

**INTEGRATED ECOLOGICAL AND SOCIAL VISION, TARGETS, GOALS,
AND OBJECTIVES FOR THE ECOLOGICAL RESTORATION OF PINE ROCKLANDS
IN MIAMI-DADE AND MONROE COUNTIES, FLORIDA**

Prepared for the Pine Rockland Business Plan
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The Society for Ecological Restoration recommends developing a project Vision, Targets, Goals, and Objectives, and the use of monitoring indicators that are specific, quantifiable measures of attributes, to directly connect longer-term goals and shorter-term objectives for ecological restoration projects or programs (Gann et al. 2019). In 2020, as part of the development of the Pine Rockland Business Plan (PRBP) led by the US Fish and Wildlife Service and The Nature Conservancy, the Ecological Restoration sub-team first drafted a vision, targets, goals, and objectives for pine rocklands in Miami-Dade and Monroe counties, Florida. This document represents an update based on discussion and field trials between 2020 and 2023, and a formal launch of this planning document. The baseline date for goals and objectives is January 2021. The restoration guidance in this document expands on those published in Maguire (1995), Possley et al. (2014), and Possley et al. (2018), and will be updated on a periodic basis.

GEOGRAPHIC SCOPE

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

CURRENT CONDITION

Inadequate protection, fragmentation, drainage, fire suppression, invasive species, local and global extinctions, illegal dumping, lack of funding for management, sea level rise, climate change, and other drivers of degradation have resulted in a decline in the total area, integrity, and diversity of globally imperiled pine rocklands in South Florida. Large high-quality pinelands 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 patches occur outside of these areas, under both public and private ownership. Some remnant patches are managed and are 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 regulators due to restrictive classification systems (e.g., previously cleared pine rocklands that have been mowed and are habitat for pine rockland groundcover layer plants and animals).

VISION

A broad coalition of stakeholders recover healthy pine rocklands wherever they still exist and in areas where they have previously been converted to other uses, including at sites with recognized or previously unrecognized 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 significant 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. This vision operates consistent with the Society for Ecological Restoration's International Principles and Standards for the Practice of Ecological Restoration and is carried out in partnership with the United Nations Decade on Ecosystem Restoration (2021-2030) and aligned global initiatives. The restoration of pine rocklands becomes a flagship restoration program worldwide and is promoted as an example of best practice restoration assessment, planning, implementation, ongoing management, and monitoring underpinned by sound science and broad community support.

ECOLOGICAL TARGETS

Restored pine rocklands have an open canopy of South Florida slash pine (*Pinus elliottii* var. *densa*), with fewer than 70 mature trees per acre and less than 50% cover, a diverse understory layer (1-2 m), and an extremely diverse groundcover layer (<1 m). The understory and groundcover layers comprise a mix of endemic, temperate, and tropical species, the composition of which changes from north to south. Native hardwoods, vines, and palms are important components of pine rocklands, but comprise less than 50% total cover in the understory and groundcover layers. Epiphytes are rarely present but may be encountered, especially on the trunks of old cabbage palms (*Sabal palmetto*). The groundcover layer (including bare ground) includes a mix of herbaceous graminoids (grasses, sedges, and similar plants), forbs (non-graminoid herbs, e.g., wildflowers), ferns and allies, creeping vines, and low woody groundcovers that have a combined cover of at least 30%; bare ground has a cover of at least 5%, and the combined total of native groundcover plants and bare ground is at least 50%. The pine rockland vegetation is expressed as a mosaic, and islands of species or groups of species are frequent. A wide diversity of native plants is present, and invasive or weedy plants and animals are minimized as practicable. Pine rocklands are habitat for an abundance of native wildlife, including pollinators, migratory birds, and small mammals; invasive animals are controlled. Rare, threatened, and listed species are documented, protected, and augmented or reintroduced when and where appropriate. Bare substrate of limestone, sand, and marl (Redland soil) is present within and between vegetation mosaics in heterogenous patterns, providing critical habitat for many plant and animal species. Pine needle and other organic litter and soil organic carbon are present within target ranges of variability. Ecosystem processes and functions, including periodic fire, pollination and dispersal, predation and herbivory, and recruitment, are present and operating. Pine rockland patches are enlarged and connected whenever possible, and substrates, hydrology, and ecosystem processes like periodic fire are restored to the extent practicable; changes in regional hydrology and irreversible soil modifications are considered when assessing, designing, implementing, managing, and monitoring pine rockland restoration projects. Pine rockland ecotones are connected to other key ecosystems that share species and habitat, including rockland hammocks and freshwater wetlands.

SOCIAL TARGETS

South Florida residents and visitors benefit from restored, well-managed pine rocklands, with ample opportunities to experience pine rocklands through accessible nature trails, informal paths, and vistas, engage in citizen science and the arts, and participate as volunteers in restoration and management activities. Information about pine rocklands, their conservation, restoration, and management, and their contributions to preventing local and global extinctions of plants and animals, mitigating climate change, and providing essential ecosystem services are integrated into robust educational programs for students of all ages. Pine rocklands are considered green infrastructure that provide essential ecosystem services including improved air and water quality, reduction of urban heat effect, reduction in noise pollution, beneficial wildlife and native plant habitat, and improved aesthetics. Pine rocklands provide much needed green spaces that provide numerous contributions to mental health and human wellbeing in the largely urban landscape of South Florida. They are embraced and cared for by a wide constituency of stakeholders. This process is underpinned by the organization of a broad coalition of stakeholders representing national and local government, nonprofits and other community groups, schools, foundation and corporate funders, private owners of conservation lands, and the public. Private and public managers of pine rocklands are provided the technical and financial support essential to their restoration and ongoing management.

GOALS (ecological and social)¹

1. The collective area of protected and managed pine rocklands in Miami-Dade County is increased by 50% in 20 years; the collective area of protected and managed pine rocklands in Monroe County is stabilized for 20 years, countering threats from sea level rise;
2. The connectivity of pine rocklands sites to each other and to critical ecotonal habitats (e.g., rocklands hammocks, freshwater wetlands) is significantly increased in 20 years;
3. Substrate and hydrological conditions, including topographical variation on former cleared sites, are restored where possible within 20 years;
4. Appropriate periodic fire, approximating a fire regime of 2-7 years, is planned and initiated within 10 years;
5. Wildfires are responded to in an appropriate way (e.g., minimizing damage to substrate, rare species, wildlife) and used to restoration advantage when safe and practical within 3 years;
6. Alternative techniques are applied as fire surrogates or to facilitate the use of prescribed fire within 10 years, but only if a combination of prescribed fire and wildfire cannot meet fire regime goals;
7. Slash pines are thinned or planted where needed to achieve appropriate canopy structure, with 30-70 mature trees per acre (>4" dbh in Miami-Dade, >3" dbh in Monroe) and <50% cover,

¹ Because these goals are written for a wide range of sites, ownership types, and conservation realities, they will not all be accomplished within the general time frames outlined here. Work on some sites will proceed rapidly, while others may take time or will never be accomplished due to unique circumstances. What is important is to maximize effort toward these goals, and the interim objectives below.

within 10 years; dead pine snags are left standing as wildlife habitat except where they pose a threat to safety;

8. Palms (*Sabal palmetto*, *Serenoa repens*, *Thrinax morissii*) are thinned or added (including *Coccothrinax argentata*) where needed to achieve appropriate structure, ranging from 10-25% cover in the groundcover layer and 1-25% in the understory layer within 10 years. On the mainland, native palms may rarely occur above 2 m with a total cover of less than 1%; in the Florida Keys, native palms may occur at higher cover than 1%;
9. Native hardwoods and vines are thinned or added where needed to achieve appropriate structure, ranging from 5 to 25% cover in the groundcover layer and 1-25% in the understory layer within 10 years; in Miami-Dade County, oaks (*Quercus pumila*, *Q. virginiana*) and coastalplain staggerbush (*Lyonia fruticosa*) may occur as scattered individuals or small groves with < 1% total cover above 2 m;
10. Pine rockland groundcover species in the groundcover layer are restored to comprise 30-75% cover, and areas of bare ground comprise 5-20% cover within 20 years; the combined total of native groundcover plants, bare ground, and open ground with litter is at least 50%; accumulated pine needles and other organic litter never exceeds 3 cm in thickness; native groundcover plants may extend into the understory layer when flowering or fruiting.
11. Previously cleared pine rocklands that have been maintained through regular mowing and other prior converted areas with potential for restoration are restored to a 4-star condition within 20 years;
12. Depleted or extirpated populations of native plants and animals are restored within 20 years, considering unsurmountable changes including changes to hydrology (including sea level rise), climate change, and fragmentation effect on wildlife populations;
13. Native species richness reaches an average of 90% of the reference model for each site within 20 years, including rare, threatened, and listed species (e.g., IUCN Red List, US Fish and Wildlife Service, State of Florida, The Institute for Regional Conservation);
14. Average cover of native invasive, ruderal, and nonnative plant species is reduced to <2% within 10 years following initiation of restoration;
15. Populations of invasive nonnative and nuisance animals are controlled to the extent practicable or extirpated within 20 years;
16. Pine rocklands are protected from point and non-point source pollution, including insect spraying, to the extent practicable within 5 years;
17. Restoration implementation is monitored throughout the 20-year period;
18. Grade-school, adult, and targeted public education and outreach about pine rocklands is doubled within 10 years;
19. The publication of peer-reviewed papers covering a component of pine rockland ecology, conservation, restoration, or ongoing management is doubled in the period 2021-2030 versus the period 2011-2020;

20. A community-based pine rockland restoration corps of practitioners, including volunteers, nonprofits, schools, and Certified Ecological Restoration Practitioners is formalized within 10 years, and formalized training and guidance is in place to support the restoration corps.
21. Community access to pine rocklands through accessible trails, informal paths, and vistas is doubled in 20 years.
22. Long-term funding adequate to support these goals and objectives is secured, and an organized yet decentralized network curates and facilitates the sharing of guidance and data, including GIS data layers, site assessments, restoration monitoring reports, and technical guidance.

OBJECTIVES (ecological and social) as measured by specific indicators

1. The collective area of pine rocklands is increased by 20% in 10 years;
2. The connectivity of pine rocklands to each other and to critical ecotonal habitats (e.g., rockland hammocks, freshwater wetlands) is initiated in 10 years;
3. Restoration of substrate and hydrological conditions, including topographical variation on former cleared sites, is initiated where possible within 10 years;
4. The assessment of individual or connected sites regarding potential use of prescribed fire as a management tool is completed within 5 years;
5. Wildfire response plans are in place for all sites within 5 years;
6. Fire surrogate techniques and plans are developed as needed for each fragment within 10 years;
7. Half of the overly dense stands of slash pine are thinned within 10 years;
8. Half of the overly dense stands of palms are thinned within 10 years, and introductions of palms to sites with no or few palms are initiated within 10 years;
9. Half of the overly dense stands of native hardwoods are thinned within 10 years, and introductions of hardwood shrubs to sites with no or few hardwood shrubs are initiated within 10 years;
10. Half of the potential areas of native pine rockland groundcover are restored to 30-75% cover of pine rockland groundcover species, and half of potential area of bare ground comprises 5-20% cover within 10 years.
11. Half of the previously cleared pine rocklands that have been maintained through regular mowing are restored to a 4-star condition within 20 years; guidance for the restoration or rehabilitation of prior converted pinelands with restoration potential (e.g., canal banks, power line easements) is developed and made available to land managers within 5 years;
12. Half of the depleted or extirpated populations of plants and animals are restored as practicable within 10 years;
13. Species richness of native plants reaches an average of 70% of the reference model for each site within 5 years of initiation of restoration at that site, and of animals within 10 years, including

rare, threatened, and listed species (e.g., IUCN Red List, US Fish and Wildlife Service, State of Florida, The Institute for Regional Conservation);

14. Average cover of native invasive, ruderal, and nonnative plant species is reduced to <5% within 5 years following initiation of restoration;
15. Populations of nonnative, invasive, and nuisance animals are reduced by 50% within 10 years, where practicable;
16. Plans are developed to protect pine rocklands from point and non-point source pollution, including insect spraying, within 5 years;
17. Initiate long-term monitoring of ecological components of the Pine Rockland Business Plan restoration implementation by year 5;
18. Increase grade-school, adult, and targeted public education and outreach about pine rocklands by 50% within 5 years, and formalized training and guidance is in place to support the restoration corps has been initiated;
19. Increase the publication of peer-reviewed papers covering a component of pine rockland ecology, restoration, or conservation by 50% in the period 2021-2030 versus the period 2011-2020;
20. Initiate the development of a community-based pine rockland restoration corps of practitioners, including volunteers, nonprofits, schools, and Certified Ecological Restoration Practitioners within 5 years;
21. Community access to pine rocklands through accessible trails, informal paths, and vistas is doubled in 20 years;
22. Long-term funding adequate to support these goals and objectives has significantly increased, and an organized yet decentralized network that curates and facilitates the sharing of guidance and data is in formation.

CITATIONS

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The Pine Rockland Business Plan is a natural resources business plan was developed in 2021 by stakeholders and partners from the pine rockland community, including; The U.S. Fish and Wildlife Service, The Nature Conservancy, Institute For Regional Conservation, Fairchild Tropical Botanic Garden, Miami-Dade County, the Pine Rockland Working Group, and other stakeholder groups, decision makers, practitioners, private landowners, and individuals. The Pine Rockland Business plan sets out to quantify and prioritize the conservation actions that are needed for pine rockland conservation in Miami-Dade and Monroe Counties in Florida. These actions need to be taken to substantially improve pine rockland extent and condition throughout its range, and to benefit plant and animals that depend on pine rocklands. These actions are essential to help with the recovery of federal listed species, and to bridge the gap between single species recovery planning and ecosystem restoration and management.