Restoring Globally Imperiled Pine Rocklands
To Protect We Must Restore

Florida International University
March 5, 2020

SER SOCIETY FOR ECOLOGICAL RESTORATION

George D. Gann
www.regionalconservation.org
www.ser.org

Institute for Regional Conservation

Acknowledgments

Concepts: Kevin Kalasz, Jennifer Possley, Janet Gil, Robin Gray-Urgelles, Dallas Hazelton, Tim Joyner, Joy Klein, Kirk Linaje, Jimmy Lange, Naqqi Manco, Michelle Smith, Cristina Stocking & Luis Moreno, Jonathan Taylor, Alicie Warren, Chris Bergh, Sarah Martin, Kathy Freeman, and many more

Images: Shirley Denton, Roger Hammer, James Johnson, Suzanne Koptur, Jimmy Lange, Natural Areas Management, Jennifer Possley, Frank Ridgley, Mark & Holly Salvato, Al Sunshine, Alicie Warren, Steve Woodmansee

Primary Funding: US Fish & Wildlife Service, US DOD, TNC

Global and Local Perspectives

SER SOCIETY FOR ECOLOGICAL RESTORATION

The Institute for Regional Conservation

World Conference on Ecological Restoration
Cape Town, South Africa 2019

Restoration site, No Name Key
National Key Deer Refuge, FL, USA

George Washington Turner

Thelma Turner

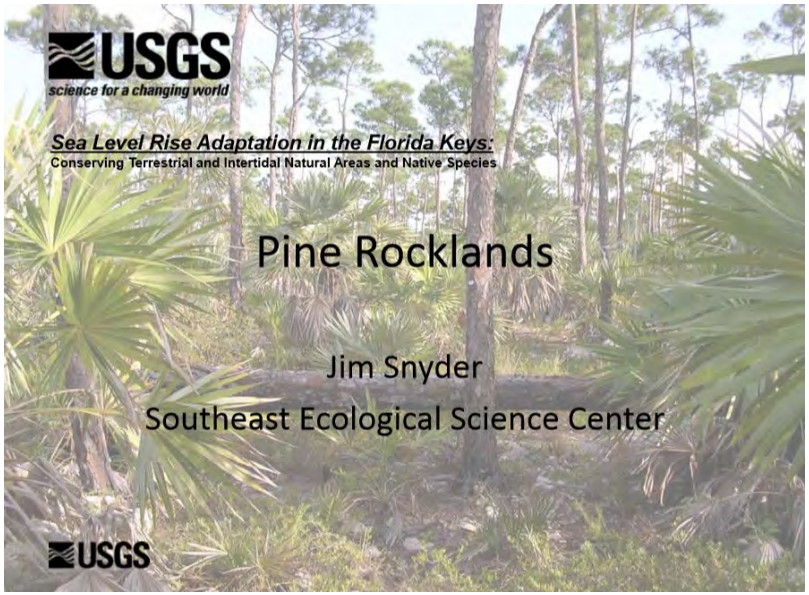
Hedwig Rutzke birthplace

My ancestors arrived in 1910 as agricultural pioneers. Miami-Dade County had just 11,933 residents.

My Aim is to

- Discuss the status of the pine rockland ecosystem in South Florida
- Introduce the **“**Expanding The Footprint” concept and the Pine Rockland Business Plan.
- Explain why we must aspire to more pine rocklands, not less, and why “Business as Usual” leads inevitably to loss.
- Discuss the PRBP in relation to the SER International Principles and Standards for the Practice of Ecological Restoration.

Pine Rockland Loss in South Florida

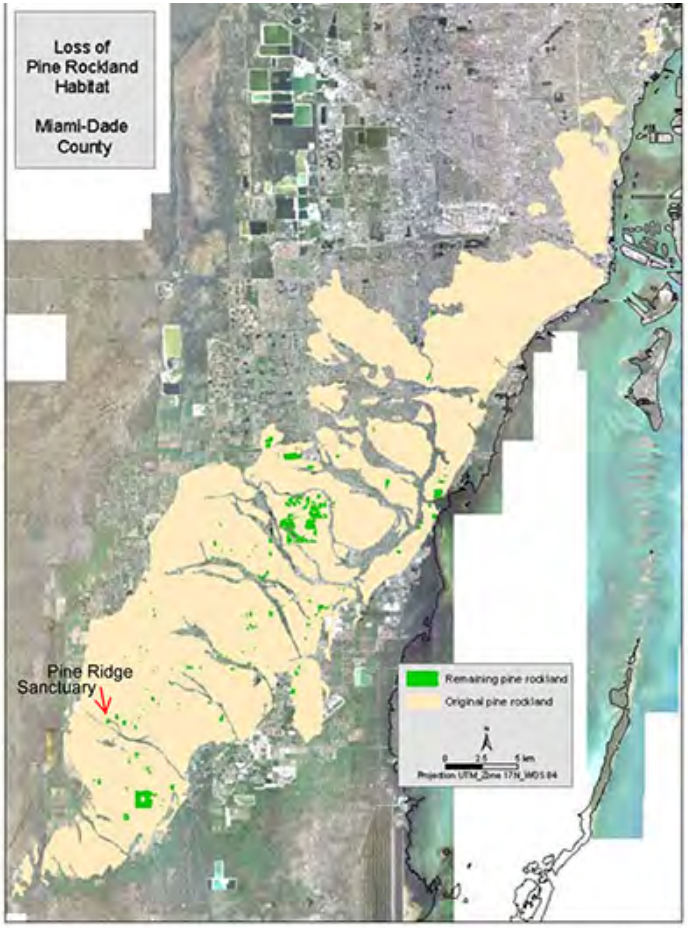


Where are pine rocklands?

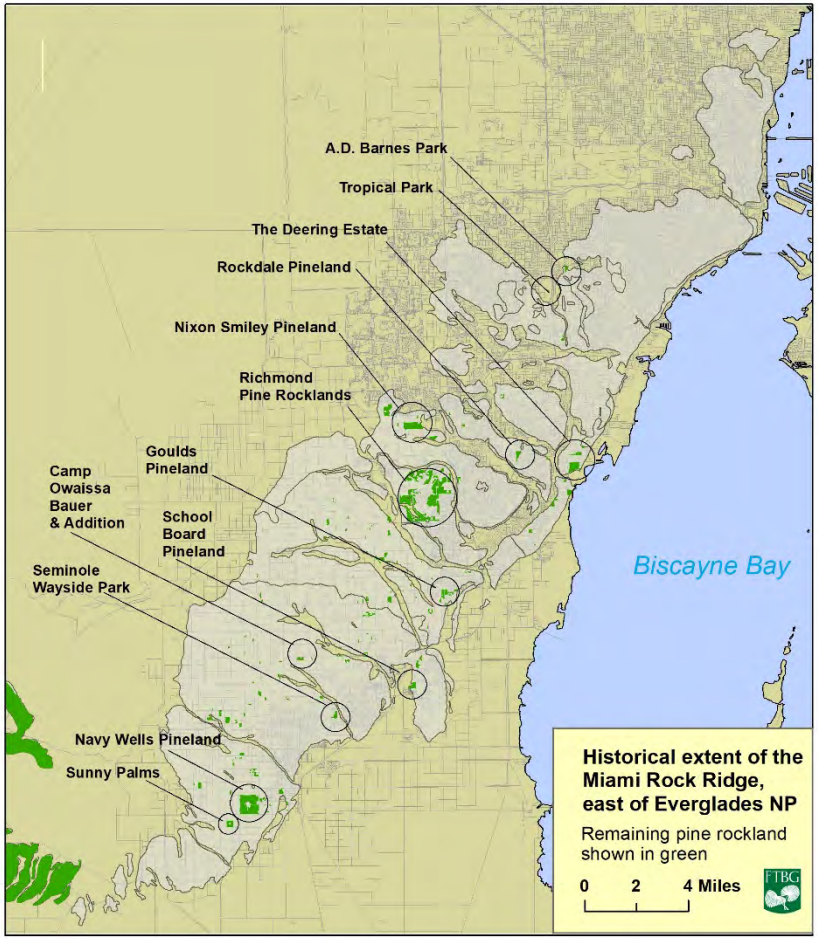
- Lower Florida Keys (<1000 ha total)
  - Big Pine
  - No Name
  - Cudjoe
  - Little Pine
  - Sugarloaf
- Miami Rock Ridge (<1000 ha outside ENP, 8000 ha in ENP)
- Grand total <10,000 ha

USGS

Also Big Cypress by some accounts



Courtesy of Barbara and Terry Glancy via the www

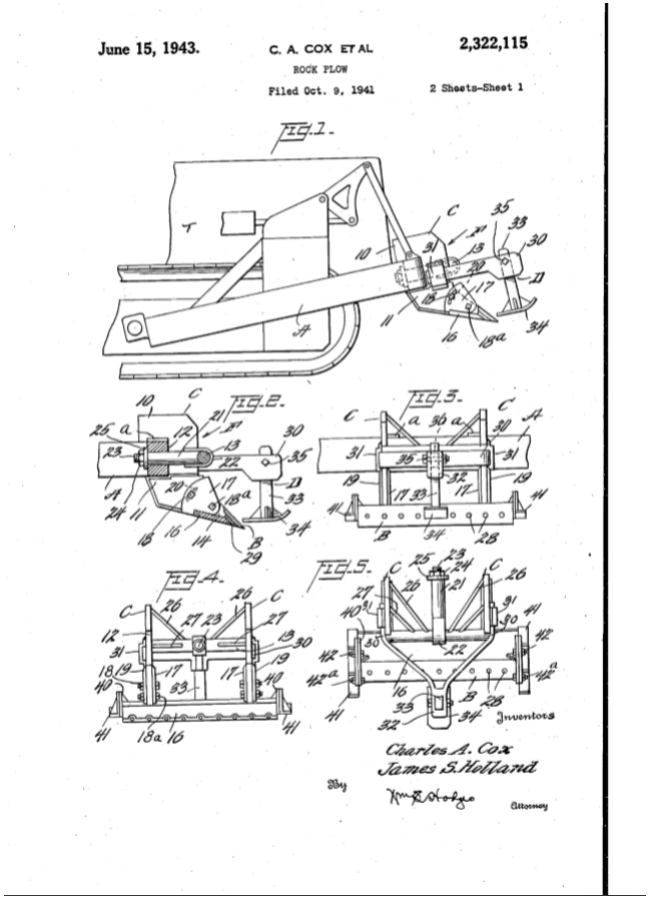


Courtesy of Jennifer Possley, FTBG

Miami-Dade County Maps

Large Scale Clearing

Coral Gables, 1922. https://www.floridamemory.com

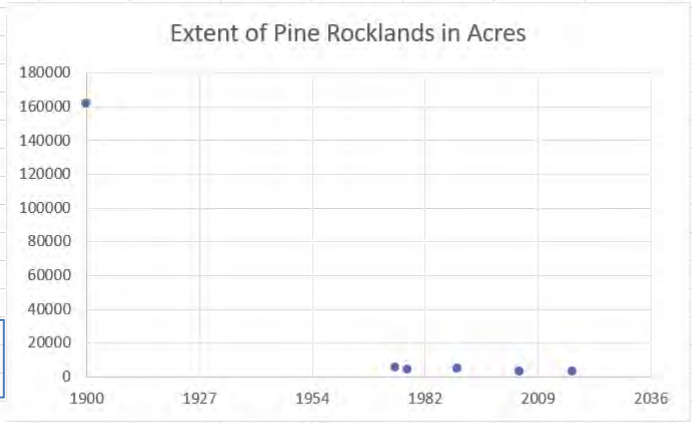


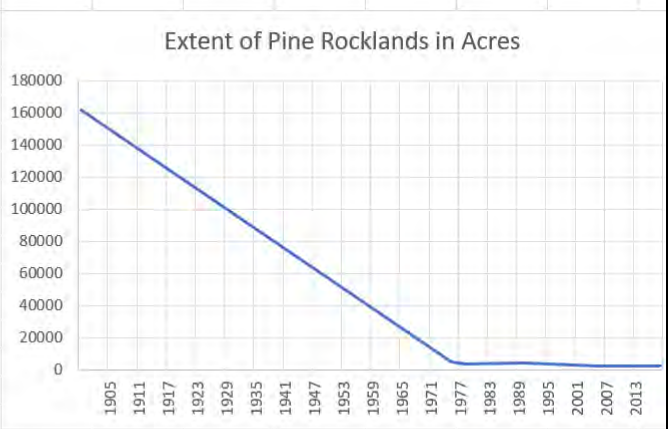
Extent of Pine Rocklands outside of Everglades National Park
From Loope et al. (1979) and subsequent

Raw data points

Date	Acres	
1900	161660	NPS
1975	5268	Shaw
1978	3977	Daugherty
1990	4400	DERM
2005	2950	IRC
2018	3017	DERM

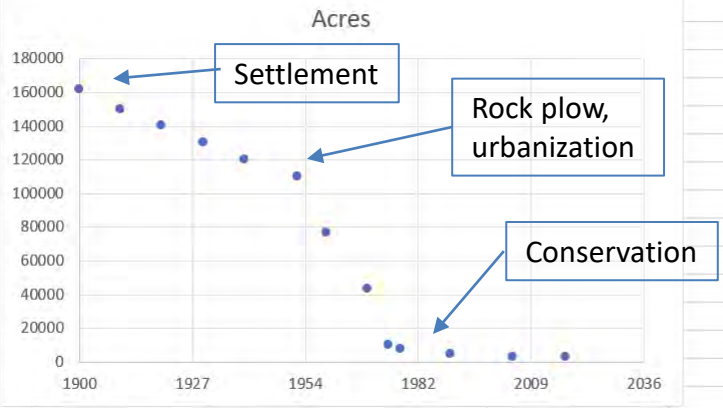
<2% remaining

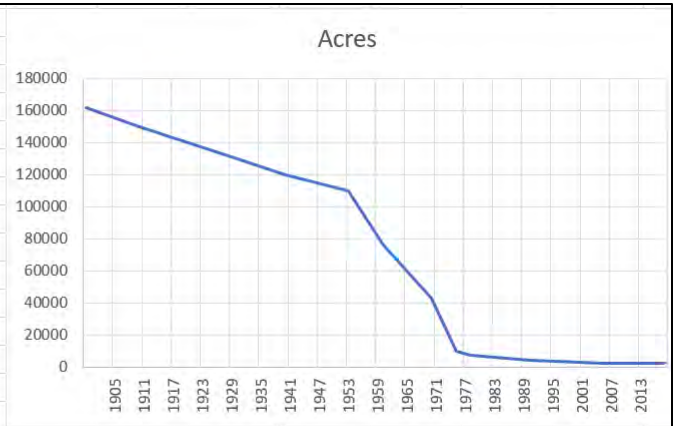




Fuzzy estimates of actual impact

Date	Acres
1900	161660
1910	150000
1920	140000
1930	130000
1940	120000
1953	110000
1960	76667
1970	43334
1975	10000
1978	7500
1990	4400
2005	2950
2018	3017





Miami-Dade County restored overgrown pine rockland at Larry and Penny Thompson Park. Patrick Farrell - Miami Herald Staff

OP-ED

Miami-Dade Commission should not betray our environmental legacy by destroying pine rocklands

BY JAESON CLAYBORN
jclay010@fiu.edu

Miami Pine Rockland Coalition founder Al Sunshine photographed a bulldozer on Friday, Dec. 8, 2017, clearing trees and brush on pine rockland targeted for a shopping mall and 900 apartments. Courtesy Al Sunshine

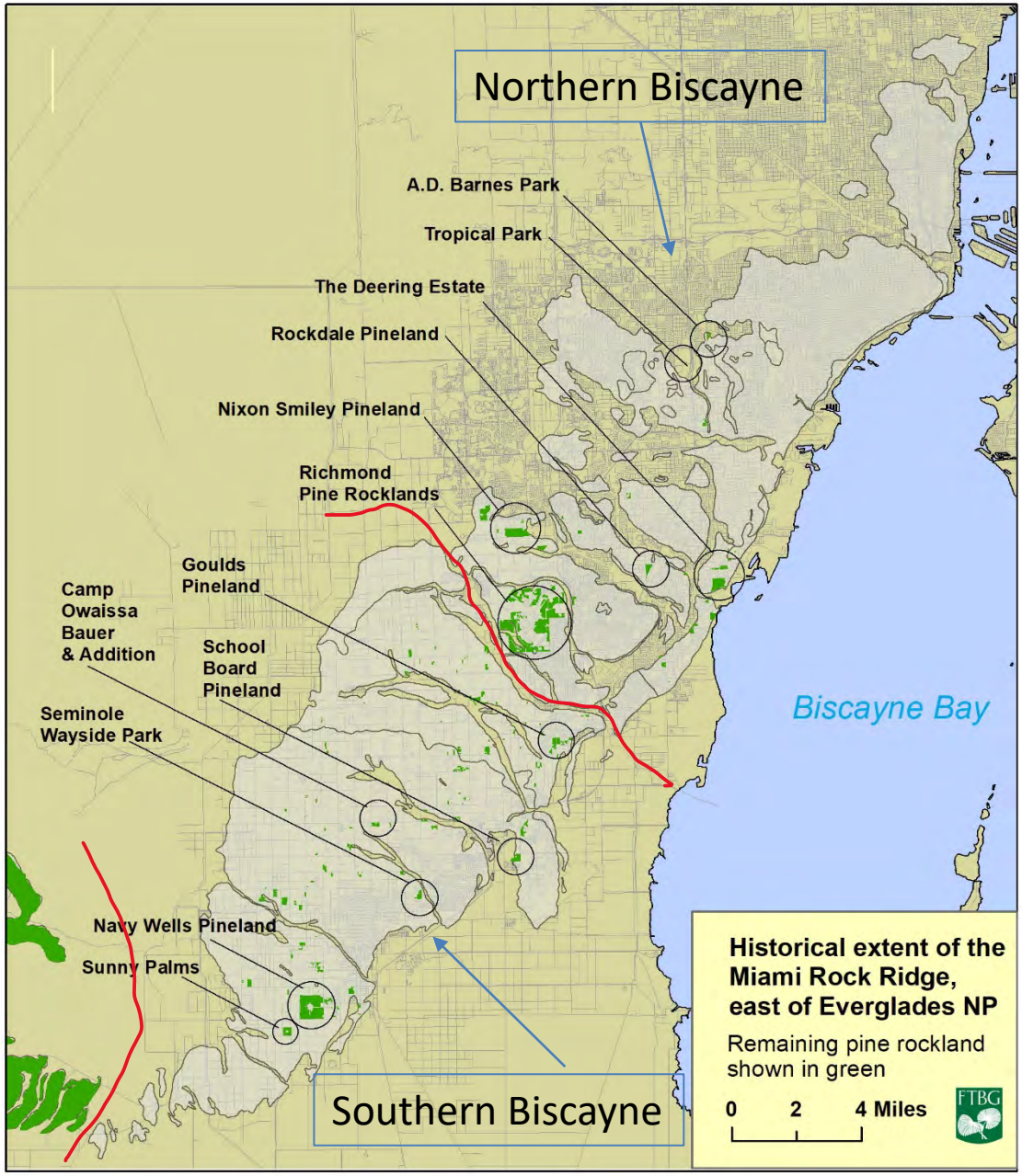
ENVIRONMENT

Judge orders emergency halt to clearing of rare Miami forest targeted for Walmart

BY JENNY STALETOVICH
istaletovich@miamiherald.com

Continuing Issues: Pine Rockland Loss and Community Response

Network of Public and Private Conservation Areas



Adapted from FTBG

Vascular Plant Taxa

(Gann 2018 unpublished)

MRR Pine Rocklands

Estimated native taxa – 420

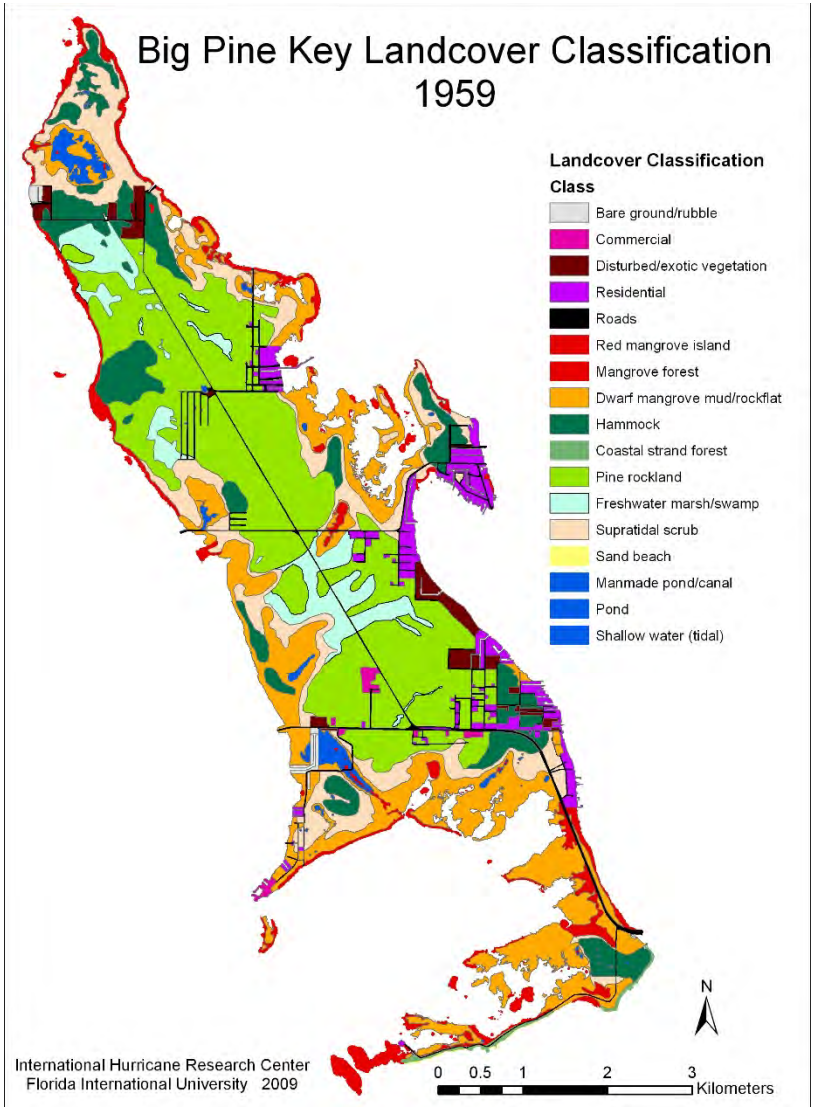
Unique Taxa

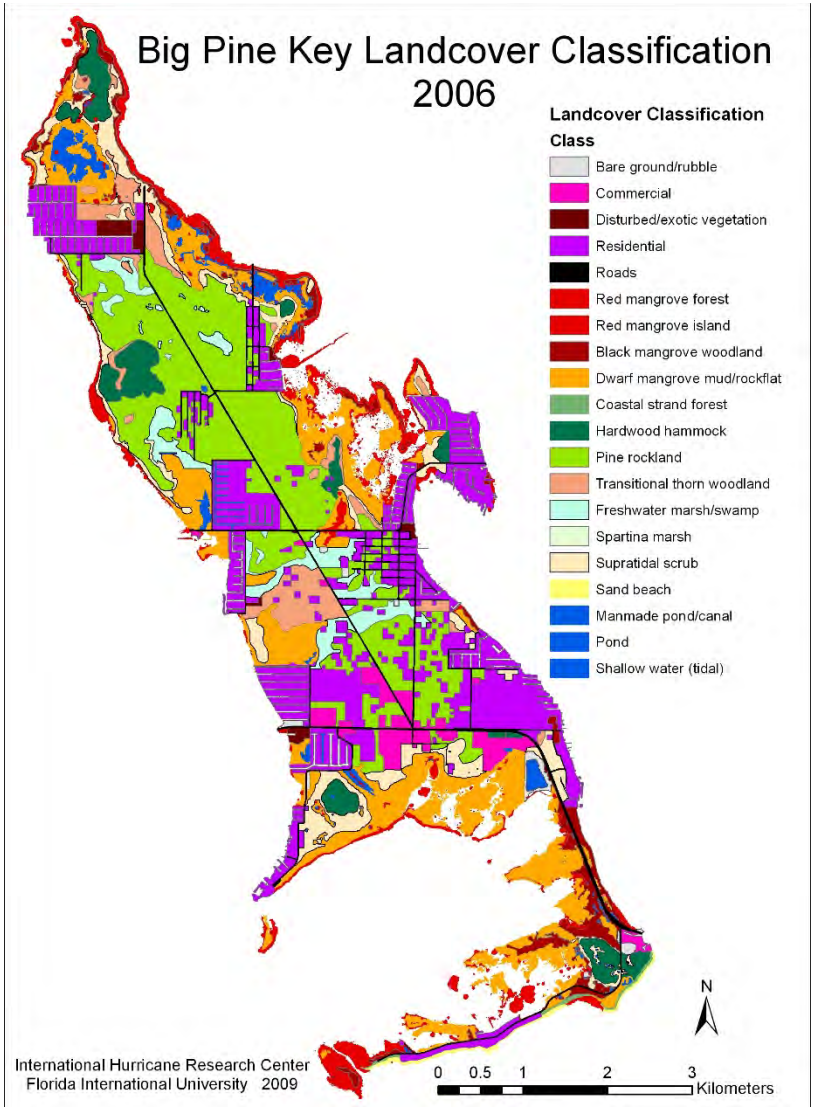
Long Pine Key – 4
Biscayne Pinelands - 119
Southern Biscayne – 5
Northern Biscayne – 52

S FL Endemics*

In Pine Rocklands – 28
On MRR only – 11
Outside LPK only - 7
Southern Biscayne only – 2
Northern Biscayne only – 2

Losses on Big Pine Key



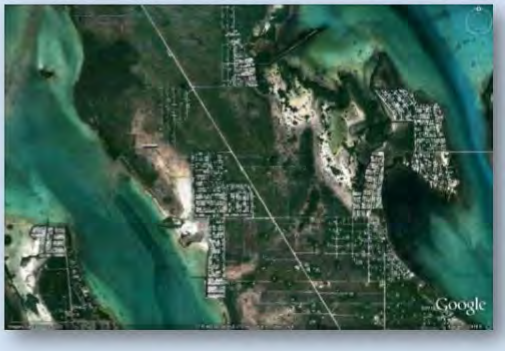


From Zhang K, Ross M, Ogurcak D, Houle P. 2010. Lower Florida Keys Digital Terrain Model and Vegetation Analysis for The National Key Deer Refuge. U.S. Fish and Wildlife Service National Key Deer Refuge, Big Pine Key, FL.

Pine Rocklands in the Florida Keys

Threats to pine rocklands

- Development
- Improper fire regime
- Exotic species
- Sea level rise



Jim Snyder

USGS

SLR impacts on pine rockland

- Taylor Alexander (1976)
  - Pine stumps in mangroves on Key Largo
- Ross, O'Brien, and Sternberg (1994)
  - Shrinking pineland on Sugarloaf Key
  - <15 cm SLR resulted in loss of 35% of pineland

46 ha in 1935

30 ha in 1991

Jim Snyder

USGS

Climatic Change
July 2011, 107:169 | Cite as

Hurricane effects on subtropical pine rocklands of the Florida Keys

Authors | Authors and affiliations

Sonali Saha, Keith Bradley, Michael S. Ross, Phillip Hughes, Thomas Wilmers, Pablo L. Ruiz, Chris Bergh

Article
First Online: 10 May 2011

Abstract

We investigate the effects of Hurricane Wilma's storm surge (23–24 October 2005) on the dominant tree *Pinus elliottii* var *densa* (South Florida slash pine) and rare plant species in

Management and Restoration

Prescribed Fire

There are never enough resources or support
so we are continuously losing ground

Native Hardwoods and Palms

Slash Pine Density and Cover

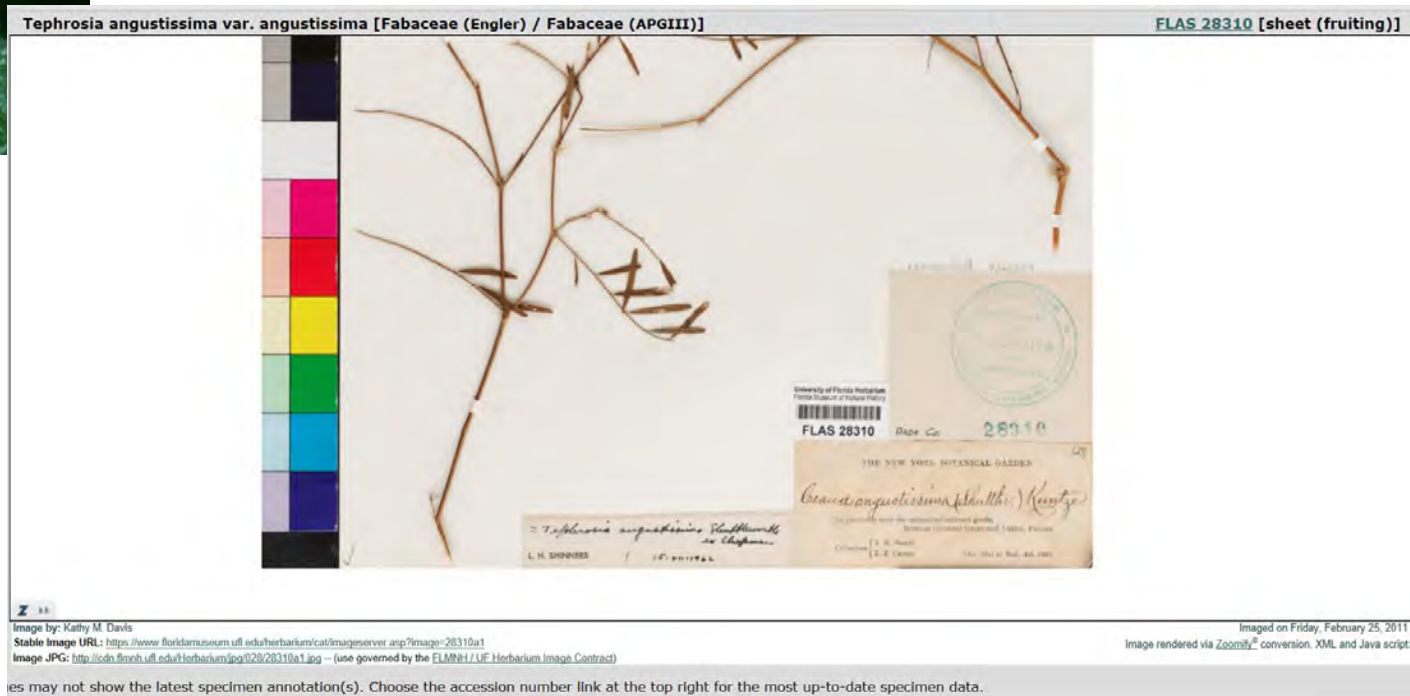
Expanding Exotics and Native Vines

Species Loss

Habitat destruction causes most extinctions, especially in the early stage of habitat fragmentation and degradation.

Here are two examples of pine rockland extinctions in South Florida, one regional, one global.

Varronia bahamensis (t)
Tephrosia angustissima (r)



But fragmentation leads to more inexorable loss

no species are lost from either pool. As fragmentation proceeds we eventually reach some critical level of reduction and fragmentation where species begin to die out. The susceptible pool loses species earlier and loses more species in total than does the resistant pool. When the resistant pool begins to lose species, it loses them very rapidly, because by this time the fragments are small and there is little habitat left.

Insularization causes extinctions over and above those expected through reduction in the total area of habitat. More species persist at equilibrium if the remaining habitat is concentrated into a single large patch rather than distributed over many small fragments (Figure 4). We stress that the results in Figure 4 are equilibrium patterns; depending on the relative time scales of habitat destruction and species'

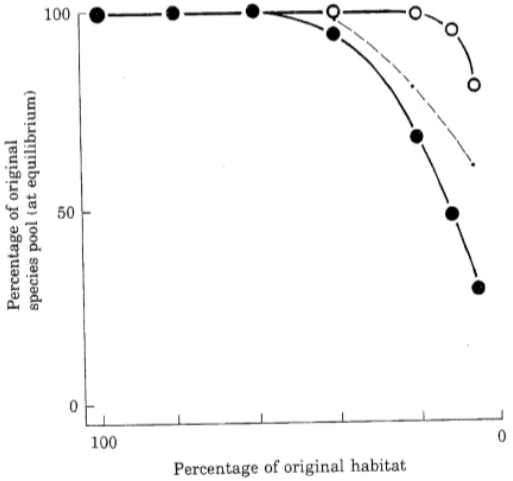


FIGURE 4. The number of species remaining in each species pool as fragmentation proceeds. Closed circles show the pool of species with large area requirements and low vagility. Open circles show the species with less stringent area requirements. The small dots connected by the dashed line depict the proportion of the first pool that would be present when the habitat is minimally fragmented. (From McLellan et al., 1986.)

Wilcove 1986

Extinction Debt

refers to the time delay between the impact of environmental changes and the time species go extinct.

(from Tilman et al. 1994)

Following Habitat Destruction The Debt Must be Paid

Some species and groups go faster.


©Shirley Denton


Some go slower.

Dark Diversity

refers to the missing portion of a species pool for a given habitat in a given region.

(from Pärtel et al. 2011)

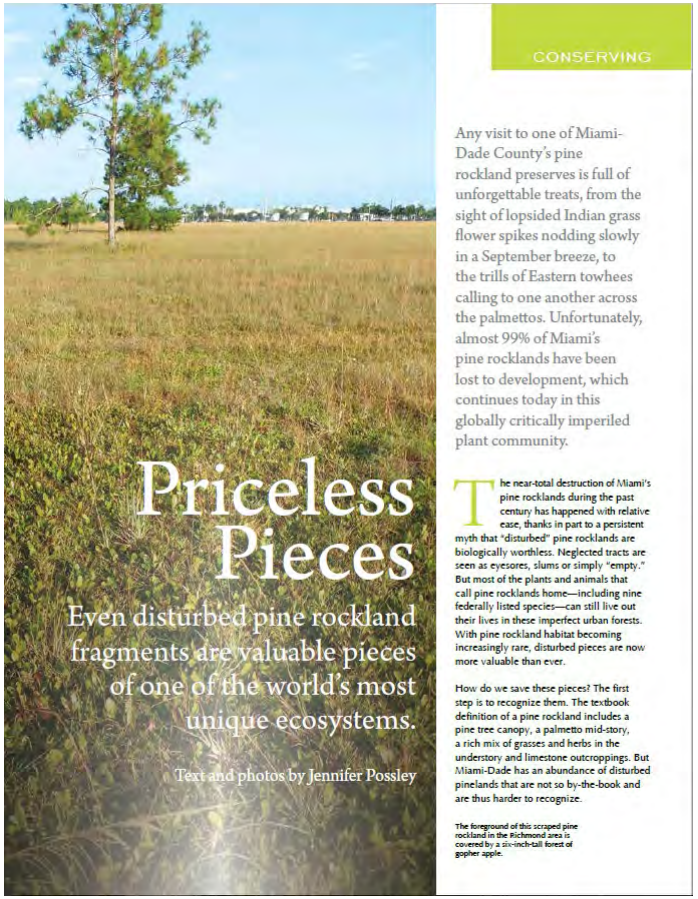
Following Extinction The Debt Paid Should be Measured

Agalinis obtusifolia
Asclepias connivens
Bletia patula
Chloris elata
Chrysopsis linearifolia var. dressii
Clitoria mariana
Crocanthemum corymbosum
Cuscuta americana
Desmodium strictum
Gymnopogon brevifolius
Indigofera caroliniana
Melochia tomentosa
Phaseolus polystachios var. sinuatus
Polygonella ciliata
Polygonella gracilis
Sabal etonia
Salvia micrantha
Sericocarpus tortifolius
Solanum chenopodioides
Spiranthes amesiana
Tephrosia angustissima
Tephrosia chyrsophylla
Tillandsia x smalliana
Warea carteri

Possible Plant Extirpations Across All Pine Rocklands in South Florida

Thinking Big

To Give Credit Where It Is Due



CONSERVING

Priceless Pieces

Even disturbed pine rockland fragments are valuable pieces of one of the world's most unique ecosystems.

Text and photos by Jennifer Possley

Any visit to one of Miami-Dade County's pine rockland preserves is full of unforgettable treats, from the sight of lopsided Indian grass flower spikes nodding slowly in a September breeze, to the trills of Eastern towhees calling to one another across the palmettos. Unfortunately, almost 99% of Miami's pine rocklands have been lost to development, which continues today in this globally critically imperiled plant community.

The near-total destruction of Miami's pine rocklands during the past century has happened with relative ease, thanks in part to a persistent myth that "disturbed" pine rocklands are biologically worthless. Neglected tracts are seen as eyesores, slums or simply "empty." But most of the plants and animals that call pine rocklands home—including nine federally listed species—can still live out their lives in these imperfect urban forests. With pine rockland habitat becoming increasingly rare, disturbed pieces are now more valuable than ever.

How do we save these pieces? The first step is to recognize them. The textbook definition of a pine rockland includes a pine tree canopy, a palmetto mid-story, a rich mix of grasses and herbs in the understory and limestone outcroppings. But Miami-Dade has an abundance of disturbed pinelands that are not so by-the-book and are thus harder to recognize.

The foreground of this scraped pine rockland in the Richmond area is covered by a six-inch-tall forest of gopher apple.

Today, with frequently burned pinelands so rare, these long-ago scraped pinelands can be important refuges for flora and fauna that require sunny, open habitat.

TOP
Native pine rockland species can persist for decades in disturbed pine rocklands. At least four native species are pictured here in this scraped area underneath power lines: butterfly pea, mouse pineapple, blue paspalum and three-seeded mercury.
Photo by Jason Woodhouse.

ABOVE
This fire-suppressed pine rockland is gaining shrubby hardwoods at the expense of understory grasses and herbs.

There are two major types of disturbed pine rocklands. First are scraped areas, where heavy equipment was used decades ago to scrape away vegetation and jagged limestone. These often look like old fields and can be found under power lines, alongside railroad tracks or canals and in vacant lots. Many of these scraped areas likely will never again support saw palmetto, pine rockland's most common shrub species. However, because pine rocklands hold most of their plant diversity in the understory—more than 300 species—the loss of one species is not catastrophic. In fact, most of the diverse plants that make pine rocklands special are still present in scraped pinelands. This includes some of the rarest plants, such as deltoid spurge and Carter's sand flax. Today, with frequently burned pinelands so rare, these long-ago scraped pinelands can be important refuges for flora and fauna that require sunny, open habitat.

The second type of disturbed pine rocklands are those that are **fire-suppressed**, meaning that fires have not been allowed to burn in the area for years. Pine rocklands are dependent on, and thrive with, fire—so without fire every three to seven years, a parcel can begin to transition to a hardwood-dominated forest or to a stand of exotic plants such as Burma reed or Brazilian pepper. But fire-suppressed parcels are far from doomed. Like scraped pinelands, they also provide critical habitat for native plants and animals. Some understory plant species can persist for decades without fire (though they will rarely reproduce). Even dense weeds can be conquered, and the combination of chainsaws and fire can release the soil seed bank and diverse herbaceous layer from the smothering pressure of overgrown hardwoods. When partners like Miami-Dade County's Natural Areas Management Division, the Florida Forest Service or The Institute for Regional Conservation work together to remove exotic vegetation and reintroduce fire to a preserve, a pine rockland can be reborn, seemingly overnight, through a process known as ecological restoration. In short, fire-suppressed pine rocklands can almost always make a complete recovery.

Possley 2015

Expanding the Pine Rockland Footprint Workshop

1 May 2018
Fairchild Tropical Botanic Garden
10:00 am – 12:00 noon

Organized by The Institute for Regional Conservation, Miami-Dade County,
U.S. Fish & Wildlife Service and Fairchild Tropical Botanic Garden

Draft Agenda

IRC's Pine Rockland Initiative
Private Pine Rockland Owners' Summit, October 2018

Restoration Opportunities

refers to the restoration of both **the extent** (e.g. expanding the footprint) and **the quality** (e.g., integrity) of pine rocklands, including degraded or “transitional” pinelands not currently measured.

What do we really have?

If We Don’t Ask For
What We Need
We Won’t Get It

Pine Rockland Business Plan
Team Kickoff Meeting
7.2.19



US Fish and Wildlife Service, TNC, IRC, Miami-Dade County, FTBG +

Pine Rocklands Are Resilient

Cleared, c. 1970 or earlier

Degradation versus Destruction

Florida City, 2018

Stipulation –
We can’t fix everything
(e.g., sea level rise).

Opportunities: Scraped Sites

Richmond Pine Rocklands

National Key Deer Refuge

Opportunities: Highly Fire-suppressed or “Transitional” Pinelands

National Key Deer Refuge

Florida City Pineland

Opportunities: Other Highly Degraded Sites

North Edge, Sunny Palms

Proof of Concept

Firebreaks & Restored Scraped Sites

Figure 91. Bruce Holst of Marie Selby Botanical Gardens and EVER Botanist Jimi Sadle showing length of *Sporobolus clandestinus* inflorescence near Osteen Hammock in EVER, 2012.

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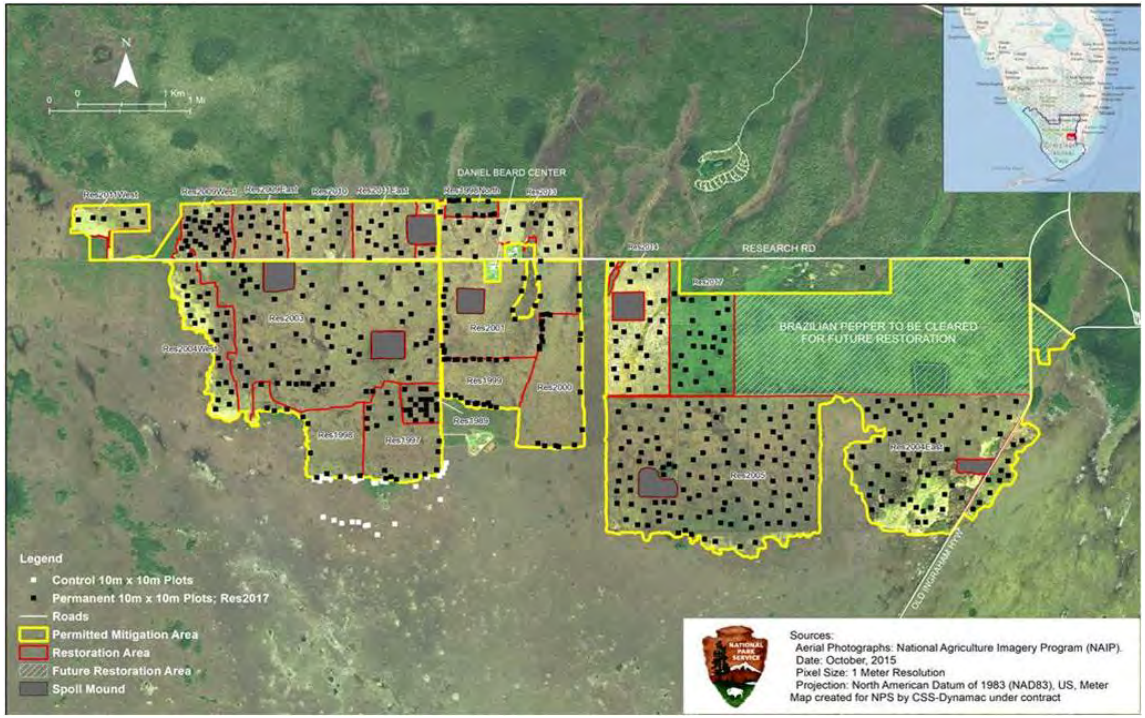
Long Pine Key, Everglades National Park

Former Scraped Site, SOCSOUTH



Hole-in-the-Donut
Everglades National Park

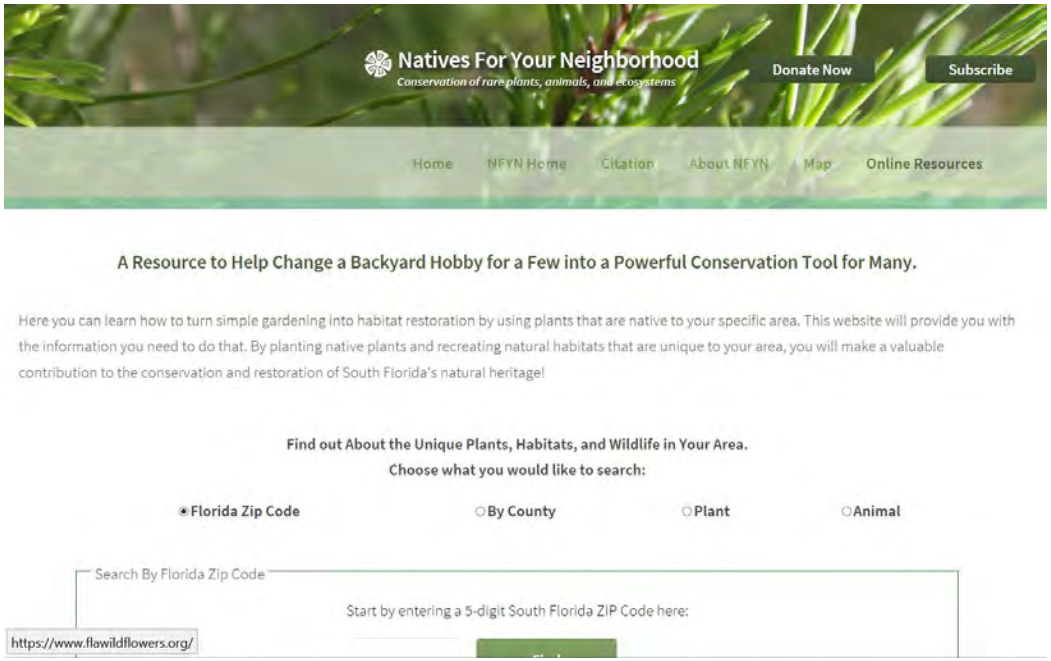
Nixon Smiley Pineland Preserve

Figure 1. 10 X 10 m plots at different stages during the Nixon Smiley restoration study. a) Applying seed treatments within a control plot July 14, 2010. b) NAM staff removing dead vegetation from an herbicide plot July 14, 2010, 16 days following the application of the herbicide treatment. c) A plot following a mechanical scrape on June 10, 2010. d) A control plot Feb. 4, 2011. e) An herbicide plot Feb. 4, 2011. f) A scrape plot Feb. 4, 2011. g) Control plot on July 17, 2012 showing tall Napier grass. h) An herbicide plot July 13, 2012 showing heavy West Indian dropseed and woody species cover. i) A scrape plot April 24, 2012.

From Krueger, unpublished

Zoo Miami

Opportunities: Urban Sites



New Tools and Methods

Skid Steer with Forestry Mulcher

Billy Goat Brush Cutter

SOCSOUTH

7-2018

1-2019

7-2019

1-2020

Research and Planning Tools

Select Language ▼

Translator Disclaimer

1 June 2013

Self-Incompatibility in *Byrsonima lucida* (Malpighiaceae), a Threatened Pine Rockland Specialist

Jason L. Downing, Hong Liu

Plant Animal Interactions | Published: 18 December 2003

Seed dispersal by the Florida box turtle (*Terrapene carolina bauri*) in pine rockland forests of the lower Florida Keys, United States

Hong Liu ✉, Steven G. Platt & Christopher K. Borg

Oecologia **138**, 539–546(2004) | Cite this article

Pollination, Herbivory, and Habitat Fragmentation: Their Effects on the Reproductive Fitness of Angadenia berteroi, a Native Perennial Plant of the South Florida Pine Rocklands

Beyte Barrios Roque, *Florida International University*

Document Type
Dissertation

Degree
Doctor of Philosophy (PhD)

Integrating Research and Management Around Key Issues: e.g., Dispersal, Pollination, Species Rarity and Loss

Miami-Dade County's Management Plan for the Richmond Pine Rocklands

Second Edition

2018

ACKNOWLEDGMENTS

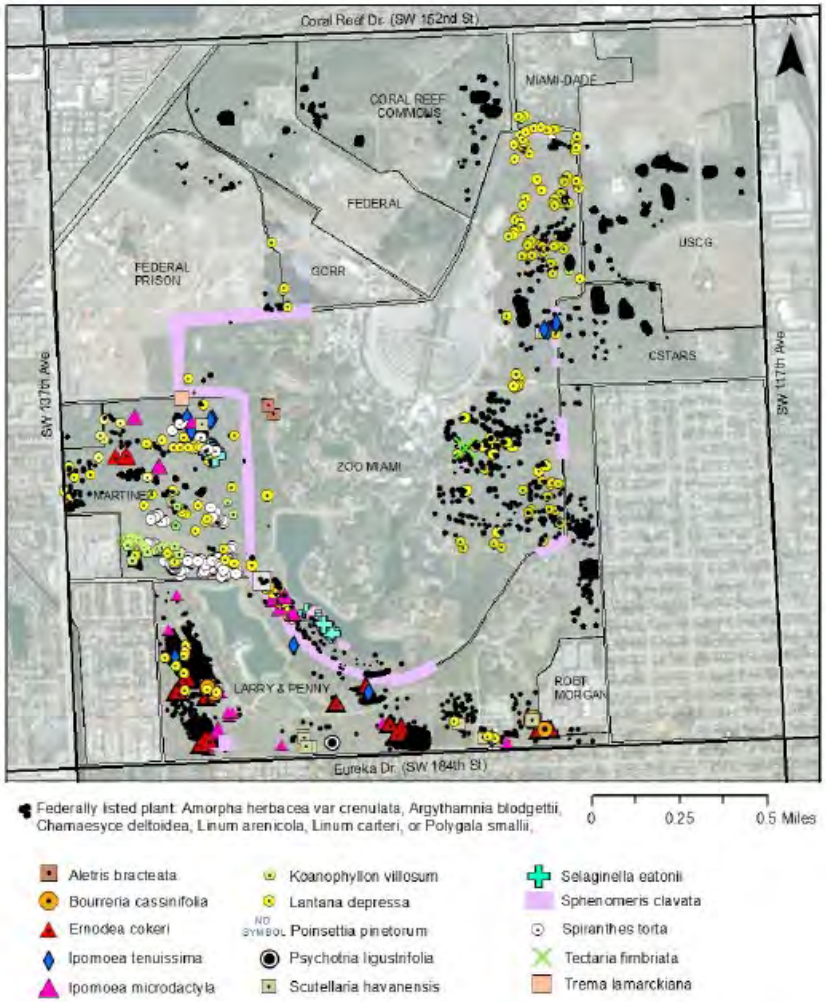
This second edition of the Richmond Pine Rockland Management Plan was funded by Miami-Dade County, Department of Parks, Recreation, and Open Spaces and Zoo Miami, through an inter-agency agreement which was approved by the Board of County Commissioners (Resolution R-476-16). This revision was prepared by Fairchild Tropical Botanic Garden, and the principal author for the revision and updated GIS maps was Jennifer Possley. Many other authors contributed to sections, including Joe Maguire, Joy Klein, Sonya Thompson, Frank Ridgley, Craig Grossenbacher, James Duncan, Robin Gray-Urgellés, Gwen Burzycki, Janet Gil, Tiffany Melvin, Tim Joyner, Luis Moreno, Jimmy Lange, Alicie Warren, Dallas Hazelton, and Steven Whitfield. Technical reviewers providing substantial comments included: George Gann, Paula Halupa, Mark Salvato, Dave Bender, Shawn Christopherson, Nikki Lamp, Ashleigh Blackford, Roxanna Hinzman and David Cook. Staff and volunteers who collected data for the GIS maps presented in this management plan included Devon Powell, Erick Revuelta, Frank Ridgley, Dustin Smith, Sonya Thompson, Cristina Urbina, Lydia Cuni, Lisa Krueger, Ed McSweeney, Chris Cifuentes, Mary Rose, Jimmy Lange, Stephen Hodges, and Emily Magnaghi.

The first edition of this management plan was completed in 1994, with funding from the U.S. Department of Interior Fish & Wildlife Service (Grant #14-16-0004-92-987). The plan was prepared by Dade County's Department of Environmental Resources Management, by principal authors Joe Maguire, Deborah Drum, and Renee Rasha. Field work was conducted by Keith Bradley, Deborah Drum, Debbie Duvall, Joy Klein, Joe Maguire, and Renee Rasha. Digital mapping was completed by Deborah Drum and Renee Rasha.

Cover photos by Jennifer Possley and Sonya Thompson. All other photos throughout this document have initials in their captions, crediting the following photographers:

AB = Amanda Bailey/UF
AM = Alba Myers/FTBG
BH = Bobby Hattaway/www.discoverlife.org
DERM = file photo, Miami-Dade Dept. of Environmental Resources Management
DS = Dustin Smith/Zoo Miami
FR = Frank Ridgley/Zoo Miami
GGa = George Gann/IRC
JF = Janeen Feiger/Miami-Dade
JL = Jimmy Lange/FTBG
JJM = Joyce Maschinski/FTBG
JM = Joe Maguire/ Miami-Dade
JP = Jennifer Possley/FTBG
KW = Kristie Wendelberger/FTBG
MF = Mike Freedman/FTBG
MT = Mary Truglio/UF
RH = Roger Hammer
TW = Tom Wilmers

Suggested Citation:
Possley, J., J. Duncan, J. Klein and J. Maguire. 2018. Miami-Dade County's management plan for the Richmond pine rocklands, 2nd Edition. Prepared by Fairchild Tropical Botanic Garden for Miami-Dade County, Department of Parks, Recreation and Open Spaces and Zoo Miami. 136 Pages.



Map 8. Known locations of Florida endangered plant species in Richmond, Miami-Dade County Properties only. Surveys by Fairchild Tropical Botanic Garden and cooperators, 2002-2017. Data were gathered via systematic transects. Details for federally listed species shown as black dots are illustrated in Map 7 on the previous page. Note that all federally listed species are also state listed. *Poinsettia pinetorum* (=*Euphorbia pinetorum*) is not included on this map due to very high abundance in Richmond.

IV. MIAMI-DADE COUNTY'S STRATEGIC ACTION PLAN FOR RESTORING COUNTY-OWNED PORTIONS OF THE RICHMOND PINE ROCKLANDS

Because the Richmond pine rocklands are a unique and important resource, this document includes a strategic action plan with goals, objectives and actions to ensure that Richmond is managed and restored in the best way possible. Primary to carrying out the plan is understanding its overall vision:

Vision statement:

Richmond's unparalleled diversity of plants, animals, and habitats is widely embraced as a priceless piece of South Florida's natural heritage, and merits the highest standards for protection, restoration, and management, now and for future generations.

Miami-Dade County Goals for Restoring Richmond Pine Rocklands

GOAL 1: Restore
Restore and maintain habitat structure and function to maximize native biodiversity and preserve natural resources

GOAL 2: Monitor
Implement monitoring to ensure that Goal 1 objectives are being met

GOAL 3: Communicate
Foster communication within separate County-owned properties and with non-County properties to ensure that Goal 1 objectives are being met

GOAL 4: Best Practices
Develop best practices for habitats consistent with other stated goals.

Management of natural areas in Richmond will need to happen in perpetuity, but native biodiversity can be maximized and costs can be minimized if optimal management techniques are employed. The operational goal of habitat management at Richmond is to achieve a "maintenance level," whereby management treatments are conducted to sustain the conditions achieved through restoration efforts.

This section consists of four management goals. The primary goal is to restore and maintain habitat, in order to preserve Richmond's native biodiversity. Goals 2-4 relate to monitoring, communicating, and best practices. Monitoring is essential for choosing the best management techniques. For example, monitoring rare species periodically can inform a manager whether that population is increasing or decreasing, and allow him or her to modify techniques to promote population growth. For agencies that do not have staff with expertise to conduct monitoring, a list of potential monitoring resources and contractors is included in **Appendix 3**, and training resources are listed in **Appendix 4**. Communication with other Richmond land managers is essential for sharing information on effective (or ineffective) restoration methods and is paramount in conducting safe and effective prescribed fires, which is by far the most needed restoration activity in Richmond. To help foster communication, a list of all current Richmond land owners and regulating agencies and contact information is included in **Appendix 5**. Finally, the Best Practices section seeks to ensure that management efforts are executed in ways that are not counter-productive to the other goals in this strategic action plan.

- When restoring pine canopy via planting tubelings, implement a strategy for uneven-aged stands to reach the goal of 50-70 mature trees per acre. For example, plant 10 trees per acre once a year for 5 years (or more, if mortality is high).

1.4 In pine rockland areas with excessive pine density, if the appropriate fire regime cannot feasibly be re-established, then consider thinning pines to achieve the appropriate canopy (pine) structure, with 50-70 mature trees per acre (≥4"), in an irregularly-spaced, uneven-aged stand. Unit 2, the southwest management unit of Larry & Penny Thompson Memorial Park, provides an example.

- Manually remove pines with chainsaws, not heavy equipment, to minimize damage to adjacent vegetation.
- Remove felled pines from pine rockland to prevent smothering of sensitive vegetation and excess fuel build-up.
- Consider duff (needle) removal in areas to improve habitat for threatened and endangered species such as the Miami Tiger Beetle.

1.5 In pine rockland areas with excessive palm density, consider thinning palms to achieve the appropriate structure, with approximately 25% cover, and with presence of *Serenoa repens*, *Sabal palmetto*, and *Coccothrinax argentata*. Palms should be naturally spaced, with some "islands" and some gaps to allow for intermittent expanses of grasses, herbs, and bare mineral soil.

- Manually remove palms with chainsaws, not heavy equipment, to minimize damage to adjacent vegetation.
- Avoid leaving palm material on the ground to prevent smothering of sensitive vegetation and excess fuel build-up.

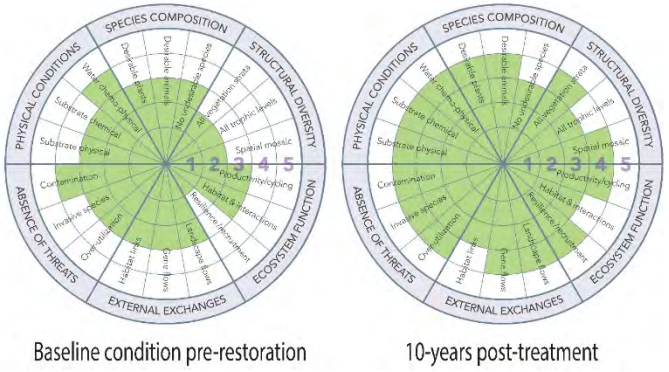
1.6 In pine rockland units with excessive density of native hardwoods, consider thinning hardwoods to achieve the appropriate structure in pine rocklands, ranging between 5 and 25% cover. Hardwoods should be naturally spaced, with some "islands" and some gaps to allow for intermittent expanses of grasses, herbs, and bare mineral soil.

- Manually remove hardwoods with chainsaws, not heavy equipment, to minimize damage to adjacent vegetation.
- Removal efforts should focus on common hardwoods such as live oak (*Quercus virginiana*) and sumac (*Rhus coppalinum*).

- Do not remove all individuals of native hardwoods that are important sources of nectar or wildlife food such as willow bustic (*Sideroxylon reclinatum*) or poisonwood (*Metopium toxiferum*).
- Use caution when reducing hardwoods in areas with Florida endangered shrubs (such as *Koanophyllon villosum* or *Bourreria cassinifolia*), shrubs that are the larval host plants for rare butterflies (*Croton linearis*, *Byrsonima lucida*) or uncommon shrubs (such as *Lyonia fruticosa*). Preserve managers may flag rare shrubs prior to crew work to ensure they are not removed.

1.7 In areas with few trees and shrubs that are dominated by native herbs and forbs, ensure that

RESTORATION TARGETS
Reference Models, Ecosystem Attributes & The Recovery Wheel



From Gann et al. 2019.
International Principles and Standards for the Practice of Ecological Restoration.

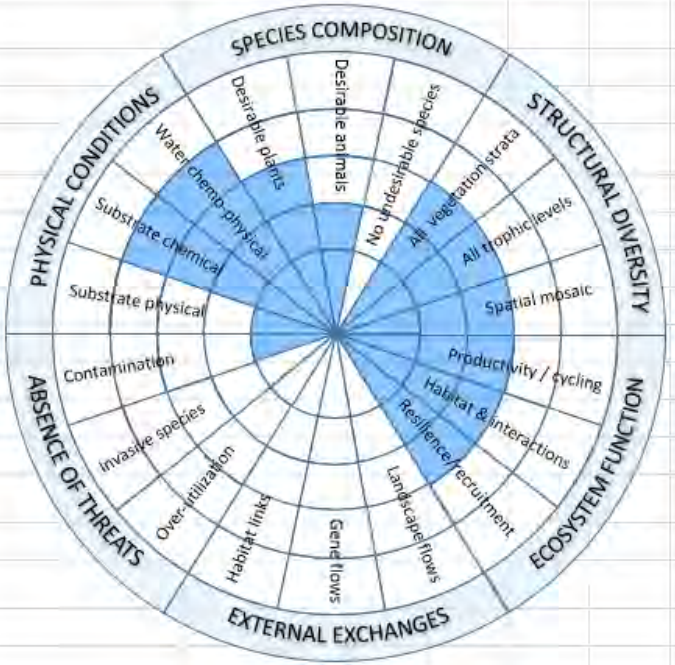
BASELINE FOR PINE ROCKLAND RECOVERY - MIAMI-DADE PINE ROCKLANDS OUTSIDE OF EVERGLADES NATIONAL PARK (DRAFT)

ASSESSOR: George Gann

SITE: All Pine Rocklands combined

DATE: 2020-3-4

ATTRIBUTE CATEGORY	BASELINE (1-5)	Recovery Target	EVIDENCE FOR RECOVERY LEVEL (e.g., INDICATORS)
ATTRIBUTE 1. Absence of threats			
Over-utilization	0	1	Cessation of habitat destruction
Invasive species (external)	0	3	Reduction of seed rain, invasion
Contamination	1	4	Reduced contamination (e.g., dumping, insect spraying)
ATTRIBUTE 2. Physical conditions			
Substrate physical	1	4	No dumped material; see Plant table
Substrate chemical	4	4	No soil contamination
Water chemo-physical	4	4	No saltwater intrusion where possible
ATTRIBUTE 3. Species composition			
Desirable plants	3	5	see Plant table
Desirable animals	2	5	Diversity of fauna; carnivores; pollinators
No undesirable species	0	4	No exotic, invasive or ruderal plants or animals; see also Plant table
ATTRIBUTE 4. Structural diversity			
All strata present	3	5	See Plant table
All trophic levels	3	4	Herbivory, predation
Spatial mosaic	3	5	Mosaics of pines, palms, hardwoods, open ground
ATTRIBUTE 5. Ecosystem function			
Productivity, cycling etc (Fire)	3	4	Fires every 2-7 years
Habitat & interactions	3	4	Presence of key host/nectar plants for pollinators
Resilience, recruitment etc	3	4	Pine, rare species recruitment
ATTRIBUTE 6. External exchanges			
Landscape flows	0	3	Stepping stones across private and non-conservation landscapes
Gene flows	0	3	Movement of animals, seeds, pollen between fragments
Habitat links	0	3	Ecotones with wetlands/rockland hammocks



Update recovery wheel

Source: Gann G, McDonald T, Walder B, et al. (2019) International principles and standards for the practice of ecological restoration. Second edition. *Restoration Ecology* 27(S1): S1-S46, doi: 10.1111/rec.13035.

Artwork: Little Gecko Media. **Excell file formulated by** Simone Pedrini.

EvaluationForm | Macro

SOUTH FLORIDA PINE ROCKLANDS

INTEGRATED ECOLOGICAL AND SOCIAL GOALS FOR ECOLOGICAL RESTORATION

Pine Rockland Business Plan
Ecological Restoration Sub Team

4 March 2020 DRAFT

SCOPE

Historical footprint of pine rocklands in Miami-Dade and Monroe counties, Florida, plus potential habitat on limestone fill on adjacent lands.

CURRENT CONDITION

Fragmentation, modified hydrology, fire suppression, invasive species, local and global extinctions, and other drivers of degradation have resulted in a decline in the area, condition, and diversity of globally imperiled pine rocklands in South Florida. Large, high-quality remnants are protected in Everglades National Park in Miami-Dade County and the National Key Deer Refuge in Monroe County, although both regions are at relatively low elevations and threatened by sea level rise. More than 100 isolated fragments occur outside of these areas, under both public and private ownership. Some remnant fragments are managed and in relatively good condition, while most have suffered severe degradation, which has modified the structure, composition, and function of these remnant ecosystems. In addition, some degraded pine rocklands have been unrecognized or ignored by managers due to restrictive classification systems (e.g., previously cleared pine rocklands that have been mowed and contain pine rockland understory plants).

VISION

The recovery of healthy pine rocklands wherever they still exist, including at sites with recognized potential for restoration. These pine rocklands are cared for and enjoyed by the residents of Florida, as well as visitors and scientists from around the world. This results in an elevated sense of social cohesion and a signification contribution toward sustainable ecosystem management, including the recovery of local biodiversity, the delivery of ecosystem services, and the mitigation of and adaptation to climate change.

ECOLOGICAL TARGETS

Undegraded pine rocklands have an open canopy of South Florida Slash Pine (*Pinus elliottii* var. *densa*), a diverse shrub and palm layer (1-2 m), and an extremely diverse groundcover layer (<1 m). The shrub and understory layers are composed of a mix of temperate and tropical species, the composition of which changes from north to south. Native hardwoods and palms are an important component of pine rocklands, but do not exceed 45% cover in the shrub and palm layer. The understory layer is composed of a mix of graminoids and non-graminoid herbs, which have a cover of at least 50%. The vegetation is expressed as a mosaic, and islands of species or groups of species are frequent. Pine rocklands are habitat for wildlife, including pollinators, migratory birds, and small mammals, and invasive animals are controlled. A wide diversity of native plants are present, and invasive exotics and native weedy plants are reduced to a minimum. Rare species are documented, protected, and augmented or reintroduced when appropriate. Fragments are enlarged and connected whenever possible, and ecosystem processes

like regular fire are restored to the extent practicable. Changes in regional hydrology and irreversible soil modifications are considered when designing, implementing, and monitoring pine rockland restoration. Pine rocklands are managed in a way that benefits residents and others, from the establishment and maintenance of nature paths, to opportunities for citizen science and volunteers to participate in restoration and management activities, to the development of educational programs for students of all ages.

GOALS (ecological and social; modified from Possley et al. 2014, 2018, in part)

1. Appropriate[1] fire regime, approximating a fire regime of 2-7 years, established for all fragments possible within 30 years;

2. Wildfires are responded to in an appropriate way and used to restoration advantage when safe and practical within 3 years;

3. Alternative techniques are applied as a fire surrogate within 10 years if a combination of prescribed fire and wildfire does not meet fire regime goals;

4. Slash pines are thinned where needed to achieve the appropriate canopy structure, with 50-70 mature trees per acre (>4" dbh in Miami-Dade, >3" dbh in Monroe), within 10 years;

5. Palms are thinned where needed to achieve the appropriate structure, ranging from 10-20% cover within 10 years;

6. Native hardwoods are thinned where needed to achieve the appropriate structure, ranging from 5 to 25% cover within 10 years;

7. Previously cleared pine rocklands that have been maintained through regular mowing are restored to a 4-star condition within 20 years;

8. Depleted or extirpated populations of native plants and animals are restored as practicable within 10 years;

9. Native species richness reaches an average of 90% of the reference model for each site within 10 years.

10. Average cover of native invasive, ruderal, and nonnative plant species is reduced to <2% within 10 years.

11. Populations of exotic and nuisance animals are controlled or extirpated within 10 years.

12. Pine rocklands are protected from point and non-point source pollution, including insect spraying, to the extent practicable within 5 years.

13. The collective size and connectivity of pine rocklands is doubled in 20 years.

14. The connectivity of pine rocklands to critical ecotonal habitats (e.g., rocklands hammocks, freshwater wetlands) is doubled in 20 years.

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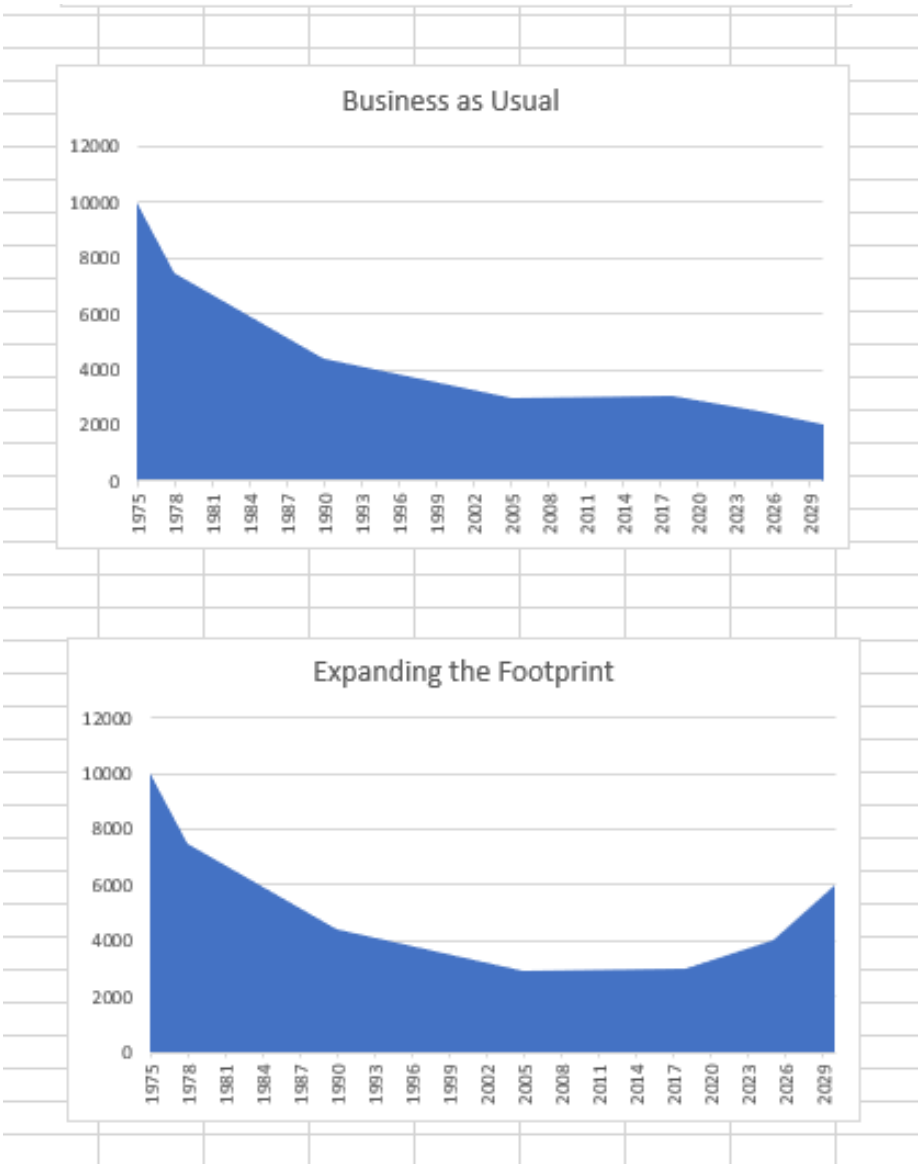
[1] Including seasonality to the extent possible.

1	Table 1. Indicators and Targets for Pine Rockland Structure and Plant Composition				
2	Gann [& Possley et al.] (DRAFT 2020-2-18)				
3			Miami-Dade	Keys	
4	**Attribute**	**Indicators**	**Quantitative Target**	**Quantitative Target**	**Notes**
20	**NONNATIVE SPECIES**	**% Cover**	<1% cover	<1% cover	
21	**RUDERALS AND WEEDY INVADERS**	**# Species, % Cover**	<1% cover	<1% cover	
22	**NATIVE SPECIES - Tree layer**	**Composition**	Slash pine only >2m	Slash pine only >2m	
23	Pinus elliottii var. densa	Density/Cover	50-70 4" dbh trees/acre; [% cover?]	50-70 3" dbh trees/acre; [% cover?]	
24			recruitment	recruitment	
25	**NATIVE SPECIES - Palm layer**	**% Cover**	10-20% cover >1m	10-20% cover >1m	
26	Coccothrinax argentata	% Cover	1-5% cover >1m	1-5% cover >1m	
27	Sabal palmetto	% Cover	1-7% cover >1m	1-5% cover >1m	
28	Serenoa repens	% Cover	15-20% cover >1m	1-5% cover >1m	
29	**NATIVE SPECIES - Palm layer, Miami-Dade variant**	**Population (# individuals; demographic parameters)**	Reintroduce	-	
30	Sabal etonia	Population (# individuals; demographic parameters)	Reintroduce	NA	
31	**NATIVE SPECIES - Palm layer, Keys variant**	**% Cover**	-	Included in Palm layer total	
32	Leucothrinax morrisii	% Cover	-	5-10% cover >1m	
33	**NATIVE SPECIES - Tall shrub layer (about 25 species; examples below)**	**% Cover**	5-20% cover >1m	5-20% cover >1m	
34	Ardisia escallonioides	% Cover	<2% cover >1m	<2% cover >1m	
35	Baccharis halimifolia	% Cover	<1% cover >1m	Presumed present; survey	
36	Bourreria cassinifolia	Population (# individuals; demographic parameters)	Augment	Possibly extirpated; survey, recover	
37	Byrsonima lucida	% Cover	<5% cover >1m	<2% cover >1m	
38	**NATIVE SPECIES - Tall shrub layer, wetland variant**	**Population (# individuals; demographic parameters)**	Included in total for shrub layer	Included in total for shrub layer	
39	Baccharis angustifolia	Population (# individuals; demographic parameters)	Protect all	Possibly extirpated; survey	

The Choice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