Preliminary Ecological Restoration and Management Plan for Native Coastal Uplands at Red Reef Park, Boca Raton, Florida

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Executive Summary

This report is part two in a series intended to identify valuable native coastal ecosystems at Red Reef Park and to develop recommendations for their conservation and restoration. It follows *Rapid Assessment of Native Coastal Uplands at Red Reef Park, Boca Raton, Florida* (Gann, March 2021), which identified Red Reef Park as an asset of the City of Boca Raton of regional and state-wide ecological importance. The Park contains important recreational space, including a golf course, access to the beach along the Atlantic coast, boardwalks, and nature trails, as well as the Gumbo Limbo Nature Center, where important work on sea turtles and other marine life is conducted. It also contains important remnant patches of native coastal ecosystems containing many rare and threatened species of native plants and animals. While many natural features and species remain, there have also been significant losses, including the almost complete loss of the shrubby coastal strand community due primarily to a prior lack of recognition of its ecological value. Restoration and management challenges are many including the persistent and growing problem of nonnative species, which have increased in diversity and cover since preliminary surveys were conducted in the mid-1970s. Nevertheless, Red Reef Park retains significant natural values, including intact beach dune communities along almost the entire length of the park, and the preservation of portions of the historic Boca Raton Hammock in association with the Gumbo Limbo Nature Center. The assessment documented in the first report is followed here by the development of restoration and management recommendations for Red Reef Park, including how to incorporate participation by volunteers and other community members.

Opportunities for ecological restoration abound, including the removal of invasive plants, and the planting of appropriate native plants in conformance with best practices for ecological restoration. Rare plant species, in particular, can be augmented or reintroduced, thus bolstering the biological diversity of this important site. These opportunities also extend to community engagement, including opportunities for volunteers to participate in restoration activities, and environmental education building on the experience and resources at Gumbo Limbo Nature Center. Challenges must also be noted, including climate change and sea level rise, extreme weather, the expanding diversity and density of nonnative invasive species inside and near the park, native plants species becoming invasive, staff training, and the need for key basic information (e.g., native animals).

Consistent with the International Principles and Standards for the Practice of Ecological Restoration, this report includes key sections on restoration planning and design and well as best practices for planning and implementation, monitoring, and aftercare and long-term maintenance.

Introduction

This report is part two in a series intended to identify valuable ecological upland resources at Red Reef Park and develop recommendations for their restoration and long-term management. It follows *Rapid Assessment of Native Coastal Uplands at Red Reef Park, Boca Raton, Florida* (Gann, March 2021), which identified Red Reef Park as an asset of the City of Boca Raton of regional and state-wide ecological importance. This report provides recommendations for the restoration and long-term management of beach dune, coastal strand, and tropical hammock forest (tropical hammock), as well as adjoining parts of the park that affect those native ecosystems. The recommendations were jointly developed by the Boca Raton Recreation Services Department, the City's Office of Sustainability, and the Institute for Regional Conservation (IRC), as the second and third components of a three-part agreement (PO 070701). Primary goals for the City include the establishment of a program that appropriately utilizes staff, professional contractors, and community volunteers (e.g., nonprofit groups, schools, individuals) in the restoration of native ecosystems and their biodiversity, together with the identification of practices that inhibit the establishment or re-establishment of invasive species following restoration activities, and reduce the use of and need for synthetic chemicals or expensive mechanical removal.

These recommendations are consistent with the Society for Ecological Restoration's International Principles and Standards for the Practice of Ecological Restoration (Fig. 1; Gann et al. 2019; hereafter SER Standards), and invasive plant best management practices in Florida (e.g., Enloe et al. 2018). The SER Standards recommend the identification of target native reference ecosystems and the development of reference models based on multiple indicators of six key ecosystem attributes (Table 1) at a suitable number of reference sites, which are discussed below. Consistent with the SER Standards, this report is organized into the following key sections: Planning and Design, Best Practices (including Implementation), Monitoring and Adaptive Management, and Post-Implementation Maintenance.

This project is being conducted in partnership with IRC's Restoring the Gold Coast program, which aims to restore the biological diversity of coastal uplands in southern Palm Beach County through the augmentation and reintroduction of rare native plants, removal of invasive vegetation, and other ecological restoration activities. Plant names and data reported here are consistent with the Floristic Inventory of South Florida (FISF) database online (Gann et al. 2021), which has been maintained by IRC continuously since 2001. Plant data for Red Reef Park already available on the FISF were updated with information collected during this project. In parallel with the preparation of the *Rapid Assessment*, IRC conducted a series of workdays at Red Reef Park as part of its Restoring the Gold Coast program in mid-2020 through early 2021. Workdays focused on trialing techniques for ecological restoration of beach dune and coastal strand ecosystems, and included collaborations with Fairchild Tropical Botanic Garden (FTBG) to reintroduce the federally endangered beach clustervine (*Jacquemontia reclinata*). These workdays, together with the *Rapid Assessment*, consultations with City staff, and the production of other IRC resource materials through Restoring the Gold Coast (e.g., Seagrapes and Biodiversity online workshop), have allowed for the preparation of management recommendations based on significant experience at the site.

Figure 1. Eight principles for ecological restoration (from Gann et al. 2019).

Table 1. Description of the key ecosystem attributes used to characterize the reference ecosystem, as well as to evaluate baseline condition, set project goals, and monitor degree of recovery at a restoration site. These attributes are suited to monitoring in Principle 5 and the Five-star System discussed in Principle 6. Reprinted from Gann et al. 2019.

Attribute	Description
Absence of threats	Direct threats to the ecosystem such as overutilization, contamination, or invasive species are absent.
Physical conditions	Environmental conditions (including the physical and chemical conditions of soil and water, and topography) required to sustain the target ecosystem are present.
Species composition	Native species characteristic of the appropriate reference ecosystem are present, whereas undesirable species are absent.
Structural diversity	Appropriate diversity of key structural components, including demographic stages, trophic levels, vegetation strata, and spatial habitat diversity are present.
Ecosystem function	Appropriate levels of growth and productivity, nutrient cycling, decomposition, species interactions, and rates of disturbance.
External exchanges	The ecosystem is appropriately integrated into its larger landscape or aquatic context through abiotic and biotic flows and exchanges.

PLANNING AND DESIGN

Stakeholder Engagement

Beginning with a kick-off meeting with City staff in November 2019, consultations have included Michael Kalvort (Recreation Services Director), Greg Stevens (Recreation Services Superintendent), Drew Leganik (Park Maintenance Administrator), Singletary Kinlaw (Park Maintenance Supervisor), Leanne Welch (Gumbo Limbo Nature Center Manager), and Lindsey Nieratka (Sustainability Manager). The City has an extensive formal and informal stakeholder consultation process, which has been incorporated into this report. Important stakeholder concerns include the conservation and protection of sea turtles and sea turtle nesting (including mitigation of light pollution), the restoration and conservation of native biodiversity (e.g., rare plants, butterflies), the protection of tree resources, and reducing or eliminating the use of synthetic herbicides and pesticides. There are also aesthetic considerations that are important to City residents and decision-makers, a mandate to maintain the multi-use nature of Red Reef Park, and requests for meaningful volunteer opportunities. The Gumbo Limbo Environmental Complex, which is operated by the city of Boca Raton, in conjunction with the Friends of Gumbo Limbo and the Greater Boca Raton Beach and Park District, is important as a source of marine science and environmental education and is located within and preserves the historic Boca Raton Hammock. The complex also houses the Florida Atlantic University Marine Science Lab and a marine turtle rehabilitation center.

Context Assessment

Red Reef Park, including Gumbo Limbo Nature Center, is located within urbanized southeastern Palm Beach County, immediately adjacent to South Beach Park to the south and within 0.7 miles of Spanish River Park to the north, both of which contain important native ecosystems and biodiversity. It comprises about 40 acres on the barrier island, from the Atlantic Ocean to the intracoastal (Fig. 2, City website). It is a multi-use park with beach access, boardwalks and nature trails, golf courses on both side of A1A, and a major environmental center. Beneficial connectivity between native ecosystems at Red Reef Park and nearby native ecosystems is high but could be improved through programs such as IRC's Restoring the Gold Coast program. Beneficial connectivity among the three upland ecosystems and coastal mangroves at Red Reef Park is relatively high, but is compromised by A1A, which divides the park into east and west sections, and the parking lot in the eastern side of the park. Connectivity in the eastern section could be improved through the restoration of coastal strand, which is currently found in only small, degraded patches (see also Baseline Inventory and Assessment below).

Site Security and Long-term Management

Public ownership of the park is secure, but there is currently no long-term management plan or funding in place for the restoration and management of native ecosystems.

Baseline Inventory and Assessment

Information included in the *Rapid Assessment*, IRC's Floristic Inventory of South Florida, and other resources, including historical aerial photography (Fig. 2) (1979 USDA), and iNaturalist have been utilized to document historical and baseline conditions at Red Reef Park.

The historical native coastal upland ecosystems at Red Reef are beach dune, coastal strand, and tropical hammock forest (tropical hammock), which were described by Austin et al. (1977) for the northern part of the park, north of Coquina Way on the intracoastal side of A1A and north of the golf course on the oceanside. An area of mangroves is also found at the Gumbo Limbo Nature Center, which replaced important freshwater wetlands that were lost by the mid-1970s due to salination of Lake Wyman and associated water bodies. In 1979, a comprehensive plan for Red Reef Park was published (Comprehensive Plan) (Reynolds, Smith, and Hills Architects, Engineers, Planners, Incorporated, and Rett Roy Landscape Architect, Planner, Inc.), which described then-current conditions throughout the park.

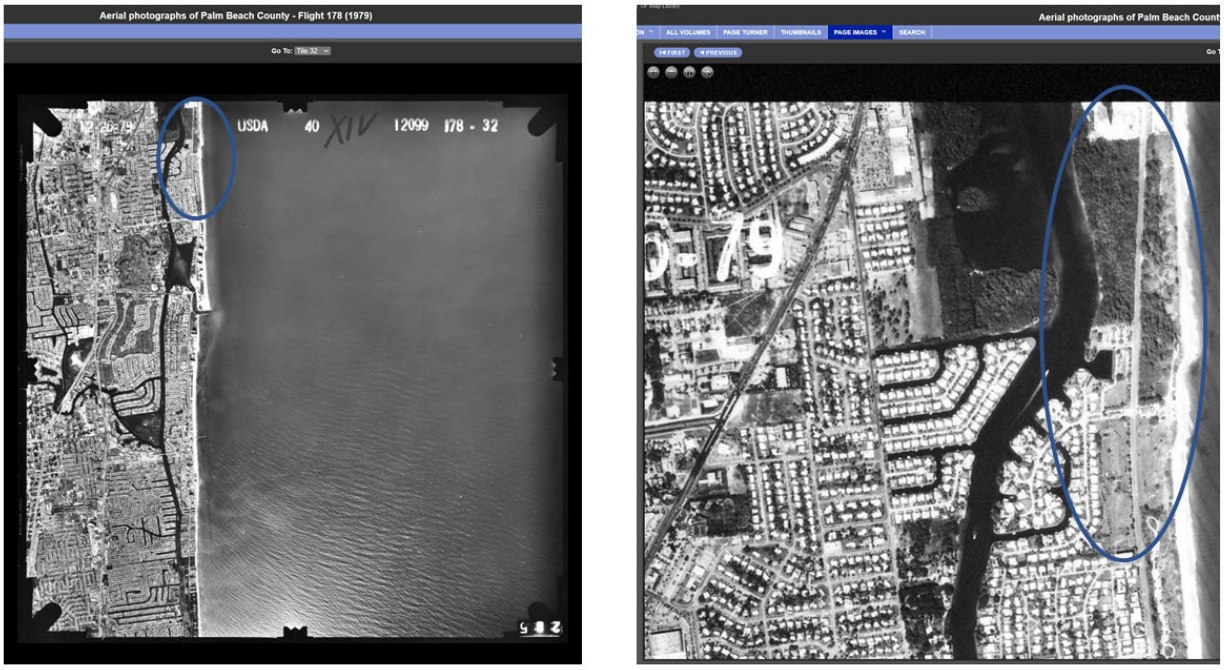

Figure 2. 1980 aerial photography. Red Reef Park is indicated within the blue ellipse.

Significant multi-use site development has subsequently occurred at the park, including the removal of invasive Brazilian-pepper (*Schinus terebinthifolius*) trees, the installation of native trees, shrubs, and groundcovers east of the parking lot in the northeastern section of the park as outlined in the 1994 Dune Restoration Plan, and the improvement in pedestrian circulation resulting in reduced erosion. As a result of development before and after the establishment of the park, the historic upland ecosystems of Red Reef Park have been heavily modified. Nevertheless, high quality beach dunes and tropical hammock exist, along with small but critically important remnants of coastal strand. These ecosystems contain many rare native plant species and provide significant habitat for native wildlife including butterflies and other

invertebrate pollinators, and birds. While there have also been significant losses (e.g., almost all the shrubby coastal strand community), potential is high for the restoration and long-term management of an appropriate mosaic of native upland ecosystems at Red Reef Park. This restoration should be encouraged where appropriate and to the extent possible given the multiple-use nature of the park.

Abiotic Conditions

Red Reef Park is located on a barrier island, historically separated from the mainland by Lake Wyman, which was a freshwater body until the 20th Century. Canalization led to the salinization of Lake Wyman, and the modification and loss of freshwater on the island. Climate conditions have also changed from an historic benchmark, with fewer hard freezes and more extreme tropical weather events. Sea level rise threatens both the Atlantic and Intracoastal side of the park.

The intensity, frequency, and duration of North Atlantic hurricanes, as well as the frequency of Category 4 and 5 hurricanes, have increased since the early 1980s (Third National Climate Assessment 2014). Hurricane-associated storm intensity and rainfall rates are projected to increase as the climate continues to warm, and, according to the National Oceanic and Atmospheric Administration (2021), 2020 was a record-breaking season with 14 hurricanes and 7 major hurricanes, with 11 named storms hitting the U.S. coastline.

With climate change, summer temperatures in Florida have increased by about 1°F since 1950, averaging 81.4°F (27.4°C) from 1991 to 2010. In the next 20 years, average summer temperatures are expected to rise above 83°F (28.3°C) under moderate and high emissions scenarios. Meanwhile, winter temperatures in Florida have increased by about 2°F, averaging 57.4°F (14.1°C) between 1950 and 1970 and averaging 59.5°F (15.3°C) between 1991 and 2010. In the next 20 years, average winter temperatures are expected to rise above 60°F (15.6°C) under moderate and high emissions scenarios (Raimi et al. 2020). Furthermore, Florida is projected to experience some of the highest frequencies of extreme heat in the U.S. by mid-century with 105 days with a heat index over 100°F (in an average year and averaged across the state) in comparison to just 25 days historically (Dahl et al. 2019). This included 63 days with a heat index over 105°F.

Beach Dune

Location. The pioneer zone, or beach dune ecosystem, runs along the eastern edge of the park east of the primary dune, transected by walking paths for the public and access points to lifeguard stands.

Structure and Composition. The beach dune ecosystem is primarily an herbaceous community with a few scattered shrubs, especially along the ecotone with coastal strand (Fig. 3). The vegetation is dominated by native grasses such as sea-oats (*Uniola paniculata*) and beachgrass (*Panicum amarum*), and is habitat for a variety of other native species. Compared to the 1970s historical reference, similarity of structure and composition is high, but invasive nonnative plant diversity and cover have expanded. Austin et al. (1977) reported 19 species for the beach dune,

of which 15 native species were listed in the Comprehensive Plan. Of these natives, all but two (vente conmigo [*Croton glandulosus*] and baycedar [*Suriana maritima*]), have been recently documented as extant in the wild at Red Reef Park. Austin et al. reported sea-oats as being dominant, together with beachstar (*Remirea maritima*) in areas of recent fire or erosion. Beach bean (*Canavalia rosea*) and railroad vine (*Ipomoea pes-caprae* subsp. *brasiliensis*) were typical of the easternmost vegetation band, and the following species were common: yellow joyweed (*Alternanthera flavescens*), coastal sandbur (*Cenchrus incertus*), seaside spurge (*Euphorbia mesembryanthemifolia*), east coast dune sunflower (*Helianthus deblis* subsp. *debilis*), beach-elder (*Iva imbricata*), seashore paspalum (*Paspalum vaginatum*), inkberry (*Scaevola plumieri*), and perennial sea-purslane (*Sesuvium portulacastrum*). The Comprehensive Plan reported the state endangered beach peanut (*Okenia hypogaea*) and Johnson et al. (1993) recorded the regionally rare beach-tea (*Croton punctatus*) and mangrove spiderlily (*Hymenocallis latifolia*), all of which are present on the site. During the *Rapid Assessment* IRC recorded two previously undocumented species indicative of a healthy beach dune ecosystem in southeastern Florida: coastal searocket (*Cakile lanceolata*) and sand-dune spurge (*Euphorbia bombensis*). See Appendix A for a list of native species of the beach dune ecosystem in southeastern Palm Beach

Figure 3. Beach dune ecosystem at Red Reef Park looking to the south from about the midpoint. Note dominance of sea-oats (*Uniola paniculata*) and native inkberry (*Scaevola plumerii*) in the foreground. The invasive beach naupaka (*Scaavola taccada*) can be seen at the base of the seagrapes (*Coccoloba uvifera*).

County and their status at Red Reef Park. Invasive species include the problematic beach naupaka (*Scaevola taccada*) and the more ephemeral crow's-foot grass (*Dactyloctenium aegyptium*).

In the northern part of the park Austin et al. described the beach-bean/railroad vine zone as being "unusually narrow and crowded up the dune slope," the sea-oat zone, as "contracted and shifted up the dune slope," and the prickly zone as absent, while the Comprehensive Plan described the beach dune area in zone 11 as "relatively undisturbed, existing vegetation in [the] primary dune zone" with typical beach dune and coastal strand species listed. The general assemblage of species is still intact more than four decades later, but the beach dune vegetation has been pushed to the east by seagrape, beach naupaka, and other shrubby vegetation. While is it unclear the extent to which the coastal strand historically extended to the east of the primary dune crest, Austin et al. described saw palmetto (*Serenoa repens*) with bases "hanging free over the east side of the dune crest" as a result of active erosion. The Comprehensive Plan described some seagrape, necklacepod (*Sophora tomentosa* var. *truncata*), and Spanish bayonet (*Yucca aloifolia*) intermixed with typical beach dune species in the area to the east of the dune crest; necklacepod and Spanish bayonet are described as coastal strand species elsewhere in the report. Historical photos from nearby South Beach Park in 2004 show remnant saw palmetto on the east side of the dune near the dune crest (Fig. 4), with limited seagrape and most of the area occupied by beach dune. Regardless, the location of the current beach dune system is much different, with almost the entire grassy dune system to the east of the eastern base of the primary dune, and the eastern face of the primary dune itself is almost everywhere dominated by seagrape intermixed with beach naupaka. The eastern extent of the beach dune vegetation is limited by beach raking and official ORV traffic.

The 1994 Dune Restoration Plan specified planting on 30,000 sq. ft. of habitat east of the dune crest, and species selected included both beach dune and coastal strand species, including dozens of seagrape along the beach. Beach dune species planted during that period include beachgrass, marshhay cordgrass (*Spartina patens*), seashore dropseed (*Sporobolus virginicus*), and the state endangered sea-lavender (*Tournefortia gnaphalodes*). All of these are regionally native and were appropriate additions to the species pool, and are still present except for sea-lavender, which was not observed in the beach dune ecosystem during the *Rapid Assessment* surveys. Both sea-lavender and baycedar have been observed just to the south at South Beach Park, possibly remnant from prior plantings.

During 2020 and 2021 IRC held a series of ecological restoration workdays to initiate and trial ecological restoration techniques at Red Reef Park (see also the coastal strand section below). These workdays focused primarily on invasive species removal, especially the invasive beach naupaka, and the planting of native species in the beach dune and coastal strand ecosystems east of the primary dune crest. These workdays, part of IRC's Restoring the Gold Coast program, including the planting of regionally rare species in the beach dune ecosystem, including attempted reintroductions of species previously recorded at Red Reef, and introductions of other regionally rare species. Species planted include beach ragweed

Figure 4. Historical interface of beach dune and coastal strand at South Beach Park. Blue flags indicate the federally endangered beach clustervine. Image courtesy of Fairchild Tropical Botanic Garden.

(*Ambrosia hispida*), beach morningglory (*Ipomoea imperati*), baycedar, and sea-lavender (see also Appendix A)

Physical conditions. Records indicate that no beach renourishment has occurred at Red Reef Park itself, but a combination of beach renourishment to the north and beach conservation practices, including controlling foot traffic and active planting of native plants, may have stabilized and generally benefited the beach dune ecosystem, especially in the southern part of the park. Austin et al. (1977) described the beach in the northern part of the park as actively eroding, and with the open beach "well formed." An illustration in their 1977 paper shows the beach penetrating into the interior of the park north of the oceanside golf course, and factors thought to have contributed to that erosion included fire east of the primary dune crest and attempts to establish a road on the dune crest. The 1979 Comprehensive Plan mapped both the disturbed area and areas of high-quality coastal uplands in both the northern and southern parts of the park (Fig. 5). It also described several "blowouts" leading to the beach in the northeastern part of the park, a result of "uncontrolled pedestrian circulation." These erosion threats have largely been resolved through the control of pedestrian traffic. Beach nourishment

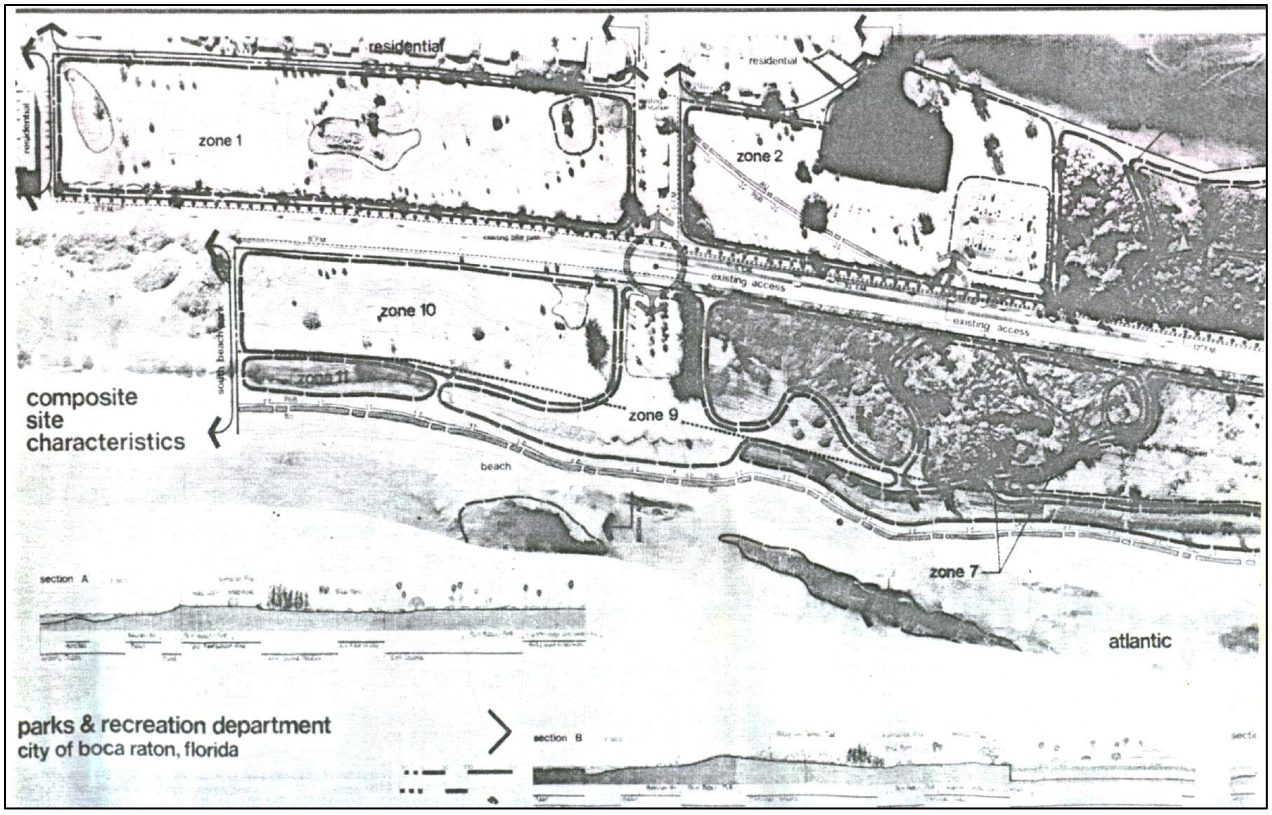

Figure 5. 1979 Comprehensive Plan showing area of highest disturbance (zone 9) and "relatively undisturbed, existing" beach dune vegetation to the north and south.

to the north, beach raking, and official ORV traffic on the beach all impact movement and quality of sand, but the effects at Red Reef Park are unknown.

Ecosystem Functions. Most ecosystem functions are operating normally. Both the open sand and eastern edge of the grassy beach dune are utilized by sea turtles for nesting, which results in the turnover of sand and the creation of temporary openings and topographic variability. Beach raking presumably results in the loss of nutrient inflows to the beach dune ecosystem that would normally be transferred by seaweed and other marine organic debris.

External Exchanges. Beneficial connectivity with adjacent and nearby beach dune communities is high but would benefit from a regional increase in native biodiversity. Connectivity with coastal strand is limited by its rarity and generally degraded condition.

Ongoing Impacts and Threats. The most significant ongoing threat to the beach dune ecosystem at present is invasive species, especially the nonnative beach naupaka (Fig. 6). This highly salt-tolerant species is capable of recruitment and rapid growth in the most seaward locations capable of supporting terrestrial plant life. Other potential threats include trees and shrubs such as Brazilian-pepper, Australian-pine (*Casuarina equisetifolia*), and tropical-almond (*Terminalia catappa*), vines such as latherleaf (*Colubrina asiatica*), and herbaceous species such as creeping wedelia (*Sphagneticola trilobata*) and St. Augustine grass *(Stenotaphrum secundatum*). See Table 2 for a comprehensive list of invasive species of major concern. In

addition, two native vines, gray nicker-bean (*Caesalpinia bonduc*) and coinvine (*Dalbergia ecastophyllum*), have become invasive in coastal uplands and may need control in the beach dune ecosystem. These latter two species were recorded only for the mangrove areas by Austin et al. (1977) and have expanded into beach dune and coastal strand at Red Reef Park and many other locations in southeastern Florida. While current cover of invasive species may still be at a moderate level, the beach dune is at a tipping point and could be quickly overwhelmed by invasive species. This is particularly noticeable at the interface between the beach dune and the seagrapes expanding from the west. Where shrubs or vines have overtaken the beach dune, the soils may have become nutrified through nitrogen fixation and the accumulation of organic matter. This further degrades the beach dune system and favors the expansion of seagrape, invasive species, and weeds (e.g., Spanish-needles [*Bidens pilosa* var. *radiata*]).

In the north the already narrow beach dune ecosystem described by Austin et al (1977) has been squeezed between the expanding seagrape zone from the west and the impacts of sea level rise, beach renourishment, ORV traffic, and beach raking that occurs as part of regular dune maintenance activities to the east (Fig. 7). This has also occurred in the south to a lesser extent but threatens the entire beach dune system at Red Reef Park. A narrowing of the dune system and its replacement with seagrapes or invasive shrubs negatively impacts many native species that are dependent on this ecosystem and could ultimately have a negative impact on sea turtle nesting. In addition, efforts to restore coastal strand vegetation east of the primary dune crest (see below) should be balanced to avoid a net loss of the grassy beach dune ecosystem. In area of with a very narrow grassy beach dune, invasive species removal and

Figure 6. Beach naupaka patches easily visible in the grassy beach dune ecosystem (blue ellipses). A nonnative coconut palm (*Cocos nucifera*) is also clearly visible.

Figure 7. A view of the cumulative impacts of vehicular traffic and dune raking, intersecting with seagrape and invasives encroachment from the west. The beach dune ecosystem in this area is very narrow.

seagrape trimming should be considered in order to expand the width of the beach dune system.

Opportunities for recovery. The beach dune ecosystem is naturally resilient and should be expected to recover without much assistance in many areas following removal of invasive species or trimming back of seagrapes. However, planting of stabilizing grasses such as sea-oats may be needed to prevent erosion. Although some rare species inventory and restoration work has been done, more work is needed, including the mapping and long-term monitoring of the rarest taxa. Some of these species require areas of relatively open sand, which should also be documented. In addition to other rare species planted out by IRC, the imperiled dune spurge (*Euphorbia trichotoma*) should be considered for addition to the beach dune at Red Reef Park.

Coastal Strand

Location. The shrub zone, or coastal strand, occupied most of historical Red Reef Park, from east of or the top of the primary dune crest west in most areas to west of A1A. An historical map can be found in Austin et al. (1977).

Structure and Composition. Historically, the coastal strand was dominated by saw palmetto mixed with a wide variety of native shrubs, vines, and herbaceous species, including grasses and wildflowers. Floristically, coastal strand was the most diverse coastal upland ecosystem at Red Reef Park. Unfortunately, only small, degraded remnant patches remain (Fig. 8). Compared to the 1970s historical reference, native plant diversity has decreased, and invasive nonnative plant diversity and cover have expanded. Austin et al. (1977) reported 50 species for the coastal strand, and more than 60 native species were reported in the Comprehensive Plan. Of these natives, about 1/3 are apparently extirpated from the wild at the site (some of these are in cultivation or have been recently planted by IRC). These include the federally endangered beach clustervine, and the endemic Curtiss' hoarypea (*Tephrosia curtissii*). Austin et al. reported saw palmetto as dominant in coastal strand, with the following species also being common: marlberry (*Ardisia escallonioides*), seagrape, white stopper (*Eugenia axillaris*), Spanish stopper (*Eugenia foetida*), blolly (*Guapira discolor*), wild-sage (*Lantana involucrata*), myrsine (*Myrsine cubana*), blackbead (*Pithecellobium keyense*), and shiny-leaved wild coffee (*Psychotria nervosa*). They reported the endemic beach clustervine as rare. Additional species reported in the Comprehensive Plan as common at Red Reef Park and present in coastal strand were: common snowberry (*Chiococca alba*), tread-softly (*Cnidoscolus stimulosus*), ocean-blue morningglory (*Ipomoea indica*), and white indigoberry (*Randia aculeata*). Note that while seagrape is among the common species, it was mixed with many other species in a diverse ecosystem mosaic.

Most of the coastal strand had been destroyed or heavily degraded by 1979, as described in the Comprehensive Plan. South of Coquina Way and in the area currently occupied by the oceanside golf course, the entire strand has been removed except some remnants near the primary dune crest. From maps in Austin et al. (1977) and signatures on the 1980 aerial photography, it appears that the strand west of A1A still existed in 1965 but had been removed and replaced by nonnative vegetation such as Brazilian-pepper by 1979. Some of those Brazilian-pepper dominated areas still exist today.

During the assessment phases in the late 1970s, a significant area of coastal strand still existed east of A1A and north of the oceanside golf course. As described in the Comprehensive Plan, the area was bisected by the old A1A roadbed, and contained characteristic strand vegetation including saw palmetto and seagrape. This area was mostly developed for parking by the time of the 1994 Dune Restoration Plan, and the remnant vegetation between the parking lot and the dune crest had been invaded by Brazilian-pepper. The 1994 plan called for the removal of Brazilian-pepper over approximately three acres (133,600 sq. ft.) out of nearly 8 acres, and subsequent replanting with a mix of native trees and shrubs. Many coastal strand species,

Figure 8. A remnant patch of coastal strand on the face of the dune, being overtaking by seagrape and nonnative Brazilian-pepper.

including saw palmetto, were planted, but the specifications included thousands of seagrape and tropical hammock forest and mangrove edge (i.e., buttonwood [*Conocaprus erectus*]) species. The small size (1 gal.) and number of saw palmetto were outcompeted by fast-growing forest trees and shrubs, mixed with Brazilian-pepper that reinvaded the site (Fig. 9). In addition, while some appropriate strand species were introduced (e.g., Florida privet [*Forestiera segregata*], Simpson's stopper [*Myrcianthes fragrans*], and red bay [*Persea borbonia*]), other species native to elsewhere in Florida were inappropriately included on the plan. These included spicewood (*Calyptranthes pallens*), orange geigertree (*Cordia sebestena*), and maidenbush (*Heterosavia bahamensis*). Spicewood and orange geigertree were recorded as still present during the Rapid Assessment.

In summary, causes of coastal strand loss have been multidimensional and include direct habitat loss (e.g., clearing for golf course, construction of A1A, park roadways and parking lots, buildings, paths and boardwalks), the planting of native trees and shrubs as part of the 1994 Dune Restoration plan, the expansion of seagrapes exacerbated by warming temperatures, the invasion of nonnative plants, and fire exclusion (see Austin et al. 1977)). Where coastal stand has been overtaken by native trees and shrubs, it has been replaced by tropical hardwood forest in varying conditions. Where it has been overtaken by nonnative species, it has been

Figure 9. Dying and dead saw palmetto (*Serenoa repens*) skeletons are commonly encountered under a canopy of Brazilian-pepper, other invasives, and outplanted native trees. Saw palmetto was the dominant species in the historical coastal strand at Red Reef Park.

replaced by low quality nonnative thickets. Total cover of saw palmetto at Red Reef Park is estimated at less than 5%, with many patches overtaken by trees and shrub and threatened with immediate decline and death.

During 2020 and 2021 restoration workdays, IRC began to trial the restoration of coastal strand east of the dune crest in collaboration with Fairchild Tropical Botanic Garden, including the removal of the nonnative beach naupaka, trimming back of seagrape, and the planting of rare species. Plantings included augmentations (additions to depleted populations), reintroductions, and introductions of other regionally rare species. Species augmented included yellow joyweed, marlberry, horizontal coco-plum (*Chrysobalanus icaco* 'Horizontal'), whitemouth dayflower (*Commelina erecta*), Devil's-potato (*Echites umbellatus*), coralbean (*Erythrina herbacea*), common fingergrass (*Eustachys petraea*), blolly, myrsine, blackbead, white indigoberry, saw palmetto, and Bahama nightshade (*Solanum bahamense*). Apparent reintroduction plantings included beach-creeper (*Ernodea littoralis*), beach verbena (*Glandularia maritima*), beach clustervine, gopher-apple (*Licania michauxii*), mouse's pineapple (*Morinda royoc*), pricklypear (*Opuntia austrina*), wild-allamanda (*Pentalinon luteum*), yellow necklacepod (*Sophora tomentosa* var. *truncata*), baycedar, and sea-lavender. Introductions of other regionally rare

species included marinevine (*Cissus trifoliata*), varnishleaf (*Dodonaea viscosa* var. *viscosa*), blacktorch (*Erithalis fruticosa*), pineland heliotrope (*Heliotropium polyphyllum*), and turkey tangle fogfruit (*Phyla nodiflora*). Also, during the *Rapid Assessment* IRC documented two coastal strand species that were previously undocumented for the site: Florida fiddlewood (*Citharexylum spinosum*) and flatleaf flatsedge (*Cyperus planifolius*).

Ongoing Impacts, Threats, and Opportunities. The most critical ongoing threat to coastal strand is the further loss of saw palmetto and other light-dependent coastal strand species due to excess shade, no matter the cause. Saw palmettos are slow growing, long-lived species, and expensive to replace; however, without fire saw palmettos can become overgrown in full sun and outcompete other coastal strand vegetation. Some patches, such as those in full sun surrounding the golf course, may need to be manually trimmed to open the groundcover to sufficient sunlight. Where coastal stand is transitioning to tropical hardwood forest or a nonnative-dominated thicket, the historically nutrient-poor soils may have become nutrified through nitrogen fixation or the accumulation of organic matter. This further degrades the coastal strand and favors expansion of seagrape, invasive species, and weeds (e.g., Spanish-needles. This nutrification can be mitigated by removal of excess vegetation and subsequent oxidation.

Invasive species are an ongoing and serious threat, including the nonnative beach naupaka, Brazilian-pepper, tropical-almond, creeping wedelia, St. Augustine grass, and many others. See Table 2 for a comprehensive list of invasive species of major concern. In addition, the native gray nicker-bean, and coinvine are invasive in coastal uplands and may need control in any remaining coastal strand patches or restoration areas. Other native vines, such as cowpea (*Vigna luteola*) should also be controlled if needed. Current cover of invasive species in remnant patches of coastal strand is high and has already overwhelmed the system.

Although some rare species inventory and restoration work has been done, more work is needed, including the mapping and long-term monitoring of the rarest taxa. Some of these species may require action very soon to avoid extirpation (e.g., Bahama nightshade). In addition to other rare species planted out by IRC, many other regionally rare species should be considered for outplanting as part of coastal strand restoration at Red Reef Park, including spurred butterly-pea (*Centrosema virginiana*), partridge pea (*Chamaecrista fasciculat*a), tropical-puff (*Neptunia pubescens*), and the endemic Curtiss' hoarypea. These represent augmentations, reintroductions, and the introduction of regionally rare species. See Appendix A for a complete list of species to consider.

Tropical Hammock

Background. Tropical hammock (a.k.a. tropical maritime hammock) was historically found west of A1A, between the coastal strand and Lake Wyman. Some small areas of hammock forest may have historically occurred east of A1A, but these were no longer present by the mid-1970s (Austin et al. 1977). A large area of historical hammock is still present west of A1A in association with the Gumbo Limbo Nature Center. A large boardwalk system provides controlled access to the hammock but also fragments the forest. Functionally, larger areas of tropical hammock now

exist to the east of A1A, including in areas of historical coastal strand where native hardwood trees were installed as part of the 1994 Dune Restoration Plan or other planting efforts. The historical hammock at Red Reef Park is an important remnant of what had been one of the longest and best developed hammocks in southeastern Florida, running from just north of Spanish River Boulevard (Jap Rock) south to the Boca Raton Inlet, a length of at least three miles. Compared to the 1970s historical reference, native plant diversity has possibly decreased, and invasive nonnative plant diversity and cover have expanded. Austin et al. (1977) reported a diverse assemblage of 32 species, and 38 native species were reported in the Comprehensive Plan. Only two species previously recorded for the tropical hammock at Red Reef Park have not been recently found: torchwood (*Amyris elemifera*) and Calusa grape (*Vitis shuttleworthii*), and both could still be present. Austin et al. reported the following species as being dominant in tropical hammock forest: gumbo-limbo (*Bursera simaruba*), white stopper, Spanish stopper, paradisetree (*Simarouba glauca*), and wild mastic (*Sideroxylon foetidissimum*). Cabbage palm (*Sabal palmetto*) was dominant in low areas and the ecotone between the hammock and mangroves. Additional species reported in the Comprehensive Plan as common at Red Reef Park and present in tropical hammock were: marlberry, common snowberry, ocean-blue morningglory, shiny-leaved wild coffee, and saw palmetto. These species are all still present.

Some previously unrecorded hammock species were planted east of A1A as part of the 1994 Dune Restoration Plan. These included sugarberry (*Celtis laevigata*), Florida privet, Simpson's stopper, and red bay. Satinleaf (*Chrysophyllum oliviforme*), firebush (*Hamelia patens*), and stiff-leaved wild-pine (*Tillandsia fasciculata* var. *densispica*) are native to tropical hammock forests in southeastern Palm Beach County but are also presumably introduced to the site from cultivated plants. As mentioned above, species native to elsewhere in Florida were inappropriately included on the plan 1994 Dune Restoration Plan (spicewood, orange geigertree, maidenbush), and spicewood and orange geigertree are still present on site. Additional tropical forest species native to elsewhere in Florida that have been planted in the park include Cinnamon bark (*Canella winterana*), wild dilly (*Manilkara jaimiqui* subsp. *emarginata*), West Indian cherry (*Prunus myrtifolia*), Bahama wild coffee (*Psychotria ligustrifolia*), royal palm (*Roystonea regia*), West Indian mahogany (*Swietenia mahagoni*), green thatch palm (*Thrinax raditata*), and butterflybush (*Varronia bullata* subsp. *humilis*). Of these, orange geigertree, West Indian mahogany, West Indian mahogany, and butterflybush are naturalized well outside of their historical ranges.

Ongoing Impacts, Threats, and Opportunities. West of A1A, sea level rise and invasive species both pose significant threats to the tropical hammock forest at Red Reef Park. While there is little that can be done to adapt directly to sea level rise, the migration of the tropical hammock forest to the west should be taken into consideration in long-term planning. Opportunities to restore areas currently dominated by invasive species west of A1A should take this predicted migration into account, even if the historical community was coastal strand. While a few common invasive species such as Brazilian-pepper and Australian-pine poses the biggest threat historically, the tropical hammock at Red Reef Park is besieged by literally dozens of species, some not yet listed by the Florida Exotic Pest Plant Council (FLEPPC). Some of these are mature

trees growing within a foot of the boardwalk at the Gumbo Limbo Nature Center, suggesting that training for management staff is urgently needed. Finally, there are many small disturbances and incursions noticeable throughout the hammock. These include water pipes coming from the facilities at Gumbo Limbo Nature Center and the construction of a new tower, which is not yet complete. Due to the extremely limited footprint of the original hammock, any future loss or modification of this habitat should be halted. East of A1A, in those areas targeted for tropical hammock forest restoration, invasive species (both plant and animal) are the most significant ongoing threat.

Native Target Reference Ecosystems and Reference Models

Statewide descriptions of beach dune, coastal strand, and maritime hammock (which includes tropical hammock) are found on the Florida Natural Areas Inventory website. Reference sites used to inform restoration targets in this report include (south to north) Hugh Taylor Birch State Park, Red Reef Park, Atlantic Dunes Park (Delray Beach), Delray Municipal Beach, Ocean Ridge Hammock Park, Juno Dunes Natural Area, Cape Canaveral National Seashore, and Smyrna Dunes Park (Fig. 10). Restoration targets for coastal uplands at Red Reef Park should align with reference models except where noted below.

Vision, Targets, Goals, and Objectives

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 (Gann et al. 2019, Principle 5). A sample vision statement and recommended ecological targets are provided below.

Sample Vision Statement

The multi-use nature of Red Reef Park is maintained while restoring a healthy mosaic of native ecosystems and their biodiversity at the park, including beach dune, coastal strand, tropical hammock forest, and mangrove swamp. The restoration of upland native ecosystems is planned and carried out in such a way as to provide opportunities for a broad coalition of stakeholders to contribute to the process. The restoration process is underpinned by science and best management practices, minimizes the use of synthetic chemicals and costly heavy machinery, and maximizes the use of natural recovery processes. The restoration is consistent with and contributes to the City of Boca Raton's Comprehensive Plan and long-term sustainability goals, 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 as part of the United Nations Decade on Ecosystem Restoration (2021-2030). The restoration of coastal uplands at Red Reef Park becomes a flagship restoration program regionally and is promoted as an example of best practice restoration planning, implementation, and monitoring underpinned by sound science and broad community support.

Recommended Ecological Targets

Beach Dune. Restored beach dunes are composed of diverse groundcover vegetation dominated by sea-oats together with other important dune plants like beach star and railroad vine, and occasional shrubs such as baycedar and sea-lavender. Temperate, tropical, and endemic species comprise a mix of graminoids (grasses, sedges, and similar plants), forbs (non-graminoid herbs, e.g., wildflowers), and creeping vines. While sea-oats comprise >50% cover overall, railroad vine and beach-bean are abundant on the easternmost portion of the dune. The beach dune vegetation is expressed as a mosaic, and islands of species or groups of species are frequent. A wide diversity of native plants are present, and invasive exotics and native weedy plants are reduced to a minimum. Beach dunes are habitat for an abundance of native wildlife, including pollinators, migratory birds, and small mammals; invasive animals are controlled. Rare species are documented, protected, and augmented or reintroduced when appropriate. Areas of relatively open sand are present within and between vegetation mosaics in heterogenous patterns, providing critical habitat for many plant and animal species. Organic litter and soil organic carbon are present within target ranges of variability. Ecosystem disturbance regimes and functions, including storm surges, nesting by sea turtles, pollination and dispersal, predation and herbivory, and recruitment are present and operating. Beach

dunes are connected whenever possible (e.g., path systems are minimized), and substrates, hydrology, and ecosystem processes are restored to the extent practicable; changes in hydrology and irreversible soil modifications are considered when designing, implementing, and monitoring beach dune restoration projects. Beach dune ecotones are connected to other key ecosystems that share species and habitat, such as coastal strand.

Coastal Strand. Restored coastal strand is dominated by saw palmetto along with a wide variety of other species. Temperate, tropical, and endemic species comprise a mix of shrubs, forbs (non-graminoid herbs, e.g., wildflowers), graminoids (grasses, sedges, and similar plants), and vines. While saw palmetto typically comprises >50% cover overall, this is the most diverse coastal upland ecosystem in southeastern Palm Beach County and dozens of other species are present. The coastal strand vegetation is expressed as a mosaic, and islands of species or groups of species are frequent. A wide diversity of native plants are present, and invasive exotics and native weedy plants are reduced to a minimum. Coastal strand is habitat for an abundance of native wildlife, including pollinators, migratory birds, and small mammals; invasive animals are controlled. Rare species are documented, protected, and augmented or reintroduced when appropriate. Areas of relatively open sand are present within and between vegetation mosaics in heterogenous patterns, providing critical habitat for many plant and animal species. Organic litter and soil organic carbon are present within target ranges of variability. Ecosystem disturbance regimes and functions, including storm surges, periodic fire, pollination and dispersal, predation and herbivory, and recruitment are present and operating. Where disturbance regimes no longer keep native vegetation low (e.g., mostly <6 feet), pruning is employed as a surrogate. Coastal strand patches are connected whenever possible, and substrates, hydrology, and ecosystem processes are restored to the extent practicable; changes in hydrology and irreversible soil modifications are considered when designing, implementing, and monitoring beach dune restoration projects. Coastal strand ecotones are connected to other key ecosystems that share species and habitat, such as beach dune and tropical hammock.

Tropical Hammock. Restored tropical hammock is composed of diverse canopy, subcanopy, and shrub layers with no single dominant species; vines and saw palmetto are present in canopy gaps and along the ecotones. The groundcover layer is open with substantial leaf litter and organic material on the surface; the vegetation is sparse and composed primarily of seedlings and saplings of canopy and subcanopy trees and shrubs. Tropical species dominate, although some temperate species (e.g., mulberry [*Morus rubra*]) are present. The tropical hammock vegetation is expressed primarily as a diverse mix of species, although some mosaics are present. A wide diversity of native plants are present, and invasive exotics and native weedy plants are reduced to a minimum. Tropical hammock is habitat for an abundance of native wildlife, including pollinators, migratory birds, and small mammals; invasive animals are controlled. Rare species are documented, protected, and augmented or reintroduced when appropriate. Organic litter and soil organic carbon are present within target ranges of variability. Ecosystem disturbance regimes and functions, including tree falls from extreme weather events, pollination and dispersal, predation and herbivory, and recruitment are present and operating. Tropical hammocks are connected whenever possible and path systems

are minimized. Substrates, hydrology, and ecosystem processes are restored to the extent practicable; changes in hydrology (e.g., salinization along Lake Wyman) and irreversible soil modifications are considered when designing, implementing, and monitoring tropical hammock restoration projects. Tropical hammock ecotones are connected to other key ecosystems that share species and habitat, such as coastal strand and mangrove swamp.

Recommended Social Targets

All Ecosystems. Beach dunes, coastal strand, and tropical hammock forests are restored and managed in a way that benefits residents and visitors, from the establishment and maintenance of nature paths to opportunities for citizen science and volunteerism during restoration activities. Robust educational programs on coastal uplands, their restoration and conservation, and their contributions to preventing local and global extinctions of plants and animals, reducing climate change, and providing essential ecosystem services, are integrated into programs for students of all ages. Coastal uplands provide essential green space and green infrastructure in the largely urban landscape of South Florida and 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 state and local government, nonprofits and other community groups, schools, and foundation, corporate, and private funders.

Long-term Goals and Shorter-term Objectives[1] (social and ecological)

All Coastal Uplands

1) Formalize a restoration and long-term management plan by March 30, 2022.
    a. Map areas designated to be restored and managed as native ecosystems within 6 months.
    b. Develop agreed restoration prescriptions within 1 year.
2) Develop a volunteer program and train volunteers to participate in restoration activities, long-term monitoring, and knowledge generation and dissemination, including Citizen Science, within 2 years.
    a. Develop a volunteer engagement schedule within 6 months.
3) Formalize stakeholder engagement regarding long-term restoration and management of native upland ecosystems at Red Reef Park within 1 year.
    a. Develop a stakeholder engagement schedule within 6 months.
4) Incorporate the plan into City program and budget processes beginning in FY23.
    a. Develop cost estimates to implement agreed restoration prescriptions within 1 year.
5) Design and implement a restoration monitoring program throughout a 20-year period.
    a. Initiate long-term monitoring of ecological components of coastal uplands restoration implementation within 1 year.
6) Reduce cover of nonnative and native invasive species throughout Red Reef Park to <2% within 10 years.

[1] These goals and objective include restoration prescriptions required for their accomplishment. Additional recommended protocols are found in the Restoration Best Practices section below.

a. Conduct initial treatments on half of total area occupied by invasive species within 1 year. Begin regular inspections and retreatments within 3 months of initial treatments. Schedule inspections and retreatments post as follows: 3 months, 6 months, 1 year, annual thereafter.
b. Initiate annual sweeps of all areas with <2% cover of invasive species within 1 year.
c. Reduce the cover of nonnative and native invasive species to <10% within 2 years.
d. Reduce the cover of nonnative and native invasive species to <5% within 5 years.

7) Formalize a community-based coastal upland restoration corps of practitioners, including volunteers, nonprofits, schools, and Certified Ecological Restoration Practitioners within 5 years.
    a. Develop a restoration corps development schedule within 2 years.
8) Protect coastal uplands from point and non-point source pollution to the extent practicable within 5 years.
    a. Evaluate point and non-point source pollution sources and effects on native plant and animal populations within 2 years.
    b. Develop plans to protect coastal uplands from point and non-point source pollution, including insect spraying, within 3 years.
9) Increase grade-school education about coastal uplands within 10 years.
    a. Evaluate current education programs on native coastal ecosystems and establish education targets within 2 years (e.g., number of students and schools participating annually).
    b. Revise curriculum to provide an accurate description of historical native upland ecosystems and their conservation importance within 3 years.
10) Control or extirpate populations of invasive nonnative and nuisance animals throughout Red Reef Park within 10 years.
    a. Reduce by half populations of invasive nonnative and nuisance animals within 5 years.

Beach Dune

1. Establish baseline width and condition of beach dune ecosystem within 1 year.
    a. Map eastern extent of beach dune vegetation within 6 months.
    b. Map western extent of beach dune vegetation/ eastern extent of seagrape/nonnative shrub line within 6 months.
    c. Map large patches (e.g., >100 sq. ft.) of invasive plants within 6 months.
    d. Map significant open areas (e.g., <10% cover in an area >100 sq. ft.) within 1 year.
    e. Document locations of rare plant taxa (<2% cover) within 1 year.
    f. Conduct wildlife surveys (e.g., butterflies and other pollinators, birds, reptiles, amphibians, small mammals) within 1 year.
2. Establish target footprint of restored beach dune ecosystem within 1 year.
    a. Draft target footprint of restored beach dune footprint within 9 months and circulate for review to staff and stakeholders.

3. Increase connectively and area of beach dunes by eliminating all unneeded open areas created by uncontrolled pedestrian and vehicular traffic within 2 years.
    a. Increase the connectively of beach dunes by eliminating half of unneeded open areas within 1 year.
4. Maintain or increase the width of the beach dune system to at least a width equal to the distance from the top of the dune to the toe of the dune with 10 years.
    a. Demarcate the western edge of dune raking and ORV traffic within 1 year and prevent further encroachment.
    b. Increase area of beach dune vegetation to half of the target area within 5 years.
5. Reduce cover of nonnative, native invasive, and native ruderal plant species to <1% within 10 years.
    a. Initiate annual invasive plant sweeps of all areas with <2% cover of invasive species within 1 year and treat small outlier infestations of invasive plants. Allow of natural recovery of native beach dune vegetation.
    b. Cut and treat 50% beach naupaka patches and other invasive species along the west edge of existing beach dune within 1 year. Haul away debris. Install native beach dune species as needed to stabilize sand and increase biodiversity. Schedule inspections and retreatments as follows: 3 months, 6 months, 1 year, annual thereafter.
    c. Complete cutting and treatment of beach naupaka patches and other invasive species along the west edge of existing beach dune within 2 years. Haul away debris. Install native beach dune species as needed to stabilize sand and increase biodiversity. Schedule inspections and retreatments as follows: 3 months, 6 months, 1 year, annual thereafter.
    b. Reduce the cover of nonnative, native invasive, and native ruderal plant species to <5% within 2 years.
    c. Reduce the cover of nonnative, native invasive, and native ruderal plant species to <2% within 5 years.
6. Reduce seagrape cover within target beach dune restoration areas on the foredune to less than 5% within 10 years.
    a. Conduct trials to reduce the lateral spread of seagrapes along the western edge of existing beach dune within 1 year. Haul away debris as appropriate. Install native beach dune species as needed to stabilize sand and increase biodiversity.
    b. Reduce seagrape cover within target beach dune restoration areas to less than 25% within 5 years. Haul away debris as appropriate. Install native beach dune species as needed to stabilize sand and increase biodiversity.
7. Restore to the extent possible depleted or extirpated populations of native plants and appropriate animals within 10 years, considering unsurmountable changes including climate change, changes to hydrology, and fragmentation effects on wildlife populations.
    a. Begin restoration of half of depleted or extirpated plant species within 3 years.
    b. Begin restoration of half of depleted or extirpated animal populations that are dependent on plants (e.g., butterflies) within 5 years.

8. Maintain or increase native species richness to 100% or more of the reference model for plants (30 species), and 90% for animals within 20 years.
    a. Maintain or increase native species richness to 100% or more of the reference model for plants (30 species), and 50% of target animals within 10 years.

Coastal Strand

1. Establish baseline area and condition of coastal strand ecosystem within 2 years.
    a. Map half of all existing patches of saw palmetto and other remnant coastal strand vegetation, with at least a centroid coordinate, and assess condition in relation to threats from overtopping or competing vegetation (e.g., poor, fair, good, excellent) within 6 months.
    b. Map eastern extent of coastal strand/seagrape/nonnative shrub line within 6 months.
    c. Map large patches (e.g., >100 sq. ft.) of invasive plants within 6 months.
    d. Document locations of other nonnative taxa, including species native to other parts of Florida (e.g., spicewood, orange geigertree) within 1 year.
    e. Map significant areas of native biodiversity (e.g., >10 target species within area >100 sq. ft) within 1 year.
    f. Document locations of rare plant taxa (<2% cover) within 1 year.
    g. Conduct wildlife surveys (e.g., butterflies and other pollinators, birds, reptiles, amphibians, small mammals) within 2 years.
2. Establish target footprint of restored coastal strand within 1 year.
    a. Draft target footprint of restored coastal strand footprint within 9 months and circulate for review to staff and stakeholders.
3. Implement restoration of all identified remnant coastal strand patches within 5 years, beginning with those assessed as poor and excellent, through the removal of nonnative vegetation and the pruning of native vegetation, including seagrape and saw palmetto.
    a. Initiate restoration of all identified coastal strand patches assessed as poor or excellent within 1 year, focusing first on preventing the loss of saw palmetto or rare native biodiversity.
    b. Initiate restoration of all identified coastal strand patches within 2 years.
4. Reduce cover of nonnative, native invasive, and native ruderal plant species to <2% within 10 years.
    a. Initiate annual invasive plant sweeps of all areas with <2% cover of invasive species within 1 year and treat small outlier infestations of invasive plants. Allow for natural recovery of native coastal strand vegetation.
    b. Cut and treat 50% beach naupaka patches and other invasive species along the eastern edge of proposed coastal strand vegetation within 1 year. Haul away debris. Install native coastal strand species as needed to stabilize sand and increase biodiversity. Schedule inspections and retreatments as follows: 3 months, 6 months, 1 year, annual thereafter.

c. Complete cutting and treatment of beach naupaka patches and other invasive species along the eastern edge of proposed coastal strand vegetation within 2 years.
d. Cut and treat 50% of other patches of nonnative vegetation growing within the mapped future footprint of coastal strand within 2 years. Haul away or pile debris as appropriate. Install native coastal strand species as needed to assist recovery and increase biodiversity. Schedule inspections and retreatments as follows: 3 months, 6 months, 1 year, annual thereafter.
d. Complete cutting and treatment of other patches of nonnative vegetation growing within the mapped future footprint of coastal strand within 5 years.
e. Reduce the cover of nonnative, native invasive, and native ruderal plant species to <10% within 3 years.
f. Reduce the cover of nonnative, native invasive, and native ruderal plant species to <5% within 5 years.

5. Reduce seagrape cover within target coastal strand restoration areas to less than 25% within 10 years with consideration of light pollution and sea turtle impacts.
   a. Conduct trials to reduce the lateral spread of seagrapes along the eastern edge of proposed coastal strand vegetation within 1 year. Haul away debris as appropriate. Install native coastal strand species as needed to initiate recovery and increase biodiversity.
   b. Reduce seagrape cover within target coastal strand restoration areas to less than 50% within 5 years. Haul away debris as appropriate. Install native beach dune species as needed to initiate recovery and increase biodiversity.
6. Restore to the extent possible depleted or extirpated populations of native plants and appropriate animals within 10 years, considering unsurmountable changes including climate change, changes to hydrology, and fragmentation effects on wildlife populations.
   a. Review list (see Appendix A) and agree on target plant species to restore with 1 year.
   b. Begin restoration of half of depleted or extirpated plant species within 3 years.
   c. Begin restoration of half of depleted or extirpated animal populations that are dependent on plants (e.g., butterflies) within 5 years.
7. Double the connectivity of coastal strand vegetation within 10 years, through the connection of existing patches.
   a. Begin increasing the connectivity of coastal strand by connecting at least two existing patches within 2 years.
8. Increase the area of the coastal strand to at least 4 acres within 10 years.
   a. Increase area of coastal strand vegetation to 2 acres within 5 years.
   b. Initiate restoration of all identified remnant coastal strand patches within 2 years, beginning with those assessed as poor and excellent.
9. Increase native species richness to 100% of the reference model for plants (70 species), and 80% for animals within 20 years.
   a. Increase native species richness to an average of 90% of the reference model for plants, and 50% of animals within 10 years.

Tropical Hammock

1) Establish baseline area and condition of tropical hammock within 2 years.
    a. Map historical tropical hammock vegetation and planted hammock forests that are not targeted for restoration to coastal strand (see above) and that will be managed as landscapes within 6 months.
    b. Map large patches (e.g., >100 sq. ft.) of invasive plants within 6 months.
    c. Document locations of other nonnative taxa, including species native to other parts of Florida (e.g., spicewood, orange geigertree) within 1 year.
    d. Document locations of rare plant taxa (<5% cover) within 1 year.
    e. Conduct wildlife surveys (e.g., butterflies and other pollinators, birds, reptiles, amphibians, small mammals) within 2 years.
2) Formalize target footprint of restored tropical hammock within 1 year.
    a. Draft target footprint of restored tropical hammock, including trail system, within 9 months and circulate for review to staff and stakeholders.
3) Implement restoration of all historical and planted tropical hammock areas within 5 years, beginning with those in the best condition, through the removal of nonnative vegetation and emphasizing natural recovery.
    a. Initiate restoration of all historical tropical hammock within 1 year.
    b. Initiate restoration of all planted tropical hammock within 2 years.
4) Reduce cover of nonnative, native invasive, and native ruderal plant species to <1% within 10 years.
    a. Initiate annual invasive plant sweeps of all areas with <2% cover of invasive species within 1 year and treat small outlier infestations of invasive plants. Allow for natural recovery of native tropical hammock vegetation.
    e. Treat in place (basal bark, frill) invasive trees and shrubs within and along inside edges of historical and planted tropical hammock within 1 year. Schedule inspections and retreatments as follows: 3 months, 6 months, 1 year, annual thereafter. Allow for natural recovery of native tropical hammock vegetation.
    f. Cut and treat nonnative vegetation growing in large patches next to A1A and in other high visibility areas within 5 years. Install native tropical hammock species as needed to assist recovery and increase biodiversity. Schedule inspections and retreatments as follows: 3 months, 6 months, 1 year, annual thereafter.
    b. Complete treatment of all large patches of nonnative vegetation growing within the mapped tropical hammock area within 5 years.
    c. Reduce the cover of nonnative, native invasive, and native ruderal plant species to <10% within 3 years.
    d. Reduce the cover of nonnative, native invasive, and native ruderal plant species to <5% within 5 years.
5) Restore to the extent possible depleted or extirpated populations of native plants and appropriate animals within 10 years, considering unsurmountable changes including climate change, changes to hydrology, and fragmentation effects on wildlife populations.

a. Review list (see Appendix A) and agree on target plant species to restore with 1 year.
b. Begin restoration of half of depleted or extirpated plant species within 3 years.
c. Begin restoration of half of depleted or extirpated animal populations that are dependent on plants (e.g., butterflies) within 5 years.

6) Maintain or increase native species richness to 100% of the reference model for plants (40 species), and 80% for animals within 20 years.
    a. Increase native species richness to an average of 90% of the reference model for plants, and 50% of animals within 10 years.

BEST PRACTICES

Site Planning

Beach nourishment, beach raking, sea level rise, light pollution, and recreational use should be considered when identifying the footprint of restoration targets. West of A1A, areas that are currently dominated by Brazilian-pepper and other invasive species were likely coastal strand in the past. However, sea level rise has greatly impacted the extent of the historical hammock to the west, which should be allowed to migrate inland and up slope. Thus, areas west of A1A that are dominated by invasive species should be targeted for tropical hammock restoration, which is also easier and less expensive to restore than coastal strand.

East of A1A, it is critical to indicate which areas will continue to be restored as hammock, which areas are “landscapes” to be managed primarily for aesthetics, and which areas could be targeted for coastal strand restoration. Most of the areas between A1A and the parking lot north of the golf course could be targeted for tropical hammock restoration, while significant areas surrounding the golf course, along the boardwalks, and north of the north parking lot could be targeted for coastal strand restoration. As described above, there is also an opportunity to restore coastal strand east of the primary dune, while considering the overall footprint of the beach dune ecosystem. In cases of coastal strand restoration, potential effects of increased light pollution on sea turtles should be evaluated.

Restoration Approaches

The SER Standards call for the identification and justification of specific restoration approaches, descriptions of specific treatments for each restoration area, and prioritization of actions. Whenever possible, the best approach is to remove sources of degradation and to utilize natural recovery potential through the process of natural regeneration. However, in many cases, restoration requires removal of the causes of degradation and active interventions to correct damage and trigger recovery. This may include enrichment planting or reintroduction of species no longer present on or near the site, and follow-up removal of invasive species. This is the assisted regeneration approach. Finally, in cases where damage is high, the reconstruction approach may be utilized. In this case not only do all causes of degradation need to be removed or reversed, and all biotic and abiotic damage corrected, but also all or a major proportion of its desirable biota may need to be reintroduced. In practice, all of these approaches may be

combined at a restoration site. At Red Reef Park, the natural regeneration approach can be utilized where small concentrations of invasive species are removed, such as in parts of the beach dune and tropical hammock. Assisted regeneration is needed where biodiversity has been depleted and invasive species are more pervasive, but planning should be limited to only what is needed to stimulate recovery. The construction approach is best employed only where necessary, which may include highly visibly areas west of A1A that are currently dominated by Brazilian-pepper.

Invasive Species

A list a nonnative species at Red Reef Park can be found on the Floristic Inventory of South Florida, along with images and links to other identification tools. Not all nonnative species are invasive, but some may become invasive in the future based on knowledge of the species in other locations. To date, about 80 species of nonnative plants have been observed at Red Reef Park, of which more than 50 are considered to be substantial threats to the park and its native ecosystems (Table 2). Some of these are common or exist in large patches in native ecosystems (e.g., beach naupaka, Brazilian-pepper, oysterplant [*Tradescantia spathacea*]), while others are currently limited to a few scattered individuals or are primarily located in landscaped areas (e.g., wart fern [*Phymatosorus grossus*]).

Comprehensive resources are available on the control of invasive species including updated guidance from the State of Florida (Enloe et al. 2018), which include information on biological, manual, mechanical, cultural (e.g., prescribed burning, flooding), and chemical control methods. Specific control methods for many individual species are also indicated. For Red Reef Park, most invasive species can be controlled through a combination of manual control (e.g., weeding by hand, digging up), cutting and treating with herbicide, basal bark herbicide applications, and targeted foliar spray. Mechanical clearing of vegetation should be avoided but may be considered in a few select location west of A1A. Boca Raton Recreation Services Department staff is working on finding a non-synthetic replacement for foliar applications calling for glyphosate. However, there is currently no known substitute for synthetic herbicides to treat woody vegetation, such as many of the trees and shrubs listed in Table 2. In these cases, triclopyr has generally been found to be effective. The oil-soluble formulations (e.g., Garlon 4 mixed with plant-based oil, Pathfinder) are effective for basal bark and cut stump applications but cannot be used near water, while the water-soluble formulations (e.g., Garlon 3A) can be used near or over water, and for cut stumps.

To reduce herbicide use and increase overall efficiency, invasive species control should be conducted as part of an ecological restoration plan, and implemented on a schedule (see Goals and Objectives above). If done properly, repeat use of synthetic herbicides should not be necessary after one year, but resprouting of some individuals should be expected within the first few months (Fig. 11). Because of the large number of species, annual sweeps for invasive species called for above should be conducted by a highly trained crew. Teams of 2-4 should

Table 2. Nonnative invasive species recently recorded at Red Reef Park that are listed by the Florida Exotic Pest Plant Council (FLEPPC 2019), or otherwise pose a substantial threat. FLEPPC ranks invasive nonnative plants as **Category I** invasives when they are altering native plant communities by displacing native species, changing community structures or ecological functions, or hybridizing with natives. This definition does not rely on the economic severity or geographic range of the problem, but on the documented ecological damage caused. **Category II** invasive nonnative plants have increased in abundance or frequency but have not yet altered Florida plant communities to the extent shown by **Category I** species. These species may become **Category I** if more ecological damage is demonstrated. Not all species that cause ecological damage at the local or regional scales are listed by FLEPPC. Key to abbreviations in Threats: BD=beach dune; CS=coastal strand; TH=tropical hammock.

Scientific name	Common name	FLEPPC category	Threat
Asystasia gangetica	Chinese-violet	II	CS, TH
Bischofia javanica	Javanese bishopwood	I	CS, TH
Calophyllum antillanum	Santa Maria, Galba	I	CS, TH
Calophyllum inophyllum	Beautyleaf		CS, TH
Carissa macrocarpa	Natal-plum		CS
Casuarina equisetifolia	Australian-pine	I	BD, CS, TH
Chamaedorea seifrizii	Bamboo palm	II	CS, TH
Cocos nucifera	Coconut palm	II	BD, CS, TH
Colubrina asiatica	Latherleaf	I	BD, CS, TH
Cupaniopsis anacardioides	Carrotwood	I	TH
Cyperus rotundus	Nut-grass		BD, CS
Dactyloctenium aegyptium	Crow's-foot grass	II	BD, CS
Epipremnum pinnatum cv. Aureum	Golden pothos	II	TH
Eugenia uniflora	Surinam-cherry	I	CS, TH
Ficus microcarpa	Laurel fig	I	CS, TH
Hamelia patens var. *glabra*	Glabrous firebush		CS, TH
Imperata cylindrica	Cogon grass	I	CS
Jasminum sambac	Arabian jasmine	II	TH
Lantana camara	Shrubverbena	I	BD, CS, TH
Livistona chinensis	Chinese fan palm	II	TH
Mimusops coriacea	Monkey's-apple		CS, TH
Momordica charantia	Wild balsam-apple	II	CS, TH
Nephrolepis brownie	Asian sword fern	I	BD, CS, TH
Nephrolepis cordifolia	Tuberous sword fern	I	TH
Noronhia emarginata	Madagascar-olive		CS, TH
Ochrosia elliptica	Elliptic yellowwood		TH
Pandanus tectorius	Pandanus-palm		TH
Panicum maximum	Guineagrass	II	CS, TH
Panicum repens	Torpedo grass	I	BD, CS
Passiflora ciliata	Fringed passionflower		CS, TH
Phoenix reclinata	Senegal date palm	II	CS, TH
Phymatosorus grossus	Serpent fern, Wart fern	I	TH
Pteris vittata	China brake	II	CS, TH
Ptychosperma elegans	Solitaire palm	II	TH

Scientific name	Common name	FLEPPC category	Threat
Richardia grandiflora	Largeflower Mexican clover	II	BD, CS
Ricinus communis	Castor-bean	II	CS, TH
Sansevieria hyacinthoides	Bowstring-hemp	II	CS, TH
Scaevola taccada	Beach naupaka	I	BD, CS
Schefflera actinophylla	Australian umbrellatree	I	CS, TH
Schinus terebinthifolius	Brazilian-pepper	I	BD, CS, TH
Senna alata	Candlestick plan		CS, TH
Sphagneticola trilobata	Creeping wedelia	II	BD, CS, TH
Stenotaphrum secundatum	St. Augustine grass		BD, CS
Terminalia catappa	Tropical-almond	II	BD, CS, TH
Thespesia populnea	Portiatree	I	CS, TH
Tradescantia spathacea	Oysterplant	II	CS, TH
Tribulus cistoides	Punctureweed	II	CS
Urochloa distachya	Signal grass		BD, CS, TH
Vitex trifolia	Simpleleaf chastetree	II	BD, CS, TH
Washingtonia robusta	Desert palm	II	CS, TH
Zamia furfuracea	Cardboard-palm		CS, TH
Zoysia spp.	Zoysia grass		BD, CS

traverse each target area within 10 feet of each other, carrying supplies needed to deal with all control measures expected. GIS coordinates can be collected for any return work needed.

Native Species Management

As discussed above, native plants may grow in such a way that they need to be managed as part of the restoration process. At Red Reef, these may include hardwoods that have invaded or been planted in areas intended for beach dune or coastal strand restoration. Most common is sea-grape, but other species like buttonwood and strangler fig may need to be cut down or heavily trimmed as part of the restoration process. Debris from those trees may need to be hauled away, and the base of the remaining trucks treated with a systemic herbicide. Saw palmettos, while a key component of coastal strand, become overgrown and outcompete most other plants in the absence of fire. Examples are found around the golf course, where giant clumps reach well above head height. In some cases, these clumps can be “cleaned out” and some of the taller stems cut down to create openings. Other examples are native weeds, which can proliferate in areas of recent soil disturbance and in areas with high light and organic soils. Strategies to monitor and treat these weedy areas can be an important part of ecological restoration process. While the common approach may be to spray with herbicides or hand pull, lighter approaches such as clipping and bagging, which also removes excess nutrients from the site can yield good results in many circumstances. In addition, two native vines, gray nicker-

bean (*Caesalpinia bonduc*) and coinvine (*Dalbergia ecastophyllum*), have become invasive in coastal uplands and may need control in the beach dune and coastal strand ecosystems.

Extra-Limital Natives

While adapting to climate change and planning for shifting ranges of native plants and animals is critical to long-term sustainability, ecological restoration standards do not sanction translocating species beyond currently understood ecologically based native ranges. Species native elsewhere in Florida planted beyond their ecologically mediated ranges can be described as "extra-limital" natives. Cultivated species in this category at Red Reef Park include paurotis palm (*Acoelorraphe wrightii*), Keys ageratum (*Ageratum maritimum*), spicewood (*Calyptranthes pallens*), cinnamon bark (*Canella winterana*), largeflower false-rosemary (*Conradina grandiflora*), Orange geigertree (*Cordia sebestena*), maidenbush (*Heterosavia bahamensis)*. Florida shrub thoroughwort (*Koanophyllon villosum*), wild dilly (*Manilkara jaimiqui* subsp. *emarginata*). West Indian cherry (*Prunus myrtifolia*), Bahama wild coffee (*Psychotria ligustrifolia*), royal palm (*Roystonea regia*), West Indian mahogany (*Swietenia mahagoni*), and Green thatch palm (*Thrinax radiata*). While some of these species are already naturalized or could spread in the future (e.g., West Indian cherry), most these species are not generally a serious threat to native ecosystems undergoing restoration – but they also should not be part of the restoration target. Exceptions are royal palms and thatch palms, seedlings of which should be removed from native ecosystems, and West Indian mahogany, which is highly invasive in coastal ecosystems.

Restoration Planting

Tools for selecting native species for restoration planting can be found in Appendix A, and on IRC's Natives For Your Neighborhood website. General principles for tropical hammock planting can be adapted from guidelines written for rockland hammocks in Miami-Dade County and the Florida Keys (Gann 2006), including the list of common trees and shrubs (with the exception of shortleaf fig which occurs to the south). For beach dune and coastal strand plantings, smaller container sizes that have less organic material and fewer nutrients are generally better. Between 2" and 6" (1-gallon) containers can be used for herbaceous plants and 1-gallon to 3-gallon containers for most shrubs. Because of their very slow growth rates, larger containers of saw palmettos can be planted. If utilizing the reconstruction approach to restoration, e.g., in mostly bare areas, then plant beach dune vegetation on 18" centers (or 4 plants per square yard); use at least six species. For coastal strand, plant shrubs in groups on 2-3 foot centers (about one to two plants per square yard), leaving open areas for grasses, herbaceous plants, and open sand; use at least 12 species. A good target for beach dune would be less than 25% cover of shrubs, and for coastal strand less than 50% cover of shrubs at maturity.

Contrary to common horticultural practice, beach dune and coastal strand plants must be buried below grade and, other than the soil that came in the pot and fertilizer, no other material should be mixed in the hole. Bury the plants 4-6" deep, deeper for some species like sea lavender, and make sure to eliminate air pockets. For beach dune and coastal strand

plantings no mulch or other organic material is added to the surface. The idea is to minimize organic content and nutrients at the surface, which increase weeds and weed competition.

Water is key to successful plantings. Once the plant is placed in the planting hole, water thoroughly to eliminate air pockets under and around the plant. Use a shovel or trowel to lightly pack the back fill around the plant. Water in the plant to set the roots. Finally, level out the planting surface so that it grades smoothly into the surrounding terrain, or create a slight depression to allow irrigation water to pool. As a general rule, no more than 10 total watering should be needed. Each watering should be equivalent to one inch or more of rainfall, or about 10 seconds at city water pressure for a 1-gallon and 30 seconds for a 3-gallon container – the idea is to provide a few deep waterings to drive the roots downward and away from the dry surface. During the first three weeks after installation water twice per week; during the next two weeks, water once per week; during the next four weeks, water once every two weeks. If the site receives one inch or more of rainfall within 24 hours of when a watering is scheduled, skip that watering. Additional watering may be necessary during the hot, dry periods of the spring and summer

AFTERCARE AND MAINTENANCE

The SER Standards reserves the term maintenance for activities that take place after restoration is complete, that is when the attributes of the ecosystem resemble the reference model. Aftercare is the term applied to special care given to plants or animals when they have been introduced to a restoration site (e.g., watering). In practice, however, restoration practitioners and others responsible for implementing restoration projects use the term maintenance for many restoration interventions that are applied throughout the restoration process. Regardless of the terminology used, the important thing is the ecological restoration takes time (years, decades, or centuries depending on the ecosystem), and interim interventions will be needed throughout the process (e.g., reducing weed competition, trimming as a surrogate to fire, removing new infestations of invasive species). In some cases at Red Reef, such as in small parts of the historical tropical hammock, degradation is minor. Invasive species can be treated, follow-up can occur, and restoration will be complete except for ongoing processes of degradation, such as those caused by nonnative animals and pollutants carried into the hammock during king tides. Another example would be where small patches of invasive species are removed in the grassy foredune, followed by the planting of rare species. In these cases, maintenance of the vegetation can commence soon thereafter, which should occur annually and cost less than $1,000 per acre. However, throughout most of Red Reef restoration interventions will need to be followed by secondary or tertiary treatment for several years before reaching a maintenance state.

For areas at Red Reef where reconstruction and most assisted natural regeneration approaches are used, long-term care primarily involves watering installed plants, weeding, trimming, and occasional re-mulching in tropical hammock areas. Fertilizing plants after installation is unnecessary and can be counterproductive. Plan on doing a light weeding every two or three months for the first year. Once the canopy has formed or the sand substrate has stabilized,

weeding will be necessary every six months to year. More frequent weeding may be needed where restoration areas connect with any lawn areas, as lawn grasses and weeds will continuously invade the edges. Whenever weeding, make sure to not pull up seedlings of native trees and shrubs that might have recruited since installation. On the other hand, vigorously remove any invasive plants that might become established, including crow's-foot grass, coinvine, and nickerbean. In some cases, native target species, such as railroad vine and beach bean, may overwhelm a planting area; these can be cut back to let the new plantings establish.

MONITORING AND ADAPTIVE MANAGEMENT

Most restoration projects are trials or experiments, and, because of this, there is a need to monitor and evaluate the extent to which they achieve project goals and objectives. Therefore, monitoring and evaluation are critical components of the restoration process. However, for monitoring to be effective, it cannot be an afterthought. Monitoring must be planned and budgeted for and included throughout the restoration process. Because each type of monitoring question requires specific types of information collected at specific time-periods, it is important to determine the questions and approach to monitoring during project planning. Timely monitoring and evaluation of results, as well as funding for ongoing restoration, allows for adaptive management, which can and should be the standard approach for any ecological restoration project, irrespective of how well-resourced that project may be. For more information on monitoring and adaptive management, see Box 6 in the SER Standards.

VOLUNTEERS

While some restoration activities require trained professionals, there are many opportunities to involve volunteers in the restoration process. Volunteers can include adults and children, formal groups and individuals, and both the trained and untrained. Volunteers can help remove invasive species, especially smaller plants that are readily removed by hand, such as Chinese-violet (*Asystasia gangetica)* and oyster plant (*Tradescantia spathacea*). They can help haul, dig holes, and install plants, and water both at and following events. Volunteers, when trained, can help with weeding restoration planting areas, and assist with project monitoring such as through repeat photography. Using tools such as iNaturalist, volunteers can help document species occurrences, especially lesser-known groups such as bees, moths, beetles, and invasive animals. To quote from the SER Standards, Principle 1:

> Ecological restoration is undertaken for many reasons including to recover ecosystem integrity and to satisfy personal, cultural, social-economic, and ecological values. This combination of ecological and social benefits can lead to improved social–ecological resilience. Humans benefit from a closer and reciprocal engagement with nature. Participating in restoration projects can be transformative, for example, when children involved in restoration projects develop personal ownership over restoration sites, or when community volunteers seek new career or vocational paths in restoration practice or science. Communities located within or near degraded ecosystems may gain health and other benefits from restoration that improves the quality of air, land, water, and habitats for native species.

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Appendix A. The historical and potential native flora of coastal uplands at Red Reef Park. Status designations are FE (federally endangered), FT (federally threatened), SCE (state commercially exploited), SE (state endangered), ST (state endangered), SF1 (IRC critically imperiled in South Florida), SF2 (IRC imperiled in South Florida), SF3 (IRC rare in South Florida), RGC1 (Restoring the Gold Coast, priority 1 species), RGC2 (Restoring the Gold Coast, priority 2 species). South Florida ranks are by IRC (Gann et al. 2021); Restoring the Gold Coast ranks are by IRC (working list 2021).

Scientific name	Common names	Status	Restoration Notes	Beach Dune	Coastal Strand	Tropical Hammock
Acanthocereus tetragonus	Barbwire cactus, Dildoe cactus	ST, SF3, RGC1	Consider for introduction	-	-	Missing
Agave decipiens	False-sisal	SF3, RGC1	Augment with SE FL germ plasm (not Florida Keys)	-	Rare	Possibly present
Ageratina jucunda	Hammock snakeroot	SF3, RGC1	Reintroduce	-	Ecotonal	Presumed extirpated; reintroduce
Alternanthera flavescens	Yellow joyweed	RGC2	Augment; plant following removal of invasives or seagrape reduction	Occasional	Occasional; augmented in ecotone	Ecotonal
Alternanthera maritima	Seaside joyweed	SF3, RGC1	Augment; plant following removal of invasives or seagrape reduction	Occasional in higher quality dunes	Ecotonal	-
Ambrosia artemisiifolia	Common ragweed		Control if needed	-	A weed if present	A weed if present
Ambrosia hispida	Beach ragweed, Coastal ragweed	SF3, RGC1	Introduce; covers ground, but ephemeral	Translocated by IRC but not yet established	Ecotonal	-
Amyris elemifera	Common torchwood, Sea torchwood	RGC1	Reintroduce	-	-	Possibly extirpated; reintroduce
Andropogon glomeratus var. pumilus	Common bushy bluestem	RGC1	Augment; plant or direct seed following removal of invasives or seagrape reduction	-	Assumed present	-
Annona glabra	Pond-apple		No action	-	-	In ecotone with mangroves

Scientific name	Common names	Status	Restoration Notes	Beach Dune	Coastal Strand	Tropical Hammock
Ardisia escallonioides	Marlberry	RGC2	Augment; plant following removal of invasives or seagrape reduction	-	Rare	Frequent
Aristida purpurascens	Arrowfeather threeawn	RGC2	Consider for introduction	Ecotonal	Missing	-
Avicennia germinans	Black mangrove		No action	-	-	In ecotone with mangroves
Baccharis halimifolia	Saltbush, Groundsel tree, Sea-myrtle	RGC1	Augment	-	Rare	Ecotonal
Bidens alba var. radiata	Spanish-needles		Control if needed	A weed	An aggressive weed	An aggressive weed
Boerhavia diffusa	Red spiderling, Wineflower		Control if needed	-	A weed if present	A weed if present
Bursera simaruba	Gumbo-limbo		Plant following removal of invasives in tropical hammock; reduce in coastal strand	-	Hammock invader; reduce to <6' in height, <1% cover	Common
Caesalpinia major	Large yellow nicker	SE, SF1, RGC1	Consider introduction	-	-	Missing
Caesalpinia bonduc	Gray nicker-bean		Control where needed	Native invasive; reduce to <1% cover, small patches <10 sq. ft.	Native invasive; reduce to <1% cover, small patches <10 sq. ft.	On ecotone with mangroves, but may need control
Cakile lanceolata	Coastal searocket	SF3	Ephemeral annual	One small population near north end of beach; map and protect	Ecotonal	-
Callicarpa americana	American beautyberry	RGC2	Augment	-	-	Present but depleted, rare
Canavalia rosea	Beach-bean, Baybean, Seaside jackbean		Control if needed	Present and abundant	Present; control if needed	-
Cardamine pensylvanica	Pennsylvania bittercress		Control if needed	-	A weed if present	A weed if present
Carica papaya	Papaya		Reintroduce native genotype (with small fruit)	-	Ecotonal	Introduced phenotype present
Cassytha filiformis	Lovevine, Devil's gut		No action	-	Missing	Ecotonal
Celtis laevigata	Sugarberry, Southern Hackberry	RGC1	Augment	-	-	Present on edge of hammock; map

Scientific name	Common names	Status	Restoration Notes	Beach Dune	Coastal Strand	Tropical Hammock
Cenchrus echinatus	Southern sandbur		Control if needed; human hazard	Assumed present; a weed	A weed if present	A weed if present
Cenchrus incertus	Coastal sandbur		No action; human hazard	Occasional	Assumed present	A weed if present
Cenchrus tribuloides	Sanddune sandbur	SF2	No action; human hazard	Possibly present; map if found	Possibly present; map if found	-
Centrosema virginianum	Spurred butterfly-pea	RGC2	Introduce; present at South Beach Park	-	Missing	-
Chamaecrista fasciculata	Partridge pea	RGC1	Consider for introduction	-	Missing	-
Chiococca alba	Common snowberry, Milkberry		Augment	-	Augmented	Occasional
Chromolaena odorata	Jack-in-the-bush		Control if needed	-	An aggressive weed; control	An aggressive weed; control
Chrysobalanus icaco	Coco-plum	RGC2	Augment horizontal form in coastal strand	-	Occasional; augmented	Ecotonal
Chrysophyllum oliviforme	Satinleaf	ST, SF3, RGC1	No action	-	-	Presumably introduced from cultivated plants
Cissus trifoliata	Marinevine, Sorrelvine	SF3, RGC1	Introduce	-	Translocated by IRC but not yet established	-
Cissus verticillata var. verticillata	Possum-grape, Seasonvine		Control if needed	-	A weedy vine	A weedy vine
Citharexylum spinosum	Florida fiddlewood	RGC2	Augment	-	Possibly present	Rare
Cnidoscolus stimulosus	Tread-softly, Finger-rot, 7-minute-itch		Protect	-	Rare	-
Coccoloba diversifolia	Pigeonplum, Tietongue	RGC2	Plant following removal of invasives in tropical hammock	-	-	Frequent
Coccoloba uvifera	Seagrape		Reduce	Reduce to <5%	Reduce to <25%	Present primarily on edges
Coccothrinax argentata	Silver palm	ST, SF3, RGC1	Consider for introduction	-	Missing	-
Commelina erecta	Whitemouth dayflower	RGC1	Augment	Ecotonal; protect	Rare; augmented	-
Conocarpus erectus	Buttonwood		Reduce east of A1A; a mangrove edge species	-	Hammock invader; reduce to <6' in height, <1% cover	In ecotone with mangroves
Crotalaria pumila	Low rattlebox	RGC1	Augment	Ecotonal; protect	Rare; map	-

Scientific name	Common names	Status	Restoration Notes	Beach Dune	Coastal Strand	Tropical Hammock
Crotalaria rotundifolia	Rabbitbells	RGC2	Introduce	Ecotonal	Missing	-
Croton glandulosus var. floridanus	Florida vente conmigo	SF3, RGC1	Consider for introduction; present at South Beach Park	Ecotonal	Missing	-
Croton glandulosus var. septentrionalis	Vente conmigo	RGC1	Reintroduce	Ecotonal	Possibly extirpated	-
Croton linearis	Pineland croton, Grannybush	RGC2	Consider for introduction from Palm Beach County germplasm	-	Missing	-
Croton punctatus	Beach-tea, Gulf croton	SF3, RGC2	Allow for natural recovery	Occasional in higher quality dunes; protect	Ecotonal	-
Cuscuta pentagona	Fiveangled dodder	SF3, RGC2	No action	-	Missing	-
Cynophalla flexuosa	Limber caper, Bayleaf capertree	RGC2	Plant following removal of invasives in tropical hammock	-	-	Rare
Cyperus ligularis	Swamp flatsedge		No action	Possibly present; ecotonal; somewhat weedy	Present; somewhat weedy	Ecotonal
Cyperus planifolius	Flatleaf flatsedge		Augment	-	Rare	Ecotonal
Cyperus tetragonus	Fourangle flatsedge	SF3, RGC1	Reintroduce	-	Presumed extirpated; reintroduce	Ecotonal
Dalbergia ecastaphyllum	Coinvine		Control where needed	Reduce to <1%, small patches <10 sq. ft.	Reduce to <1%, small patches <10 sq. ft.	In ecotone with mangroves
Dalea floridana	Florida prairieclover	FE, SE, SF1, RGC1	Introduce from plants being grown by Fairchild Tropical Botanic Garden	-	Missing	-
Desmodium incanum	Beggar's-ticks		Control if needed	-	A weed if present	A weed if present
Dichondra carolinensis	Pony-foot, Carolina ponysfoot		No action	-	Present	Ecotonal
Dicliptera sexangularis	False-mint, Sixangle foldwing	RGC1	Consider for introduction	-	-	Missing
Digitaria ciliaris	Southern crabgrass		Control if needed	-	A weed if present	A weed if present

Scientific name	Common names	Status	Restoration Notes	Beach Dune	Coastal Strand	Tropical Hammock
Diospyros virginiana	Persimmon, Common persimmon	RGC1	Augment	-	Present on edge of hammock; map	Present on edge of hammock; map
Dodonaea viscosa var. viscosa	Varnishleaf, Florida hopbush	SF2, RGC1	Introduce	-	Translocated by IRC but not yet established	-
Drymaria cordata	West Indian chickweed, Drymary		Control if needed	-	A weed if present	A weed if present
Drypetes lateriflora	Guiana-plum	ST, SF3, RGC1	Protect	-	-	Occasional; protect
Echites umbellatus	Devil's-potato, Rubbervine	RGC1	Augment	-	Rare; augmented	-
Encyclia tampensis	Florida butterfly orchid	SCE, RGC2	Consider for introduction	-	-	Missing
Eragrostis elliottii	Elliott's love grass	RGC2	Introduce; plant following removal of invasives or seagrape reduction	-	Missing	-
Erithalis fruticosa	Blacktorch	ST, SF3, RGC1	Introduce	-	Translocated by IRC but not yet established	-
Ernodea littoralis	Beach-creeper, Golden-creeper, Coughbush	RGC2	Reintroduce	Ecotonal	Presumed extirpated; translocated by IRC but not yet established	-
Erythrina herbacea	Coralbean, Cherokee bean	RGC2	Augment in coastal strand	-	Augmented	Rare on edges
Eugenia axillaris	White stopper		Plant following removal of invasives in tropical hammock; reduce in coastal strand	-	Hammock invader; reduce to <6' in height, <1% cover	Occasional
Eugenia foetida	Spanish stopper, Boxleaf stopper	RGC2	Augment; plant following removal of invasives or seagrape reduction	-	Reduce to <6' in height	Common
Euphorbia bombensis	Sand-dune spurge, Dixie sandmat	SF3	Allow for natural recovery; will recruit in open sand	Occasional in higher quality dunes	-	-
Euphorbia cyathophora	Paintedleaf, Fire-on-the-mountain		Control if needed	Present, somewhat weedy	Present, somewhat weedy	A weed if present

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Euphorbia heterophylla	Fiddler's spurge, Mexican fireplant		Control if needed	-	A weed if present	A weed if present
Euphorbia hirta	Hairy spurge, Pillpod sandmat		Control if needed	-	A weed if present	A weed if present
Euphorbia hypericifolia	Eyebane, Graceful sandmat		Control if needed	-	A weed if present	A weed if present
Euphorbia hyssopifolia	Eyebane, Hyssopleaf sandmat		Control if needed	-	A weed if present	A weed if present
Euphorbia maculata	Milk-purslane, Spotted sandmat	SF3	Allow for natural recovery	Present in disturbed areas	Present in disturbed areas	-
Euphorbia mesembryanthemifolia	Seaside spurge, Coastal beach sandmat		Allow for natural recovery	Occasional	Ecotonal	-
Euphorbia prostrata	Prostrate sandmat		Control if needed	-	A weed if present	A weed if present
Euphorbia trichotoma	Sanddune spurge	SF1	Consider for introduction	Missing	Missing	-
Eustachys petraea	Common fingergrass, Pinewoods fingergrass	RGC1	Augment; plant following removal of invasives or seagrape reduction	Ecotonal	Translocated; by IRC but not yet established	-
Exothea paniculata	Inkwood, Butterbough	RGC2	Augment; plant following removal of invasives or seagrape reduction	-	-	Rare
Ficus aurea	Strangler fig, Golden fig		Reduce in coastal strand; Allow for natural recovery in tropical hammock	-	Hammock invader; reduce to <6’ in height, <1% cover	Frequent
Flaveria linearis	Narrowleaf yellowtops	RGC1	Consider for introduction	-	Missing	-
Forestiera segregata	Florida privet, Florida swampprivet	RGC2	Allow for natural recovery; reduce if needed in coastal strand	-	Reduce to <6’ in height	Ecotonal
Funastrum clausum	Whitevine, White twinevine		Protect	-	-	Present in ecotone with mangroves
Galactia volubilis	Downy milkpea	RGC1	Allow for natural recovery; augment	Ecotonal	Rare	-
Galium bermudense	Coastal bedstraw	RGC2	Consider for introduction	-	Ecotonal	Missing

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Glandularia maritima	Beach verbena, Coastal mock vervain	FLE, SE, SF2, RGC1	Reintroduce	-	Presumed extirpated; translocated by IRC but not yet established	-
Guapira discolor	Blolly, Beeftree	RGC2	Augment; plant following removal of invasives or seagrape reduction	-	Reduce to <6' in height	Present
Guettarda scabra	Rough velvetseed	RGC1	Consider for introduction	-	Missing	Ecotonal
Habenaria floribunda	Rein orchid, Toothpetal false reinorchid	RGC2	Consider for introduction	-	-	Missing
Hamelia patens var. patens	Firebush		Control as needed	-	Hammock invader; remove if present	Introduced from cultivated plants
Helianthus debilis subsp. debilis	East Coast dune sunflower		Augment following removal of invasives or seagrape reduction	Occasional; ephemeral	Rare; ephemeral;	-
Heliotropium angiospermum	Scorpionstail	RGC2	Allow for natural recovery	-	Present; map	Present; map
Heliotropium polyphyllum	Pineland heliotrope	RGC2	Introduce	-	Translocated by IRC but not yet established	-
Heterotheca subaxillaris	Camphorweed	RGC2	Consider for introduction	Ecotonal	Missing	-
Hymenocallis latifolia	Mangrove spiderlily, Perfumed spiderlily		Plant following removal of invasives or seagrape reduction	Occasional	Ecotonal	Possibly present in ecotone with mangroves
Ipomoea alba	Common moonflowers, Moonflowers		Control if needed	-	Possibly present; map if found	Assumed present; map if found
Ipomoea imperati	Beach morningglory	SF2, RGC1	Introduce on foredune; ephemeral	Translocated by IRC but not yet established	Ecotonal	-
Ipomoea indica	Ocean-blue morningglory		Control as needed	-	Aggressive vine; reduce to <5% cover	Aggressive vine; reduce to <5% cover
Ipomoea pes-caprae subsp. brasiliensis	Railroad vine, Bayhops		No action	Present and abundant	Ecotonal	-

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Ipomoea violacea	Coastal morningglory		Control if needed	Possibly present; map if found	Rare	Occasional
Iresine diffusa	Juba's bush, Bloodleaf	RGC2	Plant following removal of invasives or seagrape reduction	-	Rare	Ecotonal
Iva imbricata	Beach-elder, Seacoast marshelder		Plant following removal of invasives or seagrape reduction	Frequent	Ecotonal	-
Jacquemontia reclinata	Beach clustervine	FLE, FE, SE, SF1, RGC1	Reintroduce	-	Presumed extirpated; translocated by IRC but not yet established	-
Krugiodendron ferreum	Black ironwood	RGC2	Allow for natural recovery	-	-	Frequent
Laguncularia racemosa	White mangrove		No action	-	-	In ecotone with mangroves
Lantana sandersii var. sandersii	East coast lantana, Florida shrubverbena	SE, SF1, RGC1	Introduce after eliminating invasive Lantana	-	Missing	-
Lantana involucrata	Wild-sage, Buttonsage	RGC2	Augment; plant following removal of invasives or seagrape reduction	-	Rare	Ecotonal
Lepidium virginicum	Poor-man's-pepper, Virginia pepperweed		Control if needed	-	A weed if present	A weed if present
Licania michauxii	Gopher-apple	RGC1	Reintroduce; at South Beach Park	-	Presumed extirpated; translocated by IRC but not yet established	-
Melanthera nivea	Snow squarestem	RGC1	Reintroduce	-	Possibly extirpated; reintroduce	-
Melothria pendula	Creeping-cucumber	RGC1	No action	-	Rare	Rare
Mentzelia floridana	Poorman's-patch, Stickleaf	SF3, RGC1	No action	-	Missing	Ecotonal
Metopium toxiferum	Poisonwood, Florida poisontree		Label and protect	-	Rare	Rare

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Mikania cordifolia	Florida Keys hempvine	RGC1	Reintroduce	-	Presumed extirpated	-
Mikania scandens	Climbing hempweed, Climbing hempvine	RGC1	Consider for introduction	-	Missing	-
Morinda royoc	Mouse's pineapple, Redgal, Yellowroot	RGC1	Reintroduce	-	Presumed extirpated; translocated by IRC but not yet established	-
Morus rubra	Red mulberry	RGC1	Augment	-	-	Rare on edge of hammock; map
Muhlenbergia capillaris	Muhlygrass, Hairawn muhly		No action	-	Missing	-
Myrcianthes fragrans	Twinberry, Simpson's stopper	ST	Within native range but not known from coastal uplands in this area	-	Reduce to <6' in height	Introduced from cultivated plants
Myrica cerifera	Wax myrtle, Southern Bayberry		Reintroduce	-	Possibly extirpated	Ecotonal
Myrsine cubana	Myrsine, Colicwood	RGC2	Augment; plant following removal of invasives or seagrape reduction	-	Augmented; reduce to <6' in height	Occasional
Nectandra coriacea	Lancewood	RGC2	Plant following removal of invasives in tropical hammock	-	-	Frequent
Nephrolepis exaltata	Wild Boston fern	RGC2	Introduce from verified source	-	-	Missing
Neptunia pubescens	Tropical-puff	RGC1	Reintroduce; present at South Beach Park	-	Possibly extirpated	-
Oenothera humifusa	Seaside evening-primrose	RGC1	Consider for introduction	Ecotonal	Missing	-
Oenothera simulans	Southern gaura, Southern beeblossum	RGC1	Consider for introduction	-	Missing	-
Okenia hypogaea	Beach-peanut, Burrowing four-o'clock	SE, SF2	Allow for natural recovery; annual	Present but ephemeral	Ecotonal	-
Oplismenus hirtellus subsp. setarius	Woodsgrass, Basketgrass	RGC2	Consider for introduction	-	-	Missing

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Opuntia humifusa	Pricklypear	RGC1	Reintroduce from coastal germplasm	Ecotonal	Presumed extirpated; translocated by IRC but not yet established	-
Opuntia stricta	Erect pricklypear	ST, RGC2	Augment through division of existing plants	Occasional	Occasional	-
Orthosia scopoaria	Hairnetvine, Leafless swallowwort	RGC1	Introduce	-	-	Missing
Oxalis corniculata	Lady's-sorrel, Common yellow woodsorrel		Control if needed	-	A weed if present	A weed if present
Panicum amarum	Beachgrass, Bitter panicgrass, Bitter panicum		Plant following removal of invasives or seagrape reduction	Frequent	Occasional	-
Panicum virgatum	Switchgrass	RGC2	Consider for introduction	-	Missing	-
Parthenocissus quinquefolia	Virginia-creeper, Woodbine		Control if needed	-	Occasional	Frequent
Paspalum setaceum	Thin paspalum		No action	-	Rare	Ecotonal
Paspalum vaginatum	Seashore paspalum		Plant where appropriate following removal of invasives or seagrape reduction	Assumed present	Ecotonal	-
Passiflora suberosa	Corkystem passionflower	RGC1	Allow for natural recovery	-	Occasional	Ecotonal
Pentalinon luteum	Wild-allamanda, Hammock viperstail	RGC1	Reintroduce	-	Presumed extirpated; translocated by IRC but not yet established	Presumed extirpated
Persea borbonia var. borbonia	Red bay	SF3. RGC1	Augment	-	Introduced from cultivated plants; rare on hammock edge; map	Introduced from cultivated plants; rare on hammock edge; map
Phlebodium aureum	Golden polypody	RGC1	Allow for natural recovery	-	-	Freequent

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Phyla nodiflora	Turkey tangle fogfruit, Capeweed, Frogfruit	RGC1	Introduce	-	Translocated by IRC but not yet established	-
Phyllanthus abnormis	Drummond's leafflower	SF3, RGC1	Consider for introduction	Missing	Missing	-
Physalis walteri	Walter's groundcherry	RGC1	Reintroduce; present at South Beach Park	Ecotonal	Possibly extirpated	-
Phytolacca americana	American pokeweed		No action	-	Rare	Ecotonal
Pilea microphylla	Artillery plant, Rockweed		No action	-	A weed if present	Present
Piriqueta cistoides var. caroliniana	Piriqueta, Pitted stripeseed	RGC1	Consider for introduction	-	Missing	-
Pithecellobium keyense	Florida Keys blackbead	ST, RGC2	Augment; plant following removal of invasives or seagrape reduction	-	Rare	Rare
Pleopeltis polypodioides var. michauxiana	Resurrection fern	RGC1	Allow for natural recovery	-	-	Rare
Plumbago zeylanica	Wild plumbago, Doctorbush, Florida plumbago, White plumbago	SF3, RGC1	No action	-	Ecotonal	Rare
Polygala violacea	Guava	RGC2	Reintroduce	Ecotonal	Possibly extirpated	-
Portulaca pilosa	Pink purslane, Kiss-me-quick	RGC1	Consider for introduction	-	Missing	-
Psilotum nudum	Whisk-fern	RGC1	No action	-	-	Rare
Psychotria nervosa	Shiny-leaved wild coffee		Plant following removal of invasives in tropical hammock	-	Present; do not augment	Common
Psychotria tenuifolia	Shortleaf wild coffee	RGC2	Consider for introduction	-	-	Missing
Quadrella cynophallophora	Jamaica caper-tree	RGC2	Plant following removal of invasives in tropical hammock	-	-	Rare
Quercus virginiana	Virginia live oak		No action	-	-	Rare

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Randia aculeata	White indigoberry	RGC2	Augment; plant following removal of invasives or seagrape reduction	-	Augment; maintain at <6 feet in height	Occasional
Remirea maritima	Beachstar	SE, SF2	Allow for natural recovery; will recruit in open sand	Occasional, mostly in areas of open sand	-	-
Rhabdadenia biflora	Mangrove rubbervine, Mangrovevine		Protect	-	-	Present in ecotone with mangroves
Rhizophora mangle	Red mangrove		No action	-	-	Present in ecotone with mangroves
Rhynchosia minima	Least snoutbean		Control if needed	-	A weedy vine if present	A weedy vine if present
Rivina humilis	Rougeplant		No action	-	Occasional	Ecotonal
Sabal palmetto	Cabbage palm		Reduce in coastal strand	Ecotonal	Reduce to <6' in height, <5% cover	Frequent
Salvia coccinea	Tropical sage, Scarlet sage, Blood sage	SF2, RGC1	Reintroduce from coastal germplasm	-	Presumed extirpated; cultivated in butterfly garden only	-
Scaevola plumieri	Inkberry, Beachberry, Gullfeed	ST, SF3	Plant following removal of invasives or seagrape reduction	Frequent, a healthy population	Ecotonal	-
Schoepfia schreberi	Gulf graytwig, Graytwig	SF3, RGC2	Consider for introduction	-	-	Missing
Serenoa repens	Saw palmetto	RGC2	Should be dominant in coastal strand with 25-50% cover	Ecotonal	Protect and restore stressed patches; allow for recovery to 25-50% cover in areas targeted for coastal strand restoration	In open pockets
Sesuvium portulacastrum	Perennial sea-purslane, Shoreline seapurslane		Augment along front line of dune	Occasional	Ecotonal	-

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Setaria macrosperma	Coastal foxtail, Coral bristlegrass	SF3, RGC2	Consider for introduction	-	Missing	Ecotonal
Sida acuta	Common wireweed, Common fanpetals		Control if needed	-	A weed if present	A weed if present
Sideroxylon foetidissimum	Wild mastic, False mastic	RGC2	Plant following removal of invasives in tropical hammock	-	-	Frequent
Sideroxylon salicifolium	Willow-bustic, White bully	RGC2	Plant following removal of invasives in tropical hammock	-	-	Presumed introduced from cultivated plants
Simarouba glauca	Paradisetree	RGC2	Plant following removal of invasives in tropical hammock	-	-	Occasional
Smilax auriculata	Earleaf greenbrier		Control if needed	-	Occasional	Ecotonal
Smilax bona-nox	Saw greenbrier	RGC2	No action	-	Possibly extirpated	-
Smilax havanensis	Havana greenbrier, Everglades greenbrier	ST, SF3, RGC1	Protect	-	Rare	-
Solanum bahamense	Bahama nightshade	SF3, RGC1	Augment; plant following removal of invasives or seagrape reduction	-	Rare	-
Solidago sempervirens	Seaside goldenrod		Introduce	Ecotonal	Translocated by IRC but not yet established	-
Sophora tomentosa var. truncata	Yellow necklacepod	SF3, RGC1	Reintroduce	Ecotonal	Presumed extirpated; translocated by IRC but not yet established	-
Spartina patens	Marshhay cordgrass, Saltmeadow cordgrass	SF2	Plant following removal of invasives or seagrape reduction	Rare	Ecotonal species	-
Spermacoce remota	Woodland false buttonweed		Control if needed	-	A weed	-

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Sporobolus virginicus	Seashore dropseed		Plant following removal of invasives or seagrape reduction	Occasional	-	-
Suriana maritima	Baycedar	RGC1	Reintroduce; plant following removal of invasives or seagrape reduction	Presumed extirpated; translocated by IRC but not yet established	Presumed extirpated; translocated by IRC but not yet established	-
Tephrosia curtissii	Curtiss' hoarypea	FLE, SE, SF3 RGC1	Reintroduce from plants being grown by Fairchild Tropical Botanic Garden	-	Presumed extirpated	-
Thelypteris kunthii	Southern shield fern	RGC2	Consider for introduction	-	-	Missing
Tillandsia fasciculata var. densispica	Stiff-leaved wild-pine, Cardinal airplant	SE, RGC2	Allow for natural recovery	-	-	Presumably introduced from cultivated plants
Tillandsia recurvata	Ball-moss	RGC2	Allow for natural recovery	-	-	Present near butterfly garden
Tillandsia usneoides	Spanish-moss	RGC2	Consider for introduction	-	-	Missing
Tillandsia utriculata	Giant wild-pine, Giant airplant	SE, RGC2	Consider for introduction	-	-	Missing
Tournefortia gnaphalodes	Sea-lavender	SE, SF3	Introduce	Translocated by IRC but not yet established	-	-
Toxicodendron radicans	Eastern poison-ivy		Control where needed; do not extirpate	-	Rare	Ecotonal
Trema micrantha	Florida trema, Nettletree	RGC1	Allow for natural recovery where appropriate	-	Rare	Ecotonal
Trichostema dichotoma	Forked bluecurls	RGC1	Reintroduce	Ecotonal	Presumed extirpated; translocated; introduce	-

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Uniola paniculata	Sea-oats		Plant following removal of invasives or seagrapes reduction	Dominant	-	-
Verbesina virginica	Frostweed, White crownbeard	RGC1	Augment	-	Rare	Ecotonal
Vigna luteola	Cow-pea, Hairypod cowpea		Control as needed	Aggressive vine; reduce to <5% cover	Aggressive vine; reduce to <2% cover	Aggressive vine; reduce to <2% cover
Vitis cinerea var. floridana	Florida grape	RGC1	Protect; allow for natural recovery	-	-	Present
Vitis rotundifolia	Muscadine, Muscadine grape	RGC2	Control if needed	-	Rare	Ecotonal
Vitis shuttleworthii	Calusa grape	RGC1	Reintroduce	-	-	Possibly extirpated; reintroduce
Vittaria lineata	Shoestring fern	RGC2	Consider for introduction	-	-	Missing
Yucca aloifolia	Spanish-bayonet, Aloe yucca	RGC2	Augment	Ecotonal	Occasional	-
Ximenia americana	Hog-plum, Tallowwood	RGC2	Consider for introduction	-	-	Missing
Zamia integrifolia	Coontie , Florida arrowroot	SCE	No action; within native range but not typical of coastal uplands in this area	-	Cultivated	Cultivated
Zanthoxylum clava-herculis	Hercules'-club	SF3, RCG1	Within native range but not typical of coastal uplands in this area;	-	Missing	Missing; on edges
Zanthoxylum coriaceum	Biscayne prickly-ash	SE, SF1, RGC1	Consider for introduction		-	Missing; on edges
Zanthoxylum fagara	Wild-lime, Lime prickly-ash	RGC2	Consider for introduction	-	Occasional	Occasional