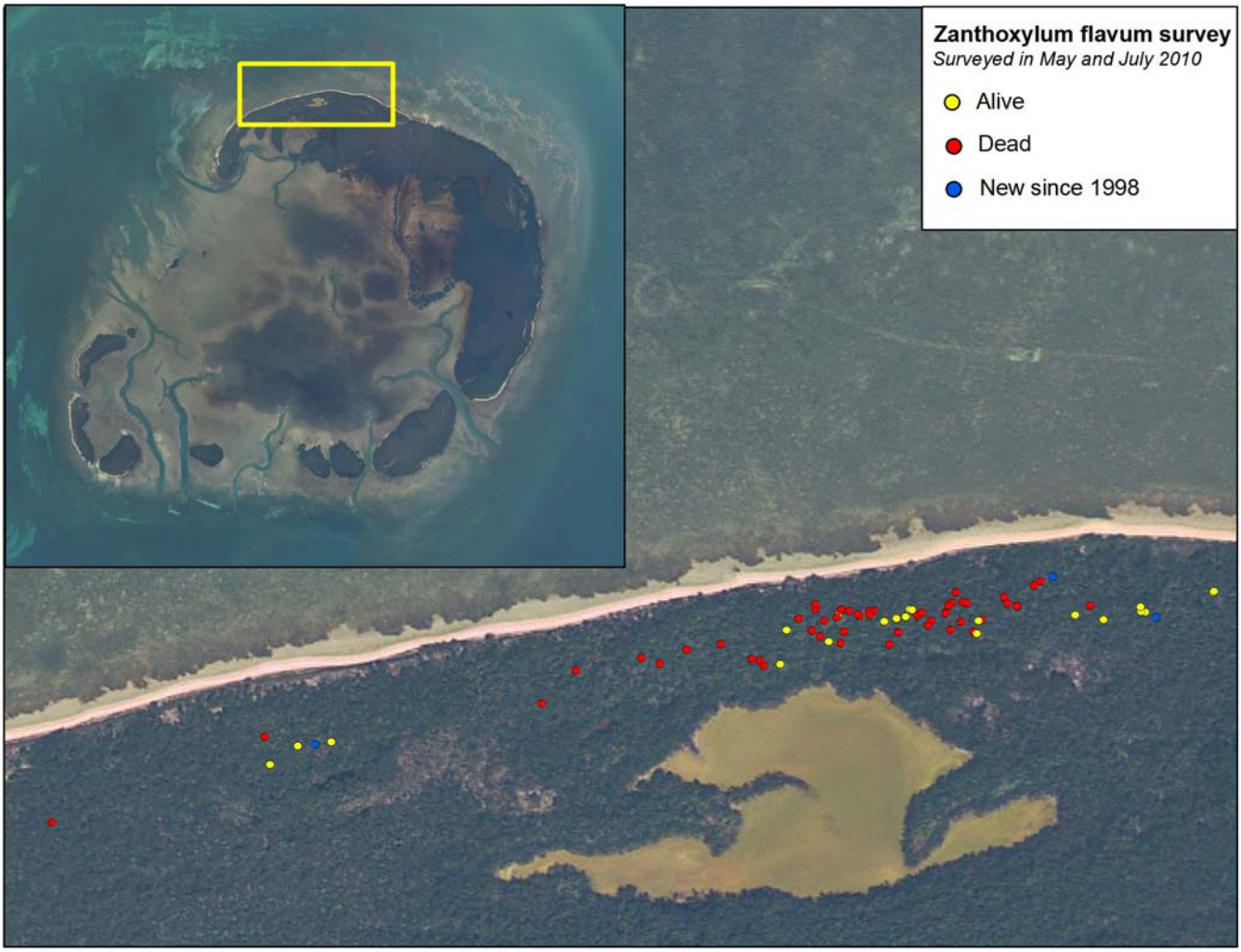

Figure 14-2. Map showing alive (yellow), dead (red) and previously undocumented (blue) *Zanthoxylum flavum* trees.

Recommendations

The large decline of the *Z. flavum* population at KWNWR over the last 12 years is a major concern. The future sustainability of the species relies on protection of the remaining plants, collection and storage of seeds and re-establishment of new populations through translocations. We list recommendations below that could assist in the recovery of *Z. flavum*:

1) Protect remaining trees

Surveys of remaining populations should be conducted on a more regular basis, perhaps every 1-2 years. The KWNWR and BHSP sites are on protected conservation lands but the KWGC is on private property and thus not protected. A closer relationship with the golf course should be established in a effort to provide the population more protection and awareness.

The dunes on KWNWR were breached by Hurricane Wilma (Wilmers pers. comm.), causing the soil within the vicinity of the *Z. flavum* trees to be indundated with salt water. The majority of the dunes now contain herbaceous dune species. These species are good sand binders but are not as efficient as *Uniola paniculata* (sea oats) at building dunes. If possible *U. paniculata* should be re-established on the dunes in front of the remaining *Z. flavum* in order to build up the dunes and further protect the trees.

2) Collect and store seed from remaining trees

In order to preserve the germplasm of the current plants, seeds should be collected from the remaining wild trees. At least half of the collected seeds should be sent to The National Center for Genetic Resources Preservation (NCGRP) in Fort Collins, Colorado for safekeeping. Collections should be conducted from August to November when fruiting occurs (Garvue 1999). Only 10% of fruits should be collected at a given time as suggested by guidelines established by the Center for Plant Conservation. Due to the small numbers of trees in the wild, seeds should also be collected from ex-situ populations. Known ex-situ populations occur at:

a) Fairchild Tropical Botanic Garden, Miami
b) Bahia Honda State Park, Bahia Honda Key
c) Key West Tropical Forest and Botanic Garden, Stock Island
d) Charles "Sonny" McCoy Indigenous Park, Key West
e) Key West Butterfly and Nature Conservancy, Key West

3) Conduct further ecological research

More research is needed to understand the microhabitat elements that constitute suitable and safe habitat for *Z. flavum*. Also, understanding environmental factors that may have contributed to the decline of the population is essential to sustainability of the species in the wild. Suggested research topics are listed below.

a) Determine if the location along the dune-to-hammock–to-mangrove gradient and distance from the high tide line is correlated to survival of *Z. flavum*.
b) Determine if elevation is correlated to *Z. flavum* health and survival.
c) Determine if there is a difference in soil salinity when comparing live and dead *Z. flavum* locations.

The above information could be used to determine suitable sites for possible future translocations. This information could also be used to determine whether there are nearby sites that contain suitable habitat but have not yet been surveyed for *Z. flavum*. New plants could potentially be discovered.

4) Increase plant numbers

A priority should be to increase *Z. flavum* populations in the wild within its natural range. If suitable habitat is available, emphasis should be placed on increasing population sizes at the KWNWR and BHSP. A secondary recommendation would be to outplant populations within close vicinity of current wild populations. Depending on site conditions, Site BC having once contained an extirpated population (Gann et al. 2002) could be a good candidate site for an outplanting. *Z. flavum* was reported to be quite common on Key West in the mid 1800s (Nutall 1849). Key West no longer contains much natural area, but Little Hamaca Park could also act as an appropriate outplanting site.

We suggest using a planting design implemented by Gary Milano of Miami-Dade for an outplanting of congener *Zanthoxylum coriaceum* at CR. In 1998, trees were planted in a 2:1 (male:female) ratio to improve pollen exchange. It was theorized at the time of planting that the design would increase polinator visits thereby benefitting pollen transfer and fertilization (Possley 2002). Although it took six years for plants to reach sexual maturity, we documented that the outplanted females outproduced the wild population females for the first four years of a demography study (Wright 2009). If it is possible to know the sex of each tree, we recommend using this outplanting design.

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Public Outreach

The Connect to Protect Network

The Connect to Protect Network (CTPN) is a program designed to reduce the effects of fragmentation on rare plant populations in the globally endangered pine rocklands by encouraging the local community to create pine rockland corridors and stepping stone gardens (Figure 15-1) on their property. We think that pollinators and wildlife will use these corridors and gardens to move between fragments bringing with them pollen and seeds, thus reducing the effects fragmented plant populations.

Accomplishments

- We are actively recruiting public and private landowners to join the CTPN through presentations, participation in community events, and Fairchild's website. Since June 2010, we have added an additional 30 new members and distributed 200 plants.

- One of the main goals of the Connect to Protect Network is to develop an active network of members that assist each other with garden maintenance, planting, and advice. To facilitate network exchange we produced an issue of *Connections*, a newsletter for the CTPN in November 2010 (Figure 15-2 and 15-3). We distribute *Connections* by email to all network members.

- In January 2011, Fairchild and Miami-Dade County Natural Areas Management (NAM) Department held its fifth annual workday to restore endangered species habitat at Site TROP. TROP is home to one of the last remaining wild populations of *Amorpha herbacea* var. *crenulata*. Working with 50 students participating in the Fairchild Challenge, we spent several hours manually removing non-native, invasive sword fern (*Nephrolepis multiflora*).

- In January 2011, we held our first meeting for the Connect to Protect Network (Figure 15-4) at the home of Dr. Lin Lougheed, a Fairchild trustee and CTPN member. The meeting was held on a Saturday from 9-4 pm. We invited several network members to present talks about their experiences with native plant gardening and restoration, and held an information exchange session at the end of the day.

- In March 2011, Fairchild staff and volunteers assisted a CTPN member for a second year with invasive species removal. This member has remnant pine rockland on his property. This small pineland supports a diversity of native species, including the state endangered *Ipomoea microdactyla* and *Koanophyllon villosum.*

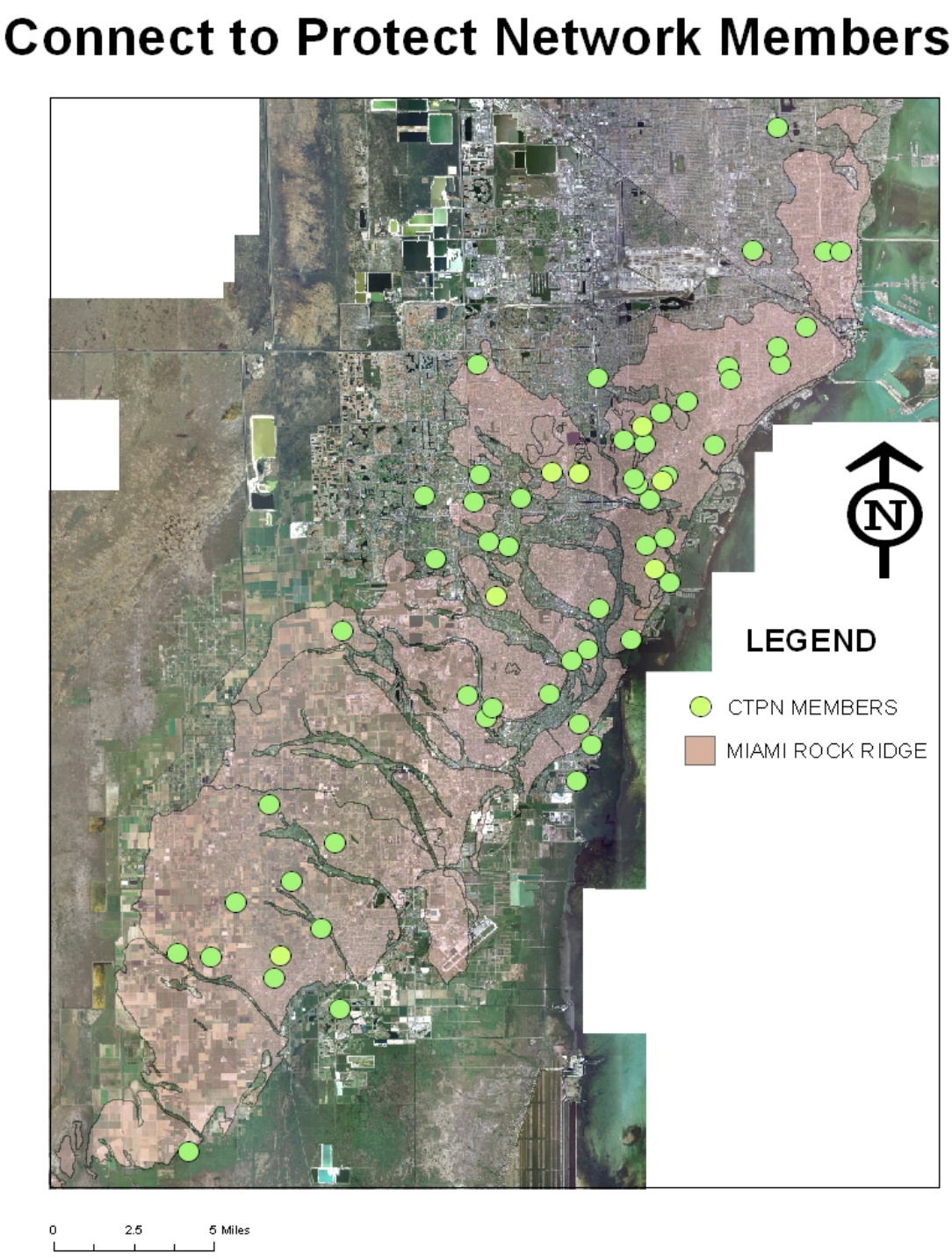

Figure 15-1. Map showing locations Connect to Protect Network Members

Connections

NEWSLETTER OF THE
CONNECT TO PROTECT NETWORK

November 2010 – Issue 3

CONNECTING MEMBERS

One of the main goals of the Connect to Protect Network is to develop an active network of members that assist each other with garden maintenance, plantings, and advice. We want to see the network flourish! To facilitate network exchange, we created *Connections*. We will regularly post useful information, including opportunities to assist with CTPN related activities throughout Miami.

Learn about upcoming events and recent developments through *Connections*. If you have information that you would like us to distribute through the newsletter, please email Joyce Maschinski (jmaschinski@fairchildgarden.org) or Devon Powell (dpowell@fairchildgarden.org).

GARDEN IN FOCUS

In our third issue of *Connections* we focus our attention on the pine rockland garden at the home of Patty Phares. Patty started gardening in the early 1980's, but it wasn't until after Hurricane Andrew, when she was forced to re-landscape, that she began gardening with natives.

When we asked Patty about her experience with gardening she said, "I have become more laissez faire as I realize that Mother Nature is in charge – not me. Thus I have a high tolerance for volunteers in the garden and imperfections in plants. Failures aren't disasters. I generally don't become too attached to particular plants". She says her garden has evolved and she has come to accept that "some things (plants) work out, and some don't".

We'd like to share some advice Patty gave us recently when asked about her experiences gardening with native plants:

1. **Choose your site carefully.** If you don't have a site as big as you want, it might be better to split it into small beds in different locations that have better conditions, rather than to try to fight with the inappropriate spot.

2. **Don't over mulch.** If you do, make it occasional and very light -- do it just before company comes so it will look pretty! Pinelands that are functioning naturally do not have a deep layer of pine needles. Too much mulch creates a moist environment for weeds to germinate, they don't necessarily keep down the weeds. As mulch decomposes, it creates nice, rich soil. That's not what you want for your pine rockland garden.

3. **Keep up with your weeding.** Weed every month in the summer, and less in the cooler, drier months, be lazy in the winter. Go out in the early morning or late evening for 15 minutes – it's worthwhile. The more you stay on top of your weeding the less work you will need to devote to weeding over time. Learn which "weeds" are aggressive and consider accepting some that are native. Native weeds, like Spanish-needles (*Bidens alba*), are attractive and beneficial to wildlife. Many species of native butterflies will nectar from *Bidens*.

Finally, Patty says "don't strive for too much order".

PLANTS TO SHARE

•Fairchild would like to share some of the extra plants in our collection: *Acacia pinetorum, Guettarda scabra, Sabal palmetto,* and several species of grasses. Please email Devon Powell if interested. dpowell@fairchildgarden.org

Figure 15-2. November 2010 Connections Newsletter of the Connect to Protect Network.

HAVE YOU SEEN THIS PLANT?

Amorpha herbacea var. *crenulata*
Crenulate leadplant

Private landowners play an important role in the conservation of rare plants. To determine how important a role they play, we would like to find out how many endangered Crenulate leadplants (*Amorpha herbacea* var. *crenulata*) may be growing on private land. If you have this plant growing in your yard and would be willing to participate in our study, please send your name, address, and the number of plants you have growing to Joyce Maschinski jmaschinski@fairchildgarden.org.

With this information we will create a map that shows the number and areas of Crenulate leadplants. It is possible that the plants growing on private land significantly increase the total living plants and help connect the wild populations currently growing in public parks. Thank you for your participation!

UPCOMING EVENTS

***Habitat Restoration Workday**
North Shore Open Space Park
(87th St. on Miami Beach)
November 18th from 9:30-1:30
Contact Sam Wright for more info.
swright@fairchildgarden.org

***Fairchild's 70th Ramble**
November 12th-14th from 9:30-4:30
There will be several vendors selling native plants, including Fairchild.

NATIVE PLANT PROFILES

Spanish-needles
Bidens alba var. *radiata*

Spanish-needles are a common perennial herb found in North (excluding Canada) and Central America. *Bidens* is the larval host to dainty sulphur butterflies and a nectar source for at least 35 species of butterflies (regionalconservation.org)

Quailberry
Crossopetalum ilicifolium

Crossopetalum ilicifolium is listed as state threatened and is found in south Florida and the Caribbean. Quailberry is a sprawling groundcover that is fairly drought tolerant and can be planted in full sun to partial shade. This plant provides a food source to wildlife.

Walter's groundcherry
Physalis walteri

Physalis walteri is a perennial herb that produces an edible fruit which looks much like a small tomatillo. Walter's groundcherry is drought tolerant and can be planted in full sun to partial shade. This species roots easily from cuttings.

CONNECT to PROTECT

Visit us at www.fairchildgarden.org/centerfortropicalplantconservation/connecttoprotect/

Figure 15-3. November 2010 Connections Newsletter of the Connect to Protect Network

Figure 15-4. Connect to Protect Network meeting agenda.

2011

Florida Rare Plant Task Force Meeting

"Preserving Rare Plant Diversity on Public Lands"

March 31 and April 1, 2011

Meeting Venue: Garden House, Fairchild Tropical Botanic Garden, Miami, Florida

Co-Hosted by Fairchild Tropical Botanic Garden and Bok Tower Gardens

Fairchild Tropical Botanic Garden and Bok Tower Gardens are pleased to announce the 2011 Florida Rare Plant Task Force sponsored by the Florida Department of Agriculture & Consumer Services Division of Plant Industry.

Each year, the Rare Plant Task Force of Florida serves as the place for Florida's professional plant conservation community to share ideas, discuss, prioritize, and coordinate ongoing plant conservation efforts around the state.

The theme of this year's meeting is preserving rare plant diversity on public lands. Thursday, March 31, 2011 will offer a full-day program featuring oral and poster presentations along with group discussion. On Friday, April 1, 2011, 8:30 a.m. to 2 p.m., there will be optional field trips led by the Fairchild South Florida Conservation Team to visit and participate in local rare plant projects. Specific details will follow.

Lunch and refreshments will be provided on March 31. Cocktails and dinner will follow the meeting on Thursday evening.

For more information please contact Joyce Maschinski jmaschinski@fairchildgarden.org.

Please forward this announcement to any interested parties.

Florida Rare Plant Task Force Meeting Day 1 Thursday, March 31, 2011

Special Thanks to Miami-Dade County Natural Areas Management for providing vans for field trips.

8:00- 8:30 registration
8:30- 8:45 Welcome – **Dr. Carl Lewis**, Director, Fairchild Tropical Botanic Garden
8:45- 9:00 Introduction to meeting – **Dr. Joyce Maschinski**, Conservation Ecologist, Fairchild Tropical Botanic Garden

SESSION I MANAGING RARE PLANT DIVERSITY ON PUBLIC LANDS (30 MINUTE PRESENTATIONS)

9:00- 9:30 **Anne Morkill,** Florida Keys National Wildlife Refuges Complex, "Managing a low island ecosystem in the face of climate change: The Florida Keys National Wildlife Refuges."

9:30- 10:00 **Chad Anderson,** National Key Deer Refuge, "Prescribed fire monitoring of rare plants in the National Key Deer Refuge, Big Pine Key, FL."

10:00- 10:15 break

10:15- 10:45 **Dr. Thomas Eason,** Florida Fish and Wildlife Conservation Commission, "Conserving Florida's Wildlife in the face of Climate Change."

10:45-11:15 **Liz Golden,** Bill Baggs Cape Florida State Park, "Cape Florida and Its Rare Plants"

11:15-11:45 **Smith, Stacy A., Eric S. Menges, and Carl W. Weekley,** Archbold Biological Station, "A landscape-level method for monitoring rare plant responses to management activities."

11:45 -12:15 Lunch – catered

12:30 – 1:25 Tour of Fairchild Tropical Botanic Garden. Please meet at Tram Circle.

SESSION II (30 minute presentations)

1:30-2:00 **Haller[1], Sarah J., Brian J. Poirier[1], Cheryl Peterson[2] and Eric S. Menges[1],** [1]Archbold Biological Station and [2]Bok Tower Gardens, "Back to the gap: experimental augmentation of a rare mint at the Lake Wales Ridge National Wildlife Refuge."

2:00- 2:30 **Cindy Campbell[1] and William VanGelder[2],** [1]Bok Tower Gardens and [2] SWFWMD, "An experimental introduction of *Chrysopsis floridana* on SWFWMD property."

2:30-3:00 break

3:00-3:30 **Drs. Jennifer L. Trusty and Herbert C. Kesler,** Gulf Coast Community College, “Discovering new populations of rare plant species in the panhandle of Florida: how GIS data can inform field surveys.”

3:30 – 4:00 **Elizabeth Gandy,** Florida Park Service, District 4, “Managing Imperiled Plants in Florida’s State Parks: Southwest Peninsula-Challenges and Successes.”

4:00 - 4:30 **Group Discussion: Potential solutions to climate change challenges to Florida rare plant populations**

4:30 – 5:30 Social and poster session Refreshments will be served.

5:30 → Dinner at local venues

RPTF Meeting Day 2 Working field trips Friday, April 1

Please note on the registration form whether you need transportation.

8:00– 12:00 In field (approx). We will stop for lunch at a local restaurant after the event to return to the garden by 2 p.m. Cost of field trip lunch is not included in registration fee.

Optional Field Trips Friday April 1, 2011

It is our recommendation that you wear a hat, sunscreen, long-sleeved shirts, long pants, and close-toed sturdy shoes for these field trips. Even seasoned field botanists can get stung, poked, and/or poisoned by the local flora and fauna. Good clothes can help make the experience more enjoyable.

Optional Field Trip 1 South Florida's Rare Ferns – Join Jennifer Possley for a trip to Hattie Bauer Hammock (formerly Orchid Jungle) to visit an ongoing restoration area that is home to some of Florida's rarest ferns. With over 120 native fern species, Florida has the highest fern diversity of any state in the continental U.S. The reason for such diversity is largely due to the unique limestone formations of the Miami rock ridge, where sinkholes, solution holes and cliffs provide substrate for these fragile, lacey plants. Miami-Dade County Natural Areas Management has recently removed many invasive exotic vines from this park. With Jennifer, trip attendees will remove the invasive "incised halberd fern" (*Tectaria incisa)* a large, sometimes trunked fern from Mexico and Central and South America that is used in landscaping in South Florida. Jennifer will provide tips on identifying local ferns and, time-permitting, will engage the group in an outplanting of FL-threatened "broad halberd fern" (*Tectaria heracleifolia).* This trip is limited to 20 people.

Optional Field Trip 2 – Visit Wild Population of *Amorpha herbacea* var. *crenulata,* Crenulate leadplant, (Pea Family*)* **and Help Restore its Habitat** - CANCELLED

Optional Field Trip 3 - Visit North Shore Open Space Park (NSOSP) with Sam Wright to see **introductions of *Jacquemontia reclinata*, beach jacquemontia** (Morning Glory family), in coastal strand and the great impact of restoration on the dune biodiversity. Federally endangered beach jacquemontia is a coastal perennial vine endemic to the southeastern coast of Florida, U.S.A. Although the eastern Florida coast once had contiguous coastal strand habitat, now intensive development has left only nine small populations of beach jacquemontia on public lands. Since 2001 Fairchild has been systematically increasing the total number of wild populations through reintroductions. This extensive effort has more than doubled the populations and numbers of individuals in the wild. The introduction at NSOSP benefited from the efforts of numerous volunteers who helped remove exotic *Scaevola taccada* prior to introducing beach jacquemontia plants propagated from seeds at FTBG. On this field trip, attendees will see dunes in various stages of succession and will participate in removing more *Scaevola taccada.* This trip is limited to 15 people.

Optional Field Trip 4 – Visit Connect to Protect parcels with Joyce Maschinski. Globally endangered pine rocklands occur only in South Florida, the Bahamas, and Cuba. Known for their South Florida slash pines (*Pinus elliotii* var. *densa*) and saw palmettos (*Serenoa repens*), they support over 400 native plant species, of which 31 are endemic, five are listed as federally endangered, and five are candidates for listing. Rapid development in South Florida has endangered pine rocklands and their rare species. To help preserve and connect our remaining pine rocklands and to increase the numbers of pine rockland plants growing in Miami-Dade County, Fairchild recently launched the Connect to Protect Network with funding from the U.S. Fish and Wildlife Service and Florida Department of Agriculture and Consumer Services. Our objective is to create corridors and "stepping stones" to connect isolated pine rockland remnants. These corridors will include any suitable parcels that can serve to increase the probability for seed and pollen transport across fragments. Attendees of this field trip will visit four of the pine rockland parcels that are part of the Connect to Protect Network.

Rare Plant Task Force 2011

Abstracts (Alphabetical by presenter):

Anderson, Chad. "Prescribed fire monitoring of rare plants in the National Key Deer Refuge, Big Pine Key, FL." Contact info: Chad Anderson, Biologist, National Key Deer Refuge, 28950 Watson Blvd., Big Pine Key, FL 33043; Chad_Anderson@fws.gov

The U.S. Fish and Wildlife Service is the managing agency for several rare and endemic plant species in the Florida Keys. In the 2009 prescribed fire season the National Key Deer Refuge established permanent monitoring plots in areas to be burned and adjacent unburned areas to determine the affects of controlled burns on plant diversity and cover. In addition to monitoring plots, rare plant mapping was conducted to assess any spatial changes in rare plant distribution pre and post prescribed fire. Findings of the mapping project offer similar results to the plots in terms of population response, but show that in some cases germination in new areas occurred.

Eason, Thomas H. "Conserving Florida's Wildlife in the face of Climate Change." Contact info: Thomas H. Eason, Ph.D., Deputy Director, Planning and Policy Development, Division of Habitat and Species Conservation, Florida Fish and Wildlife Conservation Commission, Bryant Building, 620 S. Meridian Street, Tallahassee, FL 32399-1600, email: thomas.eason@MyFWC.com

Florida's forests, rivers and creeks, and coastal waters are vital to fish and wildlife and to our own quality of life. With predictions that Florida's population may double to 36 million in the next 50 years and further indication that the changing climate will put additional stresses on habitat and wildlife, the Florida Fish and Wildlife Conservation Commission (FWC) actively is exploring how best to fulfill its mission in this changing environment. The FWC's climate change initiative began in 2007 when the Commission adopted a resolution committing the agency to conserving Florida's fish and wildlife in the face of climate change. Since then, FWC has hosted a climate change summit, created a network of internal climate change work groups, collaborated on regional and national climate change efforts, and made plans to incorporate climate change into Florida's Wildlife Action Plan. Results to date include publication of FWC's climate change summit proceedings and co-authorship of the Association of Fish and Wildlife Agencies' guidance for states to incorporate climate change into State Wildlife Action Plans. Initial focus has been on sea-level rise because of the profound impacts it may have on our wildlife resources. Upcoming actions include initiating Florida's Wildlife Action Plan revision in January, undertaking vulnerability assessments of Florida's fish and wildlife to climate change, and integrating existing conservation tools such as the Critical Lands and Waters Identification Project (CLIP) into climate change efforts. The FWC seeks to play an expanding role in ensuring that wildlife adaption strategies are firmly embedded in Florida's response to climate change over the coming decades. The FWC believes that partners and stakeholders will be integral to this effort and is working to ensure that they are engaged from the outset.

Gandy, Elizabeth. "Managing Imperiled Plants in Florida's State Parks: Southwest Peninsula-Challenges and Successes"
Contact Info: Environmental Specialist II, Florida Park Service-District 4

The southwest district of the Florida Park Service manages 33 parks comprising over 240,000 acres of conservation lands. These parks have a range of plant species considered to be imperiled by state and federal authorities. The challenge of managing these imperiled plants is multifaceted, comprising: 1) predictive surveying using natural community type and site condition indices, 2) monitoring at both the individual and natural community level, 3) evaluating and implementing proper resource management actions, 4) communications between biological and park staff, and 5) database development and dissemination. Examples of successful models for imperiled species management in Florida's State Parks include *Campanula robinsiae, Bonamia grandiflora,* scrub communities and shell mounds. Two previously described 'geographically novel species,' *Campanula robinsiae* and *Bonamia grandiflora* have required species specific surveying and monitoring on an annual basis to adequately track status and condition. Two natural community types, scrub at Highlands Hammock State Park and shell mound at Charlotte Harbor Preserve State Park, have required predictive surveying followed by natural community level monitoring due to the number of imperiled plants present in these communities. Continued implementation of these successful models will be needed for long-term management of imperiled plants at other state parks in the southwest district.

Golden, Elizabeth. "Cape Florida and Its Rare Plants." Contact info: Elizabeth Golden, Park Biologist, Bill Baggs Cape Florida State Park, 1200 South Crandon Boulevard. Key Biscayne, FL 33149 Elizabeth.Golden@dep.state.fl.us

Bill Baggs Cape Florida State Park, on the island of Key Biscayne, has been subject to some tremendous disturbances in the last 65 years, including the burial of much of its site under fill, invasion by Australian-pine, and the winds and storm surge of Hurricane Andrew. Nevertheless, over eight rare plant species, such as Beach Clustervine (*Jacquemontia reclinata*) and White Spikerush (*Eleocharis albida*), occur in this park. Due to the protection and management of the park's natural areas, most of these species are thriving. However, Florida Flatsedge (*Cyperus floridanus*) appears to be benefiting from the altered conditions. Even if a site is no longer pristine, it can still provide refuge for rare plant species.

Haller[1], Sarah J., Brian J. Poirier[1], Cheryl Peterson[2] And Eric S. Menges[1]. [1] "Back to the gap: experimental augmentation of a rare mint at the Lake Wales Ridge National Wildlife Refuge."
Contact info: [1]Archbold Biological Station, PO Box 2057, Lake Placid, FL 33862, [2] Bok Tower Gardens 1151 Tower Blvd. Lake Wales, FL 33853. shaller@archbold-station.org

Dicerandra christmanii is one of the most critically endangered plant species on the Lake Wales Ridge; of the five known *D. christmanii* populations, only one occurs on protected land, located at the Lake Wales Ridge National Wildlife Refuge (LWRNWR) Flamingo Villas Tract. Demographic data from this population suggests a steady population decline, most likely related to vegetation encroachment as a result of fire suppression. Typically found in gaps within shrub matrices in xeric oak-hickory scrub, *D. christmanii* prefers open microhabitats with reduced canopy and litter cover, conditions historically maintained by fire. Most plants at the LWRNWR are now restricted to the edges of firelanes and sand roads. To reverse these trends, we initiated an experimental augmentation, adding *D. christmanii* to a burn unit with very few plants. The augmentation is designed to evaluate the efficacy of three types of plant material (seeds, greenhouse-grown

seedlings, greenhouse-grown stem cuttings) and identify favorable microsite conditions for *D. christmanii*. Seeds and transplants were placed into recently burned or unburned gaps in three different microsites within each gap (north edge, south edge, or gap center). In August 2010, we transplanted 40 stem cuttings and 160 seedling transplants, and sowed 4,000 seeds into 40 gaps. Transplants and seed arrays were caged (to prevent herbivory) and irrigated. To date, there are 75 germinants from introduced seeds (approximately 2% germination), and transplants have high six-month survival (89% for seedling transplants and 95% for stem cuttings). We will continue to monitor this experiment and compare vital rates between the introduced population and adjacent wild populations. Results from this experimental augmentation have the potential to provide science-based land management guidelines to strengthen and conserve natural *D. christmanii* populations.

Morkill, Anne. "Managing a low island ecosystem in the face of climate change: The Florida Keys National Wildlife Refuges." Contact info: Anne Morkill, Wildlife Refuge Manager, Florida Keys National Wildlife Refuges Complex, U.S. Fish and Wildlife Service, 28950 Watson Blvd., Big Pine Key, FL 33043

Ecologically, the Florida Keys represent a truly unique vestige of the natural heritage of the United States. The Florida Keys National Wildlife Refuge Complex is comprised of National Key Deer Refuge, Key West National Wildlife Refuge (NWR), Great White Heron NWR and Crocodile Lake NWR, covering nearly 24,000 acres of uplands and 395,000 acres of nearshore marine waters from the Marquesas Keys to Key Largo. The Refuge Complex contains portions of all habitat types found in the Florida Keys ecosystem, including three globally imperiled habitats: pine rockland, tropical hardwood hammock, and mangrove forests. These habitats support more than 30 federally threatened and endangered species and other rare endemics, including the Key deer, Key Largo woodrat, Key Largo cotton mouse, Lower Keys marsh rabbit, Key tree cactus, and Big Pine partridge pea, which are found nowhere else in the world.

Low-island ecosystems such as the Florida Keys will face substantial impacts from climate change, particularly from sea level rise and coastal storms. Elevations of protected natural areas range from sea level on inundated mangrove islands to 9 feet above sea level in pine rocklands on Big Pine Key. Storm effects have already caused substantial changes in plant communities, such as the loss of pine trees from the 2005 Hurricane Wilma storm surge due to saltwater inundation. A nine inch rise in sea level recorded over the past 100 years in Key West has already reduced the size of pine forest on Sugarloaf Key by two-thrids due to saline intrusion into the freshwater lens. Isolated salt ponds become breached and transition into tidal lagoons, altering the diversity of invertebrates and fish assemblages. Storm events cause considerable physical damage to sandy beaches and native dune vegetation along vulnerable shorelines, reducing optimal nesting habitats for sea turtles and shorebirds.

The threat of climate change exacerbates the current challenges of managing small fragmented habitats in a low-island ecosystem. Many species are already living at their limit of sustainability due to habitat loss, fire suppression, and competition with invasive exotic species. The Refuge Complex is currently working with various partners to develop sea level rise and storm surge models to assess the vulnerabilities of different habitats and associated flora and fauna. These efforts will inform our management decisions and set priorities for implementing conservation strategies, with a primary focus on restoring and enhancing natural ecosystems to ensure their resiliency and adaptability to climate change in the future.

Smith, Stacy A., Eric S. Menges, and Carl W. Weekley. "A landscape-level method for monitoring rare plant responses to management activities." Archbold Biological Station, P.O. Box 2057, Lake Placid, FL 33862. ssmith@archbold-station.org

Although fire is a major historical disturbance regime worldwide, managing fire in natural areas is challenging due to smoke and escape concerns. As a result, some land managers have turned to mechanical pre-treatments or surrogates for fire to restore or maintain these fire-adapted ecosystems. In many cases, these treatments are conducted to restore vegetation structure and their effects on rare plants remains unmeasured. To monitor the impact of management activities on listed species, we designed a landscape-level method for tracking population dynamics. Since 2007, we have established 483 baseline monitoring plots at seven protected sites on the Lake Wales Ridge, targeting 24 listed plant species. Selected sites include treatments that range from prescribed fire to gyrotrack-chopping to sawing and herbicide or a combination of these treatments and fire. Our sampling methods utilize a combination of random and subjectively located 5-m radius plots. Random plot locations are generated in ArcGIS prior to entering the field, whereas subjective plot locations are established in the field using designated criteria. Within each plot, we count all individuals of our target species. Plots are resurveyed at regular intervals after management treatments. Preliminary post-treatment data has shown that responses to management treatments may vary among species. Ultimately, monitoring plots pre- and post-treatment will document the effect management activities have on the persistence of rare plant populations and will alert managers to the costs and benefits of mechanical and/or prescribed fire practices.

Trusty, Jennifer L. and Herbert C. Kesler, "Discovering new populations of rare plant species in the panhandle of Florida: how GIS data can inform field surveys." Contact info: Jennifer L. Trusty, Natural Sciences Division, Gulf Coast Community College, 5230 W. Highway 98, Panama City, FL 32401 jtrusty@gulfcoast.edu and Folius Consulting, 467 S. Main St., Camp Hill, AL 36850 (www.foliusconsulting.com)

GIS mapping and analysis has been instrumental in locating rare plant species populations and helping to identify potential rare species habitat in the Apalachicola region of the panhandle of Florida. The federally threatened carnivorous plant, *Pinguicula ionantha* is endemic to a 25-mile radius in the panhandle of Florida. Over 90% of the known *P. ionantha* populations are located within 100m of a well-maintained road despite the presence of a much larger potential habitat. Presence data of known populations within the Apalachicola National Forest (ANF) was combined with randomly generated pseudo-absences and were overlaid onto two Landsat TM5 scenes and digital elevation model (DEM) data. Generalized additive models (GAMs) were used to predict the probability of *P. ionantha* occurrence throughout the ANF. Ground surveys of twenty-one random points in areas predicted to have >90% probability of *P. ionantha* habitat were visited in the equivalent of 40 work hours. The GAM model was able to correctly discriminate herb-bog/savannah habitats in 81% of the field survey points visited. Nine points (43%) contained previously-undocumented *P. ionantha* populations, and eight points (38%) were in herb-bog/savanna habitat where no *P. ionantha* currently occur.

In contrast, when few or no rare plant locations are known in the study area, the integration of plot level species data collection with GIS remote sensing can be used to locate and delineate potential habitat for directed searches. Two hundred and eighty-nine plant species were identified during field survey of panhandle coastal habitats including fourteen Florida listed rare species. Hierarchical classification of plant species cover data yielded the identification of five upland habitats:

bayhead, flatwoods, sand pine scrub, sandhill, and scrubby flatwoods. Classification trees were used to classify Landsat Thematic Mapper images and identify and map pine dominated habitats in the study area. This GIS analysis is best used to identify habitat types and coverage rather than rare species occurrence. When a correlation between habitat type and rare plant occupation is high, the likelihood of locating undiscovered populations is increased.

Posters

Fernandez, Juan. G. Status of Rare Plants at City of Miami Parks. Contact info: Juan G. Fernandez, City of Miami, 55 S.W. 17th Rd. Miami, FL 33129; jgfernandez@CI.Miami.fl.us

Lewis, Scott and Cheryl Peterson. Using GIS to investigate factors contributing to the subsistence of an endangered plant-*Campanula robinsiae.* Contact info: Scott Lewis 930 SW 98th Terrace, Pembroke Pines, FL 33025; Scotlew@aol.com

Moore, J. A. and S.L. Richardson - Ecology of *Cladonia perforata* on the Atlantic Coastal Ridge. Contact info: Jon Moore, Wilkes Honors College, Florida Atlantic University, 5353 Parkside Dr. Jupiter, FL 33458; jmoore@fau.edu

Possley, Jennifer and Joyce Maschinski. A program to conserve Miami-Dade County's rare ferns. Contact info: Jennifer Possley, Fairchild Tropical Botanic Garden, Center for Tropical Plant Conservation, 11935 Old Cutler Rd., Miami FL 33156; jpossley@fairchildgarden.org.

Recent Publications and Presentations by FTBG Conservation staff

Peer Reviewed Publications

Fourqurean, J., T.J. Smith, J. Possley, T.M. Collins, D. Lee, and S. Namoff. 2010. Are mangroves in the tropical Atlantic ripe for invasion? Exotic mangrove trees in the forests of South Florida. Biological Invasions. Online First. DOI:10.1007/s10530-009-9660-8.

Maschinski, J. and K. E. Haskins (editors). *In press. Plant Reintroduction in a Changing Climate: Promises and Perils.* Island Press.

Maschinski, J., M. Ross, H. Liu, J. O'Brien, E. J. von Wettberg, and K. E. Haskins. 2011. Sinking Ships: Conservation Alternatives for Endemic Taxa Threatened by Sea Level Rise. *Climatic Change* 107:147–167

Maschinski, J., E. Sirkin and J.Fant. 2010. Using genetic and morphological analysis to distinguish endangered taxa from their hybrids with the cultivated exotic pest plant *Lantana camara. Conservation Genetics* DOI 10.1007/s10592-009-0035-6

Possley, J., J. Maschinski., C. Rodriguez and J. Dozier. 2009. Alternatives for reintroducing a rare ecotone species: mechanically thinned forest edge versus restored habitat remnant. Restoration Ecology 17(5):668-677.

Book Chapters

Albrecht, M.A. and J. Maschinski. *In press*. Influence of founder population size, propagule stages, and life history on the survival of reintroduced plant populations. *In* J. Maschinski and K. E. Haskins (editors). *Plant Reintroduction in a Changing Climate: Promises and Perils.* Island Press. *In press.*

Kennedy, K., M. A. Albrecht, E. O. Guerrant Jr., S. E. Dalrymple, J. Maschinski, and K. E. Haskins. *In press*. Synthesis and Future Directions. *In* J. Maschinski and K. E. Haskins (editors). *Plant Reintroduction in a Changing Climate: Promises and Perils.* Island Press. *In press.*

Maschinski, J., M. A. Albrecht, L. Monks, and K. E. Haskins *In press*. Center for Plant Conservation Best Reintroduction Practice Guidelines. *In* J. Maschinski and K. E. Haskins (editors). *Plant Reintroduction in a Changing Climate: Promises and Perils.* Island Press. *In press.*

Maschinski, J., D. A. Falk, S.J. Wright, J. Possley, J. Roncal, and K. S. Wendelberger. *In press*. Optimal Locations for Plant Reintroductions in a Changing World. *In* J. Maschinski and K. E. Haskins (editors). *Plant Reintroduction in a Changing Climate: Promises and Perils.* Island Press. *In press.*

Maschinski, J., S. J. Wright, C. Lewis. *In press*. The Critical Role of the Public: Plant Conservation through Volunteer and Community Outreach Projects. *In* J. Maschinski and K. E. Haskins (editors). *Plant Reintroduction in a Changing Climate: Promises and Perils.* Island Press. *In press.*

Manuscripts In Review

Roncal, J., J. Maschinski, B. Schaffer, S. M. Gutierrez, and D. Walters. *In review.* Testing Appropriate Habitat Outside of Historic Range: The Case of *Amorpha herbacea* var. *crenulata* (Fabaceae). *Journal for Nature Conservation*

Lay Publications

Lewis, S. and J. Maschinski. 2009. Connect to Protect: creating corridors to save South Florida's pine rockland plants. Palmetto 26:4-7.

Maschinski, J., Joie Goodman, Samuel J. Wright, Don Walters, Jennifer Possley, and Caroline Lewis. 2009. The Connect to Protect Network: Botanic gardens working to restore habitats and conserve rare species. BGJournal 6:6-9.

Technical Reports

Maschinski, J., Lewis, S., Powell, D., Walters, D., J. Possley, & K. Minkowski. 2009. Developing Corridors to Alleviate Problems of Urban Fragmentation on Rare Plant Populations in South Florida: July 2009. Report to U.S. Fish and Wildlife Service on Agreement No. 401816G137, South Florida Ecological Services Office, Vero Beach, FL.

Maschinski, J., J.L. Goodman, and D. Powell. 2009. Assessment of Population Status and Causes of Decline for *Pilosocereus robinii* (Lem.) Byles & G.D.Rowley in the Florida Keys. Final Report to U.S. Fish and Wildlife Service, South Florida Ecological Services Office, Vero Beach, FL.

Maschinski, J., S.J. Wright, J. Possley, D. Powell, V. Pence and J. Pascarella. 2009. Conservation of South Florida Endangered and Threatened Flora: 2008-2009 Program at Fairchild Tropical Garden. Interim Report Contract #013925. Florida Department of Agriculture and Consumer Services, Division of Plant Industry, Gainesville, FL. July 2009

Maschinski, J., S.J. Wright, J. Possley, D. Powell, L. Krueger, V. Pence and J. Pascarella. 2010. Conservation of South Florida Endangered and Threatened Flora: 2009-2010 Program at Fairchild Tropical Garden. Final Report Contract #014880. Florida Department of Agriculture and Consumer Services, Division of Plant Industry, Gainesville, FL.

Possley, J., J. Maschinski, and L. Krueger. 2010. Year 7 report: Biological monitoring for plant conservation in Miami-Dade County natural areas. Miami-Dade County Resolution #R-808-07.

Oral Presentations

Krueger L., J. Maschinski, S. Wright, J. Possley, K. Wendelberger and J. Roncal. 2010. "Experimental plant reintroductions inform planning for climate change" American Public Gardens Association Conference, Atlanta, Georgia, June 2, 2010.

Maschinski, J 2011. "Florida Upland Coastal Habitats and their rare plants," Fairchild Tropical Botanic Garden Volunteer Course, June 2011.

Maschinski, J. 2011. "Fairchild's South Florida Conservation Program and Case studies of easy to extremely difficult conservation problems," Fairchild Tropical Botanic Garden Workshop for Teachers, June 2011.

Maschinski, J. 2011. "Conservation Solutions: from relatively easy to extremely difficult," Dept of Biology, New Mexico State University, Las Cruces, NM. April, 2011.

Maschinski, J. 2011. "2010-2011 Happenings in the Fairchild Conservation Program." Center for Plant Conservation, National Center for Germplasm Resources Preservation Ft Collins, CO. April, 2011.

Maschinski, J. 2011. "Hybrids in Paradise: Lantana cultivars and rare *Lantana depressa* varieties." Miami-Dade Chapter Florida Native Plant Society, Pinecrest, FL. February, 2011.

Maschinski, J. 2011. “Conservation Measures for Special Rare Plants of the Florida Keys.” John Pennekamp Coral Reef State Park & Dagny Johnson Key Largo Hammock Botanical State Park, Key Largo, FL. January, 2011.

Maschinski, J. 2011. “Protecting paradise: the history and future of Fairchild Tropical Botanical Garden’s Conservation Activities,” Jupiter Island Garden Club, Hobe Sound, FL. January 2011.

Maschinski, J. 2011. “Protecting paradise: the history and future of Fairchild Tropical Botanical Garden’s Conservation Activities,” Grass River Garden Club, Boca Raton, FL. January, 2011.

Maschinski, J. 2010. “Evaluating two decades of rare plant reintroduction: implications for assisted migration.” Florida International University, Miami, FL. October, 2010.

Maschinski, J. 2010. “South Florida Rare plants and their habitats.” Fairchild Volunteer Class, Miami, FL.

Maschinski, J.2010. “South Florida Conservation Program” and “Engaging your students in conservation solutions.” Fairchild Botany Intensive, Miami, FL.

Maschinski, J. 2010. “Evaluating two decades of Fairchild Tropical Botanic Garden's Conservation Efforts in South Florida and Implications for Assisted Migration.” Florida Rare Plant Task Force, Lake Wales, FL.

Maschinski, J. 2010. “Evaluating two decades of Fairchild Tropical Botanic Garden's Conservation Efforts in South Florida: Implications for Assisted Migration,” FTBG Members Brunch, Miami, FL.

Maschinski, J. 2010. “Hybrids in Paradise: When Good Plants Go BAD,” Pine Rockland Working Group, Miami, FL.

Maschinski, J. 2010. “Evaluating two decades of rare plant reintroduction: implications for assisted migration.” Florida International University, Miami, FL.

Maschinski, J. 2010. “Conservation Solutions: from relatively easy to extremely difficult,” Conservation and Ethics Class, Memorial University, St Johns, Newfoundland .

Maschinski J. 2010. “The difficulty of finding smoking gun evidence: High salinity and other threats to the Endangered Key Tree Cactus (*Pilosocereus robinii)* in the Florida Keys,” Archbold Biological Station, FL.

Maschinski, J. 2010. “Fairchild’s South Florida Conservation Program,” Fairchild Volunteers, Miami, FL.

Maschinski, J., J. L. Goodman, P. Hughes, J. McAuliffe, K. Rice, J. Roncal. 2010. “Climate Change Threatens Endangered Key Tree Cactus (Pilosocereus robinii) in the Florida Keys USA,” Ecological Society of America, Albuquerque, NM .

Maschinski, J. Roncal, B. Schaffer and S. M. Gutierrez. 2010. “The feasibility of assisted migration for endangered crenulate leadplant outside its known historic range,” 10th International Congress of Ecology, Brisbane, Australia.

Maschinski, J., S. Wright, J. Possley, K. Wendelberger, and J. Roncal. 2010. “The feasibility of assisted migration: When will moving endangered plant species to novel sites work?” Society for Ecological Restoration, Perth, Australia.

Possley J. 2010. A Long-term vegetation monitoring plan for Miami-Dade County's pine rocklands. Pine Rockland Working Group. Miami, FL. February 11, 2010.

Possley J., L. Krueger, J. Maschinski, S. Wright. 2010. "Fairchild/Miami-Dade Biological Monitoring Program: Year 7-2009" Fairchild/Miami-Dade Biological Monitoring Program Annual Meeting, Fairchild Tropical Botanic Garden, Miami, Florida, January 28, 2010.

Possley, J. and M. Bodle. 2011. Identification workshop on upland invasive plants of Florida. 2011 Aquatic Weed Control Short Course. Coral Springs, FL. May 4 & 5, 2011.

Possley, J. "Miami's Native Ferns.". 2011. Dade Chapter of the Florida Native Plant Society's "Native Plant Day." Elane Gordon Enchanted Forest. March 12, 2011.

Possley, J. "Year 8 - FTBG/NAM Biological Monitoring Program. Fairchild Tropical Botanic Garden.". 2011. Presentation to Miami-Dade County Land Managers at Fairchild Tropical Botanic Garden. January 27, 2011.

Powell, D. 2010. "How schools can help conserve pine rocklands". Fairchild Tropical Botanic Garden, Coral Gables, FL. December 2010.

Powell, D. 2010. "How schools can help conserve pine rocklands". Fairchild Tropical Botanic Garden, Coral Gables, FL. October 2010.

Powell, D. 2010. "Preserving and Strengthening Our Remaining Pine Rocklands of South Florida" Native Plant Day at Bill Sadowski Park in Miami, Florida, March 2010.

Powell, D. 2010. "Preserving and Strengthening Our Remaining Pine Rocklands of South Florida" Home of Martha Knight for women's garden club tour, Miami, Florida, January 2010.

Wright, S.J. 2011. The Connect to Protect Network: linking up Miami-Dade's last remaining Pine Rocklands. Florida Native Plant Society Meeting-Magnolia Chapter, Tallahassee, Florida, February 3, 2011

Wright, S.J. 2010. Using volunteers and the native seedbank to restore coastal dune habitat. Surfrider Foundation Monthly Meeting-Miami Chapter, Miami Beach Botanical Garden, December 9, 2010.

Wright, S.J. 2010. Using volunteers and the native seedbank to restore coastal dune habitat. Florida Native Plant Society Monthly Meeting-Miami-Dade Chapter, Miami, Florida November 23, 2010.

Wright S. 2010. "Importance and Function of Dune Plants" Kids Ecology Corp, Dania Beach, Florida, May 15, 2010.

Wright S. 2010. "A Comeback Story of the Atala (*Eumaeus atala*) Butterfly" Imperiled Butterfly and Conservation Management Workshop, Fairchild Tropical Botanic Garden, Miami, Florida, March 21, 2010.

Wright S. 2010. "Site comparison of wild and outplanted populations of *Jacquemontia reclinata*" talk given to FIU Restoration Ecology class, Key Biscayne and Miami Beach, Florida, February 13, 2010.

Wright S. 2010. "Rare plant habitat management. Restoration through invasive removal and the "seedbank release" technique" Fairchild/Miami-Dade Biological Monitoring Program Annual Meeting, Fairchild Tropical Botanic Garden, Miami, Florida, January 28, 2010.

Poster Presentations

Krueger, L.M., J. P. Possley, J. Maschinski, and J. Maguire. "Evaluation of burning, scraping, and native seed sowing as a restoration tool in a disturbed pine rockland" for Pine Rockland Conference 2010: Consequences of Fragmentation, Fairchild Tropical Botanic Garden, Miami, Florida, February 10-13, 2010.

Krueger, L.M., J. P. Possley, J. Maschinski, and J. Maguire. "Evaluation of burning, scraping, and native seed sowing as a restoration tool in a disturbed pine rockland" for 2010 Rare Plant Task Force Meeting, Bok Tower Gardens, Lake Wales, Florida, May 29, 2010.

Possley, J. "A program to conserve Miami-Dade County's rare ferns." Florida Rare Plant Task Force, March 31, 2011.

Wright S. 2011. “Rare Plant Conservation Collaborations between City of Miami and Fairchild Tropical Botanic Garden” Poster presented at Brickell's Simpson Park Hammock Community Education Initiative, Simpson Park, Miami, Florida, May 17, 2011.