Volume 31: Number 2 > 2014

The Quarterly Journal of the Florida Native Plant Society

Palmetto

Fern Conservation in a Biodiversity Hotspot • Saving the Endangered Florida Key Tree Cactus

Fern Conservation in a Biodiversity Hotspot

Article by Jennifer Possley

Above: *Thelypteris sclerophylla* closeup of sporangia and stellate hairs. Photo: Hank Poor.

Figure 1: Miami's fern grottos are located only on the Miami Rock Ridge, a layer of oolitic limestone. Photo: J. Possley.

Who can blame Ponce de Leon for naming our state "Florida," with our splendid suite of flowering plants from both temperate and tropical climes. But peer between the branches of the trees and beyond the blooms of our flowers, and you may see that our state also boasts an amazing array of ferns. Florida has more native fern species (124) than any other state in the continental U.S., and more than one third of Florida's native fern species are found in Miami-Dade County (Nelson 2000, Wunderlin and Hansen 2008, Gann et al. 2014).

There are several ingredients that make Miami a fern diversity hotspot. If our warm, humid climate forms the base of the recipe, then our hydrology and geology are two of the most important added ingredients. Miami's fern grottos (Fig. 1) are located only on the Miami Rock Ridge, a layer of oolitic limestone that formed 130,000 years ago when higher seas began to recede to present-day levels. Over the ensuing centuries, fresh water from the Everglades percolated through the limestone, carving depressions and holes as it flowed. Areas that were closest to major water through-ways or "sloughs" carved the limestone more extensively, forming grottos.

Another crucial ingredient in the fern grotto recipe is the hardwood hammock plant community. This globally imperiled, closed-canopy, broad-leafed forest is found in Miami-Dade, Monroe and Collier Counties and derives much of its flora from similar forests of the Bahamas and the Greater Antilles (Snyder et al. 1990). Shade from the tropical hammock trees combines with the limestone substrate and fresh water from the Everglades to create the perfect levels of light and temperature, as well as constant high humidity, even through the dry season. In the forest understory, mosses and liverworts completely blanket the limestone with green (Fig. 2). These bryophytes in turn retain even more moisture, further ensuring year-round humidity and providing a perfect nursery where tiny young fern gametophytes (the sexual phase of a fern's life cycle) can live protected until conditions are right for fertilization to occur.

Unfortunately, like flowering plants, ferns are not immune to habitat loss, a phenomenon taken to the extreme in South Florida. In Miami-Dade County alone, habitat loss exceeds 98%. As a result, 14 of our native fern species are no longer found here and an additional 14 are critically imperiled (Gann et al. 2014). An analysis of our flora by The Institute for Regional Conservation found that South Florida's ferns and their allies are more likely than vascular plants to be extirpated or threatened (Gann et al. 2002). Further, they suggested that ferns suffer disproportionately from poaching and from lowering of the freshwater table because they require moisture to complete their life cycle. Thus, while Miami is blessed with high native fern diversity, we are also challenged with preserving a very high proportion of imperiled ferns.

Continued on page 6

Figure 2: In the hardwood hammock understory, oolitic limestone and a covering of mosses and liverworts form ideal fern habitat. Photo: J. Possley.

Fairchild Tropical Botanic Garden in Coral Gables is centrally located in Florida's subtropical biodiversity hotspot, and has a history of cooperating to conserve the region's fern diversity (Fig. 3). In 2002, Fairchild entered into what would be a long-term partnership with the County's Environmentally Endangered Lands Program and Natural Areas Management Division. Recognizing the importance of protecting the diversity in the County's network of small preserves, the directors of these programs sought out Fairchild biologists to map, monitor and conserve the dozens of rare plant species in their charge, many of which happened to be ferns. In the ensuing years, Fairchild's native fern conservation program has grown to encompass 18 species. The program has also taken shape into one with a specific goal and underlying objectives (Tables 1 and 2). Because many of our rare native ferns are slow-growing and/or difficult to propagate, this program could only have been possible with the luxury of time.

Twelve years after the inception of Fairchild's current fern program, we have conducted reintroductions or augmentations with some of our rare fern species. We are constrained by each species' unique biology, thus our first outplanting successes have been with species that are relatively easy to propagate and fast-growing once they reach the sporophyte stage. These characteristics are possessed by the creeping star-hair fern *Thelypteris reptans* and the broad halberd fern *Tectaria heracleifolia*, which were our first fledglings. Both species did well in cultivation from spores at Fairchild, and *T. reptans* has the added advantage that it is "radicant" (it can root from the stems), and can be vegetatively propagated. In 2011

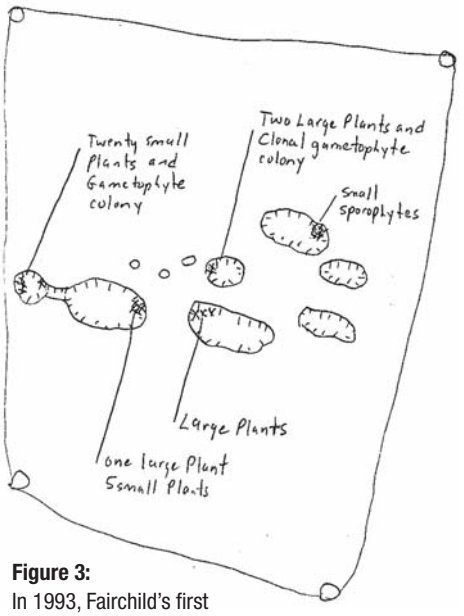

Figure 3: In 1993, Fairchild's first conservation ecologist, Carol Lippincott, joined forces with geologist Alan Cressler to conduct very thorough rare fern surveys in Miami's devastated hardwood hammocks after Hurricane Andrew. Their hand-drawn maps are still important references today.

Table 1: Fairchild's native fern conservation program

Overall Program Goal: To reduce the risk of extinction of South Florida's rare ferns.	
Objectives:	1. Collect wild propagules
	2. Develop propagation techniques
	3. Establish ex situ populations at Fairchild
	4. Deposit spores into long term storage
	5. Introduce populations to suitable habitat in Miami-Dade County preserves

Table 2: Focus species and objectives met

				Objectives Met (for Miami-Dade Preserves)					
	FL Rank	Global Rarity	Florida Counties	1a. GIS Maps	1b. Population Census	2. Propagation Techniques	3. Ex Situ Collection	4. Spores Stored	5. Reintro
Adiantum melanoleucum	E	Near Endemic	1	●	●	●	●	●	
Anemia wrightii	E	Near Endemic	1	●	❍				
Asplenium verecundum	E	Near Endemic	12	●	●	●	●	●	
Asplenium x biscaynianum	none	FL Endemic	1	●	●				
Ctenitis sloanei	E	Widespread	5	●	❍	●	●	●	
Ctenitis submarginalis	E	Widespread	6	●	●	●	●		
Lomariopsis kunzeana	E	Near Endemic	1	●	●	●	❍		
Microgramma heterophylla	E	Near Endemic	3	●	❍	●	●		
Odontosoria clavata	E	Widespread	2	●	❍				
Tectaria heracleifolia	T	Widespread	8	❍		●	●	●	●
Thelypteris patens	E	Widespread	1	●	●	●	●	●	●
Thelypteris reptans	E	Widespread	8	❍		●	●	●	●
Thelypteris reticulata	E	Widespread	5	●	●	●	●	●	
Thelypteris sancta	E	Widespread	1	●	●				
Thelypteris sclerophylla	E	Near Endemic	1	●	●	●	●	●	
Thelypteris serrata	E	Widespread	12	●	●				
Trichomanes krausii	E	Widespread	1	●	●				
Trichomanes punctatum subsp. *floridanum*	E	FL Endemic	2	●	●				

Objectives met fully (●) or partially (❍). "Near endemic" refers to species found only in Florida and one or more islands of the Greater Antilles.

and 2012, we installed 234 *Tectaria heracleifolia* and 20 *Thelypteris reptans* in a restoration area within Hattie Bauer Hammock – the former site of the old Florida attraction "Orchid Jungle." We consider this reintroduction, which has had nearly 80% survival, to be successfully established (Figs. 4A–D).

This year, we reintroduced *Thelypteris patens*, which was recently extirpated from one of its only two known locations in North America (both of which are in Miami). This species was grown from spores we collected by our cooperators at the Cincinnati Zoo and Botanic Garden's Lindner Center for Research on Endangered Wildlife (CREW), who noted that it was among the quickest of our rare native ferns to form sporophytes. With the help of dozens of staff and

Continued on page 8


4A


4B


4C


4D

Figures 4A–D: 4A. Miami-Dade County has a huge task in removing the non-native vegetation used to give Orchid Jungle the "jungly" feeling. Here, Natural Areas Management crews can be seen removing corn plant. 4B. Miami-Dade County biologists Dallas Hazelton and Jane Dozier prepare to plant Fairchild-grown rare ferns *Tectaria heracleifolia* and *Thelypteris reptans* in a restored portion of Hattie Bauer Hammock. 4C. One year after planting, Fairchild-grown rare fern *Thelypteris reptans* is well established in bryophyte-covered limestone in Hattie Bauer Hammock. 4D. Fairchild-grown *Tectaria heracleifolia* one year after planting in Hattie Bauer Hammock. Photos by J. Possley.

volunteers, we installed approximately 200 *Thelypteris patens* in the hammock preserve at The Deering Estate (Figs. 5A–D). These ferns were planted just after the finishing touches were made to a hydrology restoration project at The Deering Estate that is a component of The Central and Southern Florida Project Comprehensive Plan (Comprehensive Everglades Restoration Plan, or "CERP"). We expect that the reintroduced population of *T. patens* will thrive with the increased moisture this restoration is now delivering to the system.

In the next 2-3 years, we will be conducting plantings with other fern species. The climbing vine fern *Microgramma heterophylla* will likely be our next candidate, since it is extremely easy to propagate via cuttings and has done well in our nursery (Fig. 6). Before too long, we hope to reintroduce the fragrant maidenhair *Adiantum melanoleucum* (Figs. 7A–B) to appropriate protected habitat. CREW reports that this taxon is not the easiest to propagate from spores, but once CREW staffers have raised *A. melanoleucum* to the young sporophyte stage, they are hardy growers and can be propagated by rhizome divisions.

A few species are not on our agenda for reintroduction in the near future. These include *Trichomanes punctatum* ssp. *floridanum*, *Trichomanes krausii*, and *Lomariopsis kunzeana* (Figs. 8 and 9). The fact that these three of our rarest taxa are also exceedingly difficult to collect and cultivate is not a coincidence. Each of these ferns has several factors that contribute to natural rarity. First, all possess green spores. Most of the fern species we encounter contain spores that lack chlorophyll and can maintain viability for years. But the green spores of *Trichomanes* and *Lomariopsis* are very short-lived, so they must be sown soon after collection. *Lomariopsis kunzeana* will not sporulate until its fronds are several centimeters long, which may take years to achieve, and mature plants will only form sporangia in the month of June during years when the conditions are favorable (we suspect this is maximum shade and humidity). Our *Trichomanes* spp. sporulate throughout the year with a peak in the summer, but a tiny frond will only form a few sporangia, and these are hidden deeply inside a involucre (tube) on the leaf margin, making them difficult to access.

Despite the strides we have made, our fern conservation work is far from complete. Collection of spores for long-term storage is one of the more daunting tasks ahead of us, as we have only just begun to capture the genetic diversity within the wild populations of our 18 target species (not to mention, there are at least a dozen more species we would like to incorporate into the fold). With many of our rare fern populations being tiny, a random event such as trash dumping, a tree fall,

Figs 5A–D: Many steps are involved in a rare fern reintroduction, from collecting wild spores to propagating, to planting. 5A. A spore print from *Thelypteris patens* is a beautiful way to collect spores for propagation or storage. 5B. Young *Thelypteris patens* grown from spore by the Cincinnati Zoo and Botanic Garden's Lindner Center for Research on Endangered Wildlife. Plants are shipped to Fairchild, unwrapped, and cultured in our nursery. 5C. In Fairchild's nursery, dozens of *Thelypteris patens* await reintroduction day at The Deering Estate. 5D. Dr. Joyce Maschinski and Steve Forman reintroduce the extirpated fern *Thelypteris patens* to the hardwood hammock within The Deering Estate. Photos: J. Possley.


5B


5C


5A


5D

or a hurricane could easily wipe out an entire occurrence. The specter of global climate change suggests that some of Miami's nature preserves may be subject to salt water inundation in several decades. Clearly, the threats to Miami's fern biodiversity are many, and having "back-up" germplasm banked off-site is an important security measure (Fig. 10). Not all fern species possess spores capable of long-term storage (those with green spores do not). For those species especially, cultivating a healthy ex situ collection of live plants is crucial. We hope that this cooperative fern conservation program will be an ongoing, decades-long endeavor. Working in our favor are strong inter-agency partnerships, a long-term commitment, and the tenacious nature of our deceptively delicate-seeming fern flora.

Acknowledgements

This program is supported by Miami-Dade County's Department of Parks, Recreation and Open Spaces and Environmentally Endangered Lands Program, the Florida Department of Agriculture and Consumer Services, private donors, and Fairchild Tropical Botanic Garden.

References

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, Florida.

Gann, G. D., K. A. Bradley and S.W. Woodmansee. 2001-2014. The Floristic Inventory of South Florida Database Online. The Institute for Regional Conservation. Delray Beach, Florida.

Nelson, G. 2000. The ferns of Florida. Pineapple Press, Inc., Sarasota, Florida.

Snyder, J. R., A. Herndon and W.B. Robertson. 1990. South Florida Rockland. Pages 230-280 in: R. L. Myers and J. J. Ewel. Ecosystems of Florida. University of Central Florida Press, Orlando, Florida.

Wunderlin, R.P., and B. F. Hansen. 2008. Atlas of Florida Vascular Plants (http://www.plantatlas.usf.edu/). [S. M. Landry and K. N. Campbell (application development), Florida Center for Community Design and Research.] Institute for Systematic Botany, University of South Florida, Tampa.

About the Author

Jennifer Possley has been a field biologist at Fairchild since 2001. She maps and monitors the rare flora of Miami-Dade County and researches the effects of vegetation management. She has special interests in ferns and as well as non-native invasive plants. Prior to joining Fairchild's staff, she received a BA in biology from Kalamazoo College and a MS in agronomy from the University of Florida. She is originally from the village of Dexter, Michigan.

Figure 6: *Microgramma heterophylla.* Photo: J. Possley.

Figure 7B: Fragrant maiden hair *Adiantum melanoleucum* grows from a bed of liverworts in the side of a limestone solution hole. Photo: J. Possley.

Figure 9: *Trichomanes krausii* (top) and *T. punctatum* ssp. *floridanum* (bottom). The latter species is Florida's only endemic non-hybrid fern and will soon be added to the list of US Endangered Species. Photos: Molly Messer (top) and J. Possley (bottom).

Figure 7A: *Adiantum melanoleucum* arrives in Miami after being packaged and shipped from CREW in Cincinnati. Photo: J. Possley.

Figure 8: A portion of a fertile frond of the endangered holly-vine fern *Lomariopsis kunzeana*. The brown specks in the photos's center are sporangia, or spore cases. The yellow-green patch in the upper right are the chlorophyll-containing spores. Photo: Kristie Wendelberger.

Figure 10: A tiny tube containing thousands of spores of *Thelypteris patens* is ready to be shipped to the USDA's National Center for Genetic Resources Preservation in Ft. Collins, CO. Photo: J. Maschinski.