



## ECO-ACADEMY for Youth and Parent Educators

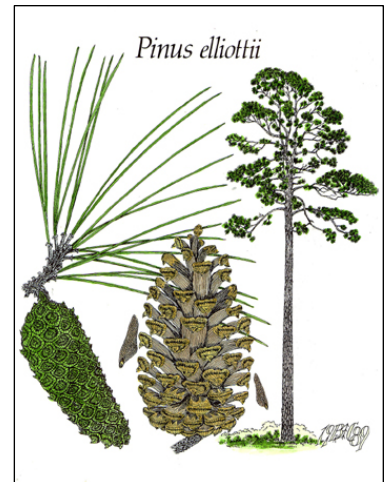
**Pine Rocklands** are found in Southern Florida, Cuba, and the Bahamas. Within Florida, pine forests are centered on limestone outcrops at the Big Cypress National Preserve, the lower Florida Keys, and along the Miami Rock Ridge. This forest type has a single dominant canopy species, South Florida slash pine (*Pinus elliottii* var. *densa*), with a rich sub-canopy layer of tropical palms and hardwood species of either tropical or temperate origins. The sub-canopy layer also contains a wide diversity of herbaceous species. Pine rocklands are fire maintained systems. Periodic fires influence sub-canopy stature and composition, understory light-penetration, pine regeneration, and hardwood establishment and growth. Therefore, human-mediated fire suppression can result in the gradual shading-out of pine rockland understory species and the eventual replacement of pine rockland ecosystems. The pine rocklands of Southern Florida are seriously endangered ecosystems.

### Module: South Florida Ecosystems

## Pine Rockland

### Sunshine State Standards:

SC.1.L.14.1, SC.1.N.1.1, SC.2.L.17.2, SC.2.N.1.1,  
SC.3.L.14.2, SC.3.N.1.1, SC.4.L.16.2, SC.4.L.17.4,  
SC.5.L.17.1, SC.5.L.15.1, SC.7.L.17.3, SC.7.L.15.3,  
SC.912.L.15.3, SC. 912.L.17.4,  
SC.912.L. 17.4



### Objectives

- Understand the ecology of Pine Rocklands
- Learn about different adaptations of plants and animals to pine rocklands
- Understand the importance of pine rocklands
- Identify the dominant plants found in Pine Rocklands
- Learn about the importance of wildfire to maintain different habitats.

## Vocabulary

**Canopy** - is the aboveground portion of a plant community or crop, formed by plant crowns.

**Ecosystem** - is a biological environment consisting of all the organisms living in a particular area, as well as all the nonliving, physical components of the environment with which the organisms interact, such as air, soil, water, and sunlight. It is all the organisms in a given area, along with the nonliving (abiotic) factors with which they interact; a biological community and its physical environment.

**Ecoregion** - is an ecologically and geographically defined area that is smaller than an ecozone and larger than an ecosystem. Ecoregions cover relatively large areas of land or water, and contain characteristic, geographically distinct assemblages of natural communities and species. The biodiversity of flora, fauna and ecosystems that characterise an ecoregion tends to be distinct from that of other ecoregions.

**Ecozone** - is the largest scale biogeographic division of the Earth's land surfaces, based on the historic and evolutionary distribution patterns of terrestrial plants and animals. Ecozones represent large areas of the Earth's surface where plants and animals developed in relative isolation over long periods of time, and are separated from one another by geologic features, such as oceans, broad deserts, or high mountain ranges, that formed barriers to plant and animal migration.

**Endemism** - is the ecological state of being unique to a particular geographic location, such as a specific island, habitat type, nation or other defined zone. To be endemic to a place or area means that it is found only in that part of the world and nowhere else.

**Limestone** - is a sedimentary rock composed largely of the minerals calcite and/or aragonite, which are different crystal forms of calcium carbonate ( $\text{CaCO}_3$ ). Like most other sedimentary rocks, limestones are composed of grains; however, most grains in limestone are skeletal fragments of marine organisms such as coral or foraminifera.

**Miami Rock Ridge** - is a continuous limestone outcropping which formerly encompassed a large extent of far southern Florida, including portions of the Everglades ecosystem. The traditional base of the elevation ranges from northern Miami-Dade County (the approximate latitude of North Miami Beach) southward to the upper Florida Keys, and it extends southwest into Everglades National Park and Long Pine Key.

**Outcrop** - is a visible exposure of **bedrock** or ancient superficial deposits on the surface of the Earth.

**Taxon** (*plural: taxa*) - is a group of (one or more) organisms, which a taxonomist adjudges to be a unit. Usually a taxon is given a name and a rank, although neither is a requirement. Defining what belongs or does not belong to such a taxonomic group is done by a taxonomist. It is not uncommon for one taxonomist to disagree with another on what exactly belongs to a taxon, or on what exact criteria should be used for inclusion.

**Wildfire** - is any uncontrolled fire in combustible vegetation that occurs in the countryside or a wilderness area. Other names such as brush fire, bushfire, forest fire, grass fire, hill fire, peat fire, vegetation fire, veldfire and wildland fire may be used to describe the same phenomenon depending on the type of vegetation being burned. A wildfire differs from other fires by its extensive size, the speed at which it can spread out from its original source, its potential to change direction unexpectedly, and its ability to jump gaps such as roads, rivers and fire breaks. Wildfires are characterized in terms of the cause of ignition, their physical properties such as speed of propagation, the combustible material present, and the effect of weather on the fire.

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## Background

### South Florida Rocklands

The **South Florida rocklands** are a subtropical moist broadleaf forest ecoregion occurring in southern Florida and the Florida Keys in the United States, where they would naturally cover an area of 2,100 km<sup>2</sup> (810 sq mi). These forests form on limestone outcroppings with very thin soil; the higher elevation separating them from other habitats such as coastal marshes and marl prairies. On mainland Florida, rocklands exist primarily on the Miami Rock Ridge, which extends from the Miami River south to Everglades National Park. South Florida rocklands are further divided into pine rocklands and rockland hammock.

### Pine Rockland



The pine rockland community canopy is dominated almost exclusively by South Florida Slash Pine. Beneath this canopy lies a rich understory composed of grasses, sedges, palms, vines, and shrubs of temperate and tropical origin, such as Broomsedge Bluestem, Coontie, Five petal Leaf-flower, Florida Bluestem, Florida Clover Ash, Florida Keys Noseburn, Pineland Snakeherb, Pineland Spurge, Silver Bluestem, and Beyrich Threeawn.

The pine rockland community is South Florida's most floristically diverse plant

community and includes several endemic species. A subclimatic community, pine rocklands have depended on wildfire to keep them from transitioning into hardwood hammocks.

The flora of pine rocklands is composed of a diverse assemblage of tropical and temperate taxa. Many endemic plant taxa are also found in this community. It is a fire maintained community, requiring periodic fires to eliminate invading hardwoods, assists in nutrient cycling, and to reduce duff layers. Pine rocklands also provide critical foraging and nesting habitat for a diverse array of wildlife, including five federally listed animal species. While significant areas of pine rocklands are now protected within preserves such as Everglades NP, Big Cypress National Preserve, and the National Key Deer Refuge, pine rockland fragments are still threatened on the Miami Rock Ridge and in the Florida Keys. Pine rocklands have been heavily impacted by outright destruction, conversion to agriculture, fire suppression, exotic plant and animal invasions, collecting pressure on plants and animals, and alterations to hydrology. Significant work has now been initiated to control exotic plant taxa in pine rocklands, although much research needs to be conducted on restoring heavily degraded sites.

## **Distribution**

Pine rocklands are found in southern Florida, the Bahamas, and Cuba. In Florida, they were historically found on limestone substrates in Miami-Dade County along the Miami Rock Ridge from approximately North Miami Beach south and west to Long Pine Key in what is now Everglades. Pine rocklands in the Florida Keys are now restricted to the Lower Keys.

## **Description**



Pine rockland is a savanna-like forest on limestone outcrops with a single canopy species, South Florida slash pine, and a diverse understory of shrubs and herbs. It is a fire-maintained community requiring periodic burns every 3 to 7 years. This community is often found in association with rockland hammock and short freshwater wetland communities.

## **Vegetative Structure and Composition**

The flora of pine rocklands is influenced by the community's proximity to the tropics as well as its peninsular connection to mainland Florida. A high degree of vascular plant endemism is observed in the pine rockland community. In a 1977 survey of the 186 species noted in Miami-Dade and Monroe county pine rocklands, 30 species were only

found in pine rockland communities in Miami-Dade County and nine of these were endemic to the pine rockland community.

Many plants reach their northern or southern limits in the pine rocklands of South Florida. Pine rocklands plants include:

- Bahama sachsia
- pineland daisy (picture on right)
- quailberry
- shrub eupatorium
- dollarweed
- Grays beakrush
- green-eyes



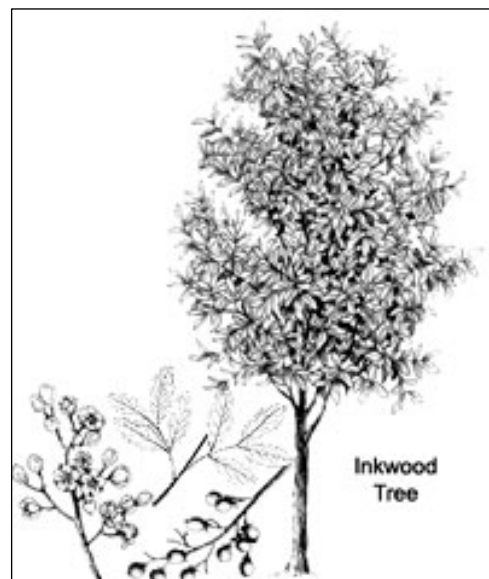
The overstory of pine rocklands is open and dominated by a canopy of South Florida slash pine ranging in height from 20 to 24 m (65.6 to 79.2 ft). This canopy provides a source of pine needles for fine fire fuel. The pine canopy ignites rarely, typically after long periods of fire suppression. Germination occurs during October, November, and December, with survival highest when optimal soil moisture is present the following dry season. The seedlings remain in the grass stage for 2 to 5 years. Growth occurs over a period of approximately 10 months from February to November. However, hardwoods that may occur in the area include live oak, wild-tamarind, and willow-bustic. These species are more abundant in areas where natural fire is suppressed and in pine rocklands in close proximity to tropical hardwood hammocks.

More than 90 shrubs occur in pine rocklands, comprising a mix of tropical and temperate organisms. Those pinelands in proximity to hammocks have more hammock shrubs present, such as

- gumbo-limbo
- inkwood
- wild-tamarind.

Fifteen species of shrubs may be present in pine rocklands throughout South Florida. These include

- cabbage palm
- coco-plum
- myrsine
- saw palmetto
- southern sumac
- strangler fig
- swamp-bay



- wax-myrtle
- white indigo berry
- willow-bustic

Almost all pine rocklands have an understory palm component. The most common species is saw palmetto. On the Miami Rock Ridge, silver palm may occur, although it is rare toward the south. In the Florida Keys, thatch palm and silver palm are common, and reach heights of several meters, much higher than palms on the Miami Rock Ridge or Big Cypress. In areas with a longer loamy soil, cabbage palm (*Sabal palmetto*) may become abundant.

Hardwood species that occur in pinelands include

- buckthorn
- dahoon holly (picture on right)
- live oak
- varnish leaf
- locust berry long-stalked stopper
- pineland croton
- pineland strongback
- rough velvetseed
- silver palm
- wild sage
- few-flowered holdback
- Keys partridge-pea
- pisonia
- pride-of-Big Pine
- small flowered lily-thorn

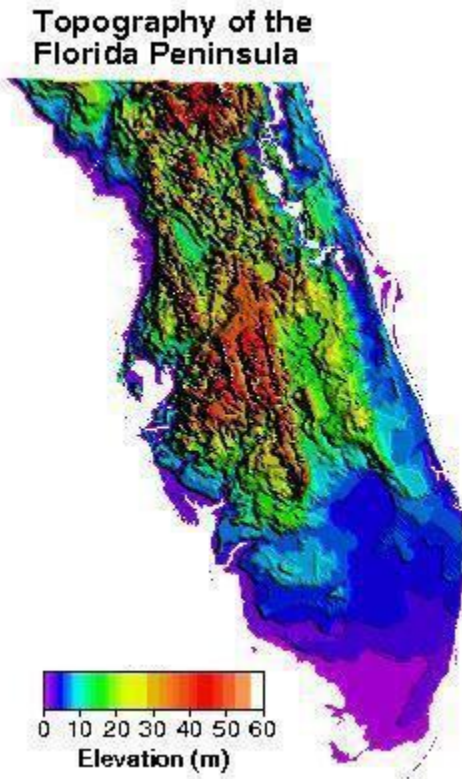


Herbs found only in pine rocklands with deep sand layers include

- big threeawn
- hair sedge
- procession flower
- tiny polygala
- wiregrass
- butterwort
- yellow colicroot
- Brickell-bush
- pineland daisy
- rockland morning-glory (picture on right)



## Soils, Hydrology and Climate



Pine rockland occurs on relatively flat, moderately-to well-drained terrain. Because limestone bedrock is at or very near the surface, soils are generally small accumulations of sand, marl, and organic material in depressions and crevices in the rock surface. Drainage varies according to the porosity of the limestone substrate, but it is generally rapid. Consequently, most sites are wet for only short periods following heavy rains. During the rainy season, however, some sites may be shallowly inundated by very slow-flowing surface water for up to 60 days per year.

Each of the three regions where pine rocklands occur in Florida has unique geological attributes a formation of Miami oolitic limestone which extends for 70 miles making the surface often irregular with solution holes up to several meters in width and depth. Organic materials and humus

accumulate in these solution holes.

The elevation of the Miami Rock Ridge varies from greater than 7 m to less than 2 m above sea level with an average elevation of approximately 3 m, varying in width from 6.4 to 16 km (4 to 10 miles). Where the ridge is evident, it is covered largely by marl soil. Elevations in the limestone formations found in the Keys are significantly lower, from 1 to 2 m above sea level.

The depth and composition of pine rockland soils varies from almost nonexistent in the to very little exposed rock. Where soil is present, it is a fine reddish-brown sandy loam, slightly acidic with less than 10 percent organic matter. The soils in solution holes may contain 30 to 50 percent organic matter. Soils in some pinelands area are quartz sands, other soils are rockier or very gravelly loam. Pine rockland soils are slightly basic.

Rainfall in the pine rockland community varies from over 163 cm (64 inches) average annual to between 122 and 143 cm (48 and 56 inches, respectively) average annual in the rest of the county.

Temperature also plays an important role in pine rocklands. Because the large constituent of tropical and subtropical plants is more exposed to below-freezing temperatures in the relatively open understory, they are more likely to succumb to

freeze damage than specifics in the sheltered rockland hammocks. Thus, below-freezing temperatures help reduce tropical hardwood encroachment in pine rocklands.

## Wildlife Diversity

Except for some birds and bats, most vertebrate animal species found in pine rocklands are temperate in origin. While plant species can be transported by birds, ocean currents, or wind from the Caribbean, most animal species had to travel to South Florida by land, and a land bridge has never connected South Florida with the Caribbean. Pine rocklands provide food, cover, roosting, and nesting sites to a wide variety of wildlife species. Fifteen species of vertebrates are endemic to South Florida rocklands, and many of these utilize pine rocklands as habitat. Ten of these are mammals and five are reptiles. There are no endemic birds found in pine rocklands.

Some birds found in pine rocklands include

- pine warbler
- red-bellied woodpecker (picture on right)
- eastern meadowlark
- northern mockingbird
- eastern kingbird
- bobwhite
- eastern bluebird
- loggerhead shrike
- common grackle
- gray kingbird
- northern cardinal



Species of reptiles and amphibians collected in pine rocklands include:

- green anole
- southern leopard frog
- southern toad
- black racer
- southeastern five-lined skink

Some West Indian vertebrates are also found in pine rockland communities, however, it is unknown if these were introduced by humans, these include:

- reef gecko.
- greenhouse frog
- Cuban treefrog
- brown anole (picture on right)
- Bahamian bark anole



- Jamaican fruit bat
- Florida mastiff bat

Other animals that use pine rockland habitats, but are also found in other plant communities as well are:

- fox squirrel (picture on right)
- Florida panther
- Florida black bear

Animals that were formerly bred in pine rockland but are not longer found there are:

- American kestrel
- brown-headed nuthatch
- eastern bluebird
- summer tanager



Invertebrate species found in pinelands include

- ants
- Bartram's hairstreak (picture on right)
- Florida leaf wing
- rockland grass skipper
- Sawgrass skipper
- ogre-faced spider
- silver argiope
- vinegaroons



## Habitat Loss

The South Florida Rocklands were never widespread and are now virtually gone as a result of population growth and land clearing in the Miami area and the Keys. Only two percent of the original habitat is thought to remain, making the pine rocklands one of the most endangered of ecoregions. Besides Long Pine Key in Everglades National Park, conversion of pine rocklands communities on the Miami Rock Ridge has left perhaps 2 percent intact within the other major block of this ecoregion. Hardwood hammocks are under much greater threat of development in the Keys, where they are mostly privately owned. Other reasons for habitat loss include conversion to agriculture through the use of rock plows to break up the limestone for planting, fire suppression, and introduction of exotic species such as Brazilian pepper. The increase in water table from agricultural irrigation, beetle epizootics, and the effects of Hurricane Andrew damaged part of the remaining stands.

## Remaining Blocks of Intact Habitat

The largest blocks of habitat occur in: Long Pine Key in Everglades National Park and Big Pine Key in the Key Deer National Wildlife Refuge

## Degree of Fragmentation

Only small remnants are left and the increased number of small fragments surrounded by other forms of land use, particularly urban areas, restricts fire management. Much of the remaining areas are surrounded by water or cities, making restoration of corridors highly unlikely.

## Degree of Protection

What little remains is represented by the existing reserves listed above. These habitats and the species they support are not secure because of fire suppression, edge effects, and high mortality of fauna from road networks and heavy vehicle traffic.

## Types and Severity of Threat

Most of the privately owned lands containing rocklands have been converted and little remains to be put under conservation management. Continued fire suppression and invasion of exotic species could drastically degrade these remaining blocks over the next two decades. Exotic plants pose a serious threat to the integrity of the rocklands.

## Associated Species of Greatest Conservation Need

### Mammals

- Lower Keys Marsh Rabbit
- Big Cypress Fox Squirrel
- Silver Rice Rat
- Lower Keys Cotton Rat
- Florida Black Bear (picture on right)
- Key Vaca Raccoon
- Key West Raccoon
- Florida Panther
- Key Deer



### Birds

- Northern Bobwhite
- Swallow-tailed Kite
- Bald Eagle
- Southeastern American Kestrel
- Mangrove Cuckoo (picture on right)
- Hairy Woodpecker
- Red-cockaded Woodpecker
- Gray Kingbird
- Loggerhead Shrike
- Black-Whiskered Vireo



- Brown-headed Nuthatch
- Cuban Yellow Warbler
- Eastern Meadowlark

### Reptiles

- Key Mud Turtle
- Florida Box Turtle
- Gopher Tortoise (on right)
- Florida Keys Mole Skink
- Lower Keys Brown Snake
- Lower Keys Ribbon Snake
- Key Ringneck Snake
- Eastern Indigo Snake
- Rim Rock Crowned Snake
- Eastern Diamondback Rattlesnake



### Invertebrates

- Florida (Matecumbe) Tree Snail
- Robinson's Anomala Scarab Beetle
- Atala
- Miami Blue (on right)
- Bartram's Hairstreak
- Florida Leafwing



### Plant Species of Concern

Federally listed plant species that depend upon or utilize pine rocklands in South Florida include:

- Garber's spurge
- deltoid spurge
- tiny polygala
- small's milkpea
- crenulate lead-plant.

More than 90 plant species of concern have been recorded in pine rocklands. Most State listed plants occurring in pine rocklands occur on the Miami Rock Ridge (88 percent). Pine rocklands of the Florida Keys contain 49 percent, while only 17 percent are found in the Big Cypress. Some of the rarest State listed species which occur in pine rocklands include:

- Brickell-bush
- Carter's orchid
- Grisebach's bindweed
- false-leadplant

- pride-of-Big Pine
- narrow-leaved hoary pea
- coral hoary pea
- 

Several State listed pine rockland endemic plants should be considered for possible

Federal listing:

- Blodgett.s wild mercury
- Brickellbush
- Carter.s small flowered flax
- false lead-plant,
- few-flowered crab grass
- Florida lantana (picture on right)
- key.s deltoid spurge
- pineland milk-pea
- sand flax



Endemic pine rockland plants are now thought to be extinct are:

- narrow-leaved hoary-pea
- Mrs. Britton's shadow-witch orchid
- Bahama manjack

## Ecology



Fire is required for the maintenance of the pine rockland community. It influences vertical structure and species composition, controls the invasion and growth of hardwood species, allows light to reach understory and herbaceous plants, and allows for pine regeneration. Although some have reported that fire also controls the ratio of pineland to hammock under natural conditions, others state

that the size and shape of hammocks remain relatively constant over time. Regardless, under conditions of fire suppression, hardwoods will invade pine rockland and eventually shade out pine rockland understory species. For this reason, this plant community has been termed a fire subclimax community, since hardwood development is kept in check by fire.

Pine rockland fires are surface fires that have minimal effects on the pine canopy. The primary source of natural fire in pine rockland systems is lightning. The majority of lightning-caused fires occur between May and September, with larger fires in the early part of the wet season. The shortest fire interval could be 2 to 3 years, the longest interval 10 to 15 years with most researchers in agreement that pine rocklands typically burn twice per decade. The estimated proper fire frequency at 3 to 7 years, although it has been suggested that a fire interval of 3 to 7 years may be too frequent for young pines to attain a large enough size to survive a fire. .

The South Florida slash pine is very resistant to fire. Seedlings of the South Florida slash pine have the ability to resprout from the root collar after a surface burn, while the northern variety is without this adaptation. It also has long needles which shield apical buds, and a thick bark which protects the inner bark and cambium (Byram 1948, Hare 1965). Pine seedlings have better survival rates in areas of low duff accumulation, and seedling establishment can be improved when fires occur soon before seed release, typically in October. If fires occur after seed release then seeds are killed.

Many herbs and shrubs resprout or grow rapidly after fire, and shrubs are seldom killed by a single fire. Fire may also stimulate flowering in these group. Fire response may vary dramatically depending on the time of year of the fire event. In a study of fire effects on 36 pine rockland plant species, 21 showed no alteration in post-fire flowering or fruiting patterns. Species with reduced flowering or fruiting activity included the eight hardwood shrubs. Six species exhibited an increase in flowering and fruiting activity in the 9 months following a fire. Other study shows that hardwood recovery was not affected by season of burning. Instead, recovery was affected by fire intensity. Reports say that fruiting of shrub species is reduced after a fire, and that repeated burning may also exhaust root reserves. Almost all herbs in pine rocklands are perennials which resprout quickly after fires. It was reported that herbs regained their pre-fire biomass 7 months after a dry season burn and 1 year after a wet-season burn. Annuals or biennials which do not resprout following fire include false-foxglove and tiny polygala.

The theoretical succession relationship between pine rockland and tropical hardwood hammocks has been much discussed. It has been reported that in the absence of fire, pine rockland will succeed to tropical hardwood hammock in 20 to 30 years but that succession may be slowed if less hammock is present in the vicinity of the pine Rockland. However, it has been reported that hammock size and shape stays remarkably constant over time. Since fire is a natural function in the South Florida Ecosystem, virtually all hammock expansion into pine rocklands in the absence of fire would have to be attributed to anthropogenic factors.

## **Conservation Threats**

Threats to Pine Rockland habitat that were also identified for multiple other habitats are addressed in the Chapter Multiple Habitat Threats and Conservation Actions. These threats include:

- Chemicals and toxins

- Conversion to commercial and industrial development
- Conversion to housing and urban development
- Incompatible fire
- Invasive animals
- Invasive plants
- Roads

The sources of stress, or threats, were used to generate conservation actions.

Sources of Stress		Habitat Source Rank	Related Stresses (see above)
1	Roads	High	A, B, C
2	Conversion to housing and urban development	High	A, B, C
3	Conversion to commercial and industrial development	High	A, B, C
4	Incompatible fire	Medium	A, B, C
5	Invasive plants	Low	A, B, C
6	Invasive animals	Low	B
7	Chemicals and toxins	Low	B
8	Incompatible residential activities	Low	A, C

Threats specific to Pine Rockland were limited to incompatible residential activities that include movement of fertilizer, herbicide, and invasive species from landscape maintenance, activities of people, their pets, and nuisance species, and disposal of yard and household waste.

The following stresses and sources of stress threaten this habitat:

Stresses		Habitat Stress Rank
A	Altered fire regime	High
B	Altered landscape mosaic or context	High
C	Habitat destruction or conversion	High
D	Fragmentation of habitats, communities, ecosystems	Medium
E	Altered community structure	Medium
F	Altered species composition/dominance	Medium
G	Excessive depredation and/or parasitism	Medium
H	Insufficient size/extent of characteristic communities or ecosystems	Medium
I	Habitat degradation/disturbance	Medium
J	Altered hydrologic regime	Low

Sources of Stress		Habitat Source Rank	Related Stresses (see above)
9	Incompatible agricultural practices	Low	B
<b>Statewide Threat Rank of Habitat</b>		<b>Very High</b>	

## Conservation Actions

Actions to abate the threats to Pine Rockland that were also identified as statewide threats (Roads, Conversion to housing and urban development, Conversion to commercial and industrial development, Incompatible fire, Invasive plants, Invasive animals, Chemicals and toxins) are in the Chapter Multiple Habitat Threats and Conservation Actions. Actions to abate specific threats that were identified for Pine Rockland habitat are below, although none were ranked of high priority for implementation. These actions were designed to reduce the impacts from activities of residents adjacent to this habitat.

### *Incompatible Residential Activities*

Overall Rank	Economic and Other Incentives	Feasibility	Benefits	Cost
M	Expand the scale of the Florida Yards and Neighborhoods program from certifying individual landowners to whole neighborhoods; certification should be renewed biennially and any time property ownership changes.	M	M	L
L	Support incentives for residential property owners to resolve issues of incompatible use, including pesticide use, pet control, feeding of wildlife, household or yard waste disposal, landscape plants, irrigation use, prescribed fire tolerance, and lighting use in coastal areas.	M	L	L
L	Identify and promote effective reward models for homeowners, maintenance companies, and municipalities for reducing impacts on neighboring conservation areas.	M	L	L
L	Develop a voluntary program directed at developers to provide on-site site-specific educational materials and recommendations to homeowner associations about incompatible residential activities.	M	L	L
Overall Rank	Education and Awareness	Feasibility	Benefits	Cost
M	Implement and fund continuing education courses for the landscape maintenance industry that includes appropriate use of chemicals, irrigation, plants, and disposal of yard waste.	H	M	M



## **Pine Rockland Working Group (PRWG)**

The mission of the Pine Rockland Working Group (PRWG) is to maintain and restore the pine rockland natural community, its associated species, and the natural processes, most notably fire, upon which they all depend.

The Pine Rockland Working Group is an informal collection of individuals representing

nongovernmental organizations; local, state, and national government agencies from Florida, the Bahamas, and Turks and Caicos Islands; and private landowners who share an interest in the management and conservation of pine rocklands.

## **Pine Rockland Initiative... Information for Private Landowners**

### *What is a Pine Rockland?*

Pine Rocklands are a globally imperiled ecosystem that exist only in southern Florida and parts of the Bahamas. They are home to many rare plant and animal species, including six Federally Endangered plants and seven candidates for protection under the Endangered Species Act. A typical pine rockland is characterized by limestone outcroppings, a canopy of Florida Slash Pine, and a diverse, herbaceous understory. Pristine pine rocklands have all but disappeared due to development activities, leaving fragments representing only 2% of the original extent of pine rocklands within Miami-Dade County's urban corridor. Existing fragments are threatened by habitat destruction, invasive pest plants, and fire suppression.

### *What is the Pine Rockland Initiative?*

The Pine Rockland Initiative is part of a grant program funded by the U.S. Fish and Wildlife Service and administered by the Institute for Regional Conservation (IRC). The goal of the program is to restore pine rockland fragments. It provides funds for IRC to restore and manage private pine rocklands.

### *What will happen on my land?*

IRC will actively manage your site and perform restoration activities to increase the quality of the habitat. Management activities will include some or all of the following:

- **Baseline Vegetation Monitoring-** An IRC biologist will visit your site and assess the quality of the habitat. This includes a floristic inventory and a survey for rare or endangered plants.
- **Invasive Exotic Plant Removal-** A trained IRC restoration team of 1-6 people will remove exotic pest plants (such as Brazilian pepper, burmared, woman's tongue, and gold coast jasmine). Some plants will be mechanically removed; others will be treated with herbicide. Initial treatments (exotic plant removal and, if applicable, hardwood removal) usually involve 1-2 visits a month for the first 3-6 months.
- **Native Hardwood Removal-** Pine rocklands that do not burn regularly are often invaded or overtaken by native hardwoods (such as poisonwood or live oak). While these plants are native, they will degrade pine rockland habitat if not controlled by fire or manually removed. Only large trees and areas of dense hardwoods will be removed or thinned.
- **Prescribed Fire-** Regular fire is vital to the long-term health of pine rockland habitat and naturally occurs every 3-7 years. To maintain optimal quality, pine rocklands need to burn at least once every 10 years. Our certified burn boss will create a fire prescription to ensure the health and safety of the habitat and surrounding areas. During burns, our burn boss will be on-site to oversee a trained and certified Florida Division of Forestry fire crew.
- **Long-Term Monitoring-** IRC will monitor the site at least once every six months. Vegetation will be inventoried at each of these visits and follow-up treatments for control of invasive exotic plants will be done as needed.

*Why do it?*

Management activities are provided **free of charge** and can help you meet the requirements for an Environmentally Endangered Lands Covenant for tax exemption through Miami-Dade County DERM. Participation also provides increased safety since maintained pine rocklands present a lower fire and hurricane risk than non-maintained pinelands. In addition, your land will be more aesthetically pleasing after restoration. Not only that, but it will be a healthier and more diverse habitat for rare plant and animal species. If you want to go green, there is no better way to do so than to be the steward of a globally imperiled habitat right in your own backyard!

## ***Sample Pine Rockland Restoration Results***



Before Management



During Management

### *What's the catch?*

Restoration is hard work. We would hate to see all that money and hard work go to waste. That is why landowners are required to sign a cooperative agreement with IRC and the U.S. Fish and Wildlife Service. This agreement states that you will not develop on land actively managed by IRC for 10 years. It also states that if you change your mind during that period and refuse IRC's assistance, you will be required to reimburse us for the amount that has been spent on your land. This is our way of ensuring that you are committed to restoring your land and keeping it healthy in the future.

### *How do I sign up?*

Contact IRC at 305-247-6547 for more information or to set up a site visit with one of the restoration biologists. If the pine rockland on your property is of high enough quality that it can be restored and managed, they will provide you with a cooperative agreement to sign and will guide you through the rest of the process.

# Activity: Plant Adaptations in Pine Rocklands

**Duration:** 1 class period

## Objectives:

- Students will learn about: adaptations, plant adaptations, Pine rockland habitat features, ecology, what is “native

## Materials

- art materials for drawing
- painting or a 3-D model of Pine Rockland
- information and resources about Pine rockland habitats, including visual representations;
- index cards listing two ecological challenges present in Pine rockland habitats

## Procedure:

### Activity Description

#### Introduction to Pine rocklands

Characterized by higher elevations; major identifiable plant species including pine trees and saw palmettos; limestone pinnacle rock

#### **Discussion question: Have you heard of Pine rocklands?**

Lead discussion on Pine rockland habitat, including an overview and visual representation of the challenges (e.g. fire, hurricanes, drought, etc; see list below) that organisms living in this habitat might face.

#### Discussion of Adaptations

##### **Discussion question:**

*“What are **ADAPTATIONS**?”*

(Give example of an adaptation: butterfly has long tongue for getting nectar from flower; bird has wings for flying to avoid predators; person has hair for protecting head from sun and keeping warm in winter).

##### **Discussion question:**

*“What adaptations do **ANIMALS** have for surviving a challenge like fire?”*

(Examples: running, flying, going underground)

**Discussion question:**

“What are *adaptations that **PLANTS** might have for surviving fire in the Pine rocklands?*”

(Examples: bark on a pine tree insulates the tree; saw palmetto roots easily and regenerates leaves after fire; dormant seeds need fire to germinate)

**Invent a Pine Rockland Plant Activity**

Students may work individually or as a group on their project. If working in groups, divide students into teams of 2-4.

**Give the following explanation of the assignment:**

1. “Your job is to ***invent a Pine rockland plant*** that is adapted to survive two ecological challenges: Fire and (another one to be assigned)”
2. “With your team, decide what sorts of adaptations your invented plant will have to meet these challenges. (Individuals in groups can be asked to be responsible for creating an adaptation for a particular plant part – root, stem, leaves.) You will then make a drawing (or model) of the plant.”
3. “After you are done, each team will present their plant and tell us how it is adapted to meeting the challenges of living in the Pine rocklands.”

**Give out cards** to each group asking them to invent a Pine rockland plant that is adapted to survive FIRE and one other challenge. Each card has the word FIRE and one of the following on it:

- Wind/Hurricanes
- Rain
- Sun/heat
- Lightning
- Living on a rock
- Drought
- Animals that can eat them
- Pollination
- Seed Dispersal
- Crowding from other plants

**After students have completed their work**, ask each group to come to the front of the room to present their plant and how it is adapted for their particular challenges.

**Concept Building**

Emphasizing the words “Native” and Ecology” may be important not only for enhancing vocabulary but for extending students’ conceptual understanding

**Extension activities**

Discussing issues linked to natives vs. exotics

Writing a short descriptive essay in place of or addition to the art project

# Activity: Investigating Seed Dispersal

**Duration:** 1- 2 hours

## Objectives:

1. Students will be able to describe four ways in which seeds are dispersed (wind, water, explosive fruit opening, external animal transport).
2. After an introductory activity to become familiar with seed dispersal mechanisms, students will use their gained knowledge to set up an experiment to measure two things: the distance a seed travels and the time it takes to land when wind is applied. Students will record data, make observations, and draw conclusions.
3. Understand concepts of: Seeds utilize many methods of dispersal. Physical characteristics of seeds often determine the ways in which they are dispersed, greatly improving their distribution and survival in a given ecosystem(s).

## Materials:

- a variety of seeds with the four different dispersal mechanisms (attempt to collect a variety of seeds that display different dispersal mechanisms, for example: seeds with wings or hairs, and small and large seeds of varying shapes and sizes),
- window or table fan
- tape measure
- watch/stopwatch
- blank paper

## Procedure 1:

### Introductory Activity:

- **Step one:** Using various seeds, have students examine them. They should pay attention to things like size, shape, texture, and weight.
- **Step two:** Once students have examined seeds, they are ready to describe what they see. Using a blank sheet of paper, have students create a table similar to the one below.

**\*Sample table for first activity**

Seed Name	Seed Sketch	Dispersal Mechanism	Physical Characteristics of Seeds
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- **Step Two, continued:** once students have made their table/data sheet. They should fill in information for all seeds they examine. Have students record data

for 5-7 seeds. In the first column: students will name each seed; second column: have students use their art skills to sketch each seed; third column: have students name the dispersal mechanism of each seed. Finally, in the fourth column, students will use their vocabulary/language skills to describe (in words) what they observe about the physical characteristics of each seed. Included below are some examples of native Pine Rockland plants/seed and common south Florida plants/seeds, and their dispersal mechanisms.

### **Examples of Native Pine Rockland Plants/Seeds and their Dispersal Mechanism**

**Common Name:** Brickell Bush

**Latin Name:** *Brickellia mosieri*

**Dispersal Mechanism:** **Wind** (seeds have fluffy, white fibers; they are picked up by wind and dispersed away from the parent plant).

**Common Name:** Tiny Polygala

**Latin Name:** *Polygala smallii*

**Dispersal Mechanism:** **Water??** (seeds have a bubble-like structure, which is thought to make them buoyant in water. As water washes over the seeds they are flushed away from the mother plant, thus being dispersed. Note: water is not a common dispersal mechanism in Pine Rocklands. This does not mean that water never assists in the dispersal of seeds. As we all know, south Florida experiences frequent heavy downpours, capable of moving seeds around a forest, or given area.

**Common Name:** Green Antelopehorn

**Latin Name:** *Asclepias viridis*

**Dispersal Mechanism:** Wind (seeds have white, fluffy hairs).

**Common Name:** Downy Milkpea

**Latin Name:** *Galactia pinetorum*

**Dispersal Mechanism:** Explosion (seed pods eventually dry out, forcing them to twist and spring open sending seeds shooting away from the mother plant).

**Common Name:** Winged Sumac

**Latin Name:** *Rhus copallinum*

**Dispersal Mechanism:** Animals (seeds are contained within a small fleshy, berry-like fruit, making them tasty to animals, like birds. Birds will gather seeds and carry them away. Some seeds may be dropped (dispersed) as birds move away from the parent plant).

### **Examples of Common Plants/Seeds in South Florida and their Dispersal Mechanisms**

**Common Name:** Mahogany Tree

**Dispersal Mechanism:** Wind (seeds have fan-like blades on their seed coats which permit them to float around as wind carries them away from the parent plant).

**Common Name:** Brazilian Pepper (**Note: NON-NATIVE, INVASIVE** plant, yet common in south Florida).

**Dispersal Mechanism:** Animals (animals, especially birds, love the berries from this plant. Animals will gather and eat seeds, spreading them around).

**Common Name:** Orchid Tree

**Dispersal Mechanism:** Explosion (seeds are contained in pods, the pods eventually dry out, spring open and disperse seeds).

**Common Name:** Spanish Needle

**Dispersal Mechanism:** Animals (small projections found at either end of seeds attach easily to animal fur, hair, and clothes).

**Common Name:** Red Mangrove

**Dispersal Mechanism:** Water (Red Mangrove is a coastal plant that typically grows in shallow bay areas. The seeds, referred to as Propagules, fall from the tree into the water. The Propagules float through the water, eventually being deposited and germinating).

## Procedure 2:

### Make Seeds Move, An Experiment!

The purpose of this experiment is to replicate the way seeds are dispersed by wind. To do this, students will use a fan to make seeds move in the classroom. The distance the seed travels, and the time it takes the seed to land will be measured through a series of trials. The trials will be averaged and the data obtained will be displayed in bar graph.

**Setup:** a fan should be placed on the floor. Make sure watch/stopwatch and tape measure are handy. Students will also need a sheet of paper and pencil to record trials. Before starting trials, it should be determined how high and how far away from the fan students will drop each seed. For example, you may decide that students will hold each seed 40 cm above the floor and 40 cm in front of the fan. Whatever measurements you choose, they should remain constant throughout the experiment.

### Procedure:

- Using a variety of seeds, drop one seed at a time in front of the fan, taking two measurements for each seed dropped (one measurement for distance, and one measurement for the time it takes seeds to hit the floor). You may have students work in teams. One student will drop seeds, while the other student records data and vice versa.
- Students will perform, record, and average six trials, (six trials: three trials for the distance each seed travels, and three trials for the time it takes the seed to land).

- Once trials are complete, have students find mean average of all trials.
  - Students should now create bar graphs to display the mean average of their trials. Have students make two bar graphs; one for distance traveled, and one for time.
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## Resources

[http://en.wikipedia.org/wiki/South\\_Florida\\_rocklands](http://en.wikipedia.org/wiki/South_Florida_rocklands)

<http://www.fws.gov/southeast/vbpdfs/commun/pr.pdf>

[http://www2.fiu.edu/~serp1/home/index\\_files/page0005.html](http://www2.fiu.edu/~serp1/home/index_files/page0005.html)

[http://myfwc.com/docs/WildlifeHabitats/Legacy\\_Pine\\_Rockland.pdf](http://myfwc.com/docs/WildlifeHabitats/Legacy_Pine_Rockland.pdf)

[http://crocdoc.ifas.ufl.edu/msrpmap/pine\\_rocklands.php](http://crocdoc.ifas.ufl.edu/msrpmap/pine_rocklands.php)

<http://www.fairchildgarden.org/centerfortropicalplantconservation/connecttoprotect/creat eapinerocklandgarden/>

[http://www.miamidade.gov/derm/pine\\_rocklands.asp](http://www.miamidade.gov/derm/pine_rocklands.asp)

[http://www.miamidade.gov/derm/prescribed\\_fire.asp](http://www.miamidade.gov/derm/prescribed_fire.asp)

[http://www.miamidade.gov/derm/pine\\_rocklands\\_conservation.asp](http://www.miamidade.gov/derm/pine_rocklands_conservation.asp)

[http://www.fnai.org/PDF/NC/Pine\\_Rock.pdf](http://www.fnai.org/PDF/NC/Pine_Rock.pdf)

<http://www.dep.state.fl.us/water/wetlands/delineation/wetcomm/pinerock.htm>

<http://fl.biology.usgs.gov/pineland/index.html>

<http://www.regionalconservation.org/ircs/aboutus/PRI.asp>

[http://www.tncfire.org/documents/FLCR-FLpine\\_v01Nov09\\_000.pdf](http://www.tncfire.org/documents/FLCR-FLpine_v01Nov09_000.pdf)

<http://www.pineridgeorchids.com/sanctuary.htm>

<http://www.nps.gov/ever/forkids/pine-rocklands.htm>

<http://www.fairchildgarden.org/uploads/docs/Education/teacher%20training/pine%20rocklands/Seed%20Dispersal.pdf>

<http://www2.fiu.edu/~serp1/projects/windthrow/windthrow.html>

[http://www.worldwildlife.org/wildworld/profiles/terrestrial/nt/nt0164\\_full.html](http://www.worldwildlife.org/wildworld/profiles/terrestrial/nt/nt0164_full.html)