Nature-Based Coastal Defenses in Southeast Florida

Published by
The Nature Conservancy
Protecting nature. Preserving life.
Southeast Florida Regional Compact Climate Change

INTRODUCTION

Miami Beach skyline ©Ines Hegedus-Garcia, 2013

Assessments of the world's metropolitan areas with the most to lose from hurricanes and sea level rise place southeast Florida at the very top of their lists. Much infrastructure and many homes, businesses and natural areas from Key West to the Palm Beaches are already at or near sea level and vulnerable to flooding and erosion from waves and storm surges. The region had 5.6 million residents in 2010—a population greater than that of 30 states—and for many of these people, coastal flooding and erosion are not only anticipated risks of tomorrow's hurricanes, but a regular consequence of today's highest tides.

Billions of dollars in property value may be swept away in one storm or slowly eroded by creeping sea level rise. This double threat, coupled with a clearly accelerating rate of sea level rise and predictions of stronger hurricanes and continued population growth in the years ahead, has led to increasing demand for action and willingness on the parts of the public and private sectors to be a part of solutions. Practical people and the government institutions that serve them want to know what those solutions are and what they will cost.

Traditional "grey infrastructure" such as seawalls and breakwaters is already common in the region but it is not the only option. Grey infrastructure will always have a place here and in some instances it is the only sensible choice, but it has significant drawbacks. These include negative impacts on the natural environment, high initial construction costs and significant replacement costs.

Hurricane Sandy approaching the northeast coast of the United States. ©NASA

This narrow beach could not stop Sandy's waves but it sheltered State Road A1A and these homes. ©South Florida Sun-Sentinel

Nature-Based Coastal Defenses in Southeast Florida

INTRODUCTION

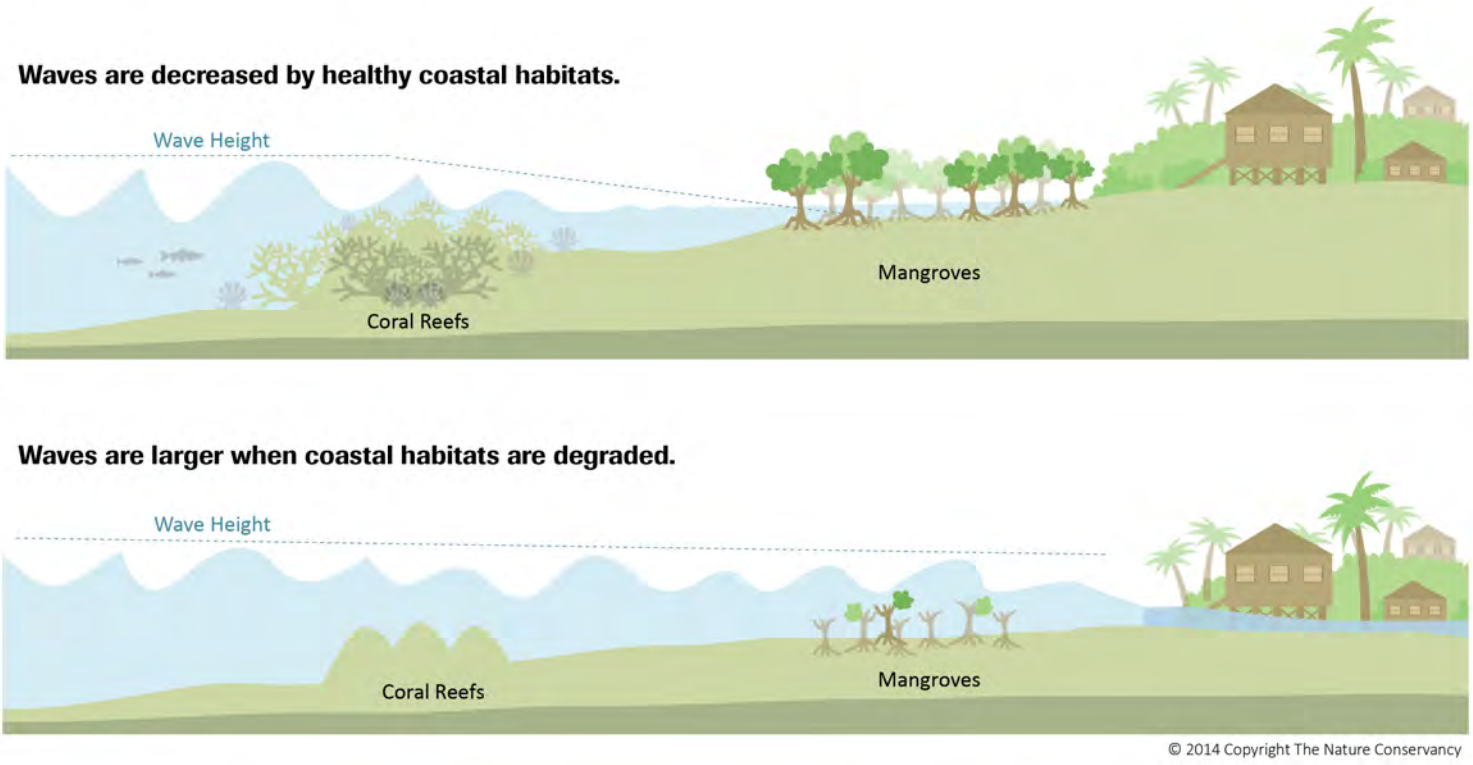
By comparison, natural or nature-based coastal defenses can be cost-effective, self-maintaining and adaptable to changing conditions including sea level rise. They are designed and constructed to work in harmony with the natural environment. In many instances they simply are the environment.

Southeast Florida's coral reefs, beaches, dunes, wetlands and coastal forests are well known for the critical habitat they provide for wildlife and are understood to be an integral part of the diverse mix of attractions that anchors the region's tourism and real estate-driven economy.

Southeast Florida's leaders are beginning to appreciate and understand the value of the coastal protection services that natural features provide to us at no cost. As a result, they are investing in the protection and restoration of marine and coastal natural areas, as well as exploring nature-based constructed projects to shore up what we now recognize as the front lines of our defense against storms.

The seven case studies in this packet were compiled by The Nature Conservancy and the Southeast Florida Regional Climate Change Compact to spotlight the role of natural and nature-based approaches to coastal defense. A diverse set of project types and sizes was selected from locations across the region. Case study project leaders include county and municipal governments and a not-for-profit conservation organization working with a consortium of public and private players. These case studies are representative of numerous other excellent projects that have been completed in southeast Florida.

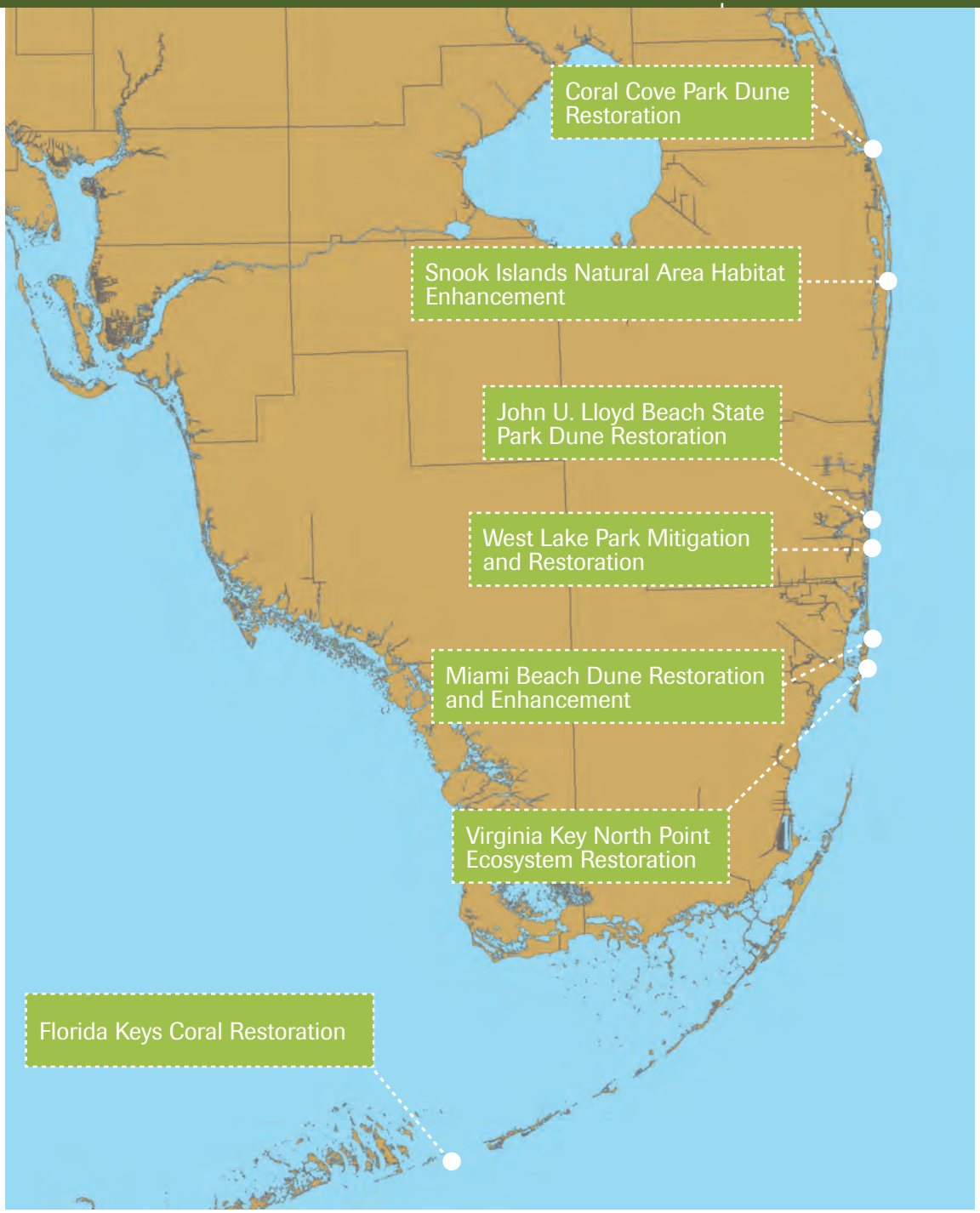
Perhaps most importantly, these case studies are representative of projects that have yet to be conceived and implemented. The Nature Conservancy and the Compact are developing a catalogue of new project opportunities based on cutting-edge science and local knowledge. In order to become a reality, every potential project will need a champion who recognizes the value of nature in protecting our coastal communities from storms and sea level rise.



Nature-Based Coastal Defenses in Southeast Florida

PROJECT LOCATOR MAP

Published by
The Nature Conservancy
Protecting nature. Preserving life.
SOUTHEAST FLORIDA REGIONAL COMPACT CLIMATE CHANGE



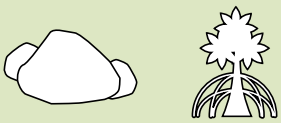
These seven case studies represent a range of natural or nature-based projects that mitigate the effects of flooding and erosion in southeast Florida. Some of the projects involved restoration of native species populations or natural features that had been degraded or lost over time. Others created entirely new coastal features by combining natural materials and native species in novel constructions. Some were designed with coastal defense objectives squarely in mind and others were not. But whether large or small or complex or simple, every one of these projects left the natural world and nearby coastal communities in better shape than it found them.

To access the full report, visit **nature.org/southeastfloridareport**

Nature-Based Coastal Defenses in Southeast Florida

PROJECT DESCRIPTION

Published by
The Nature Conservancy
Protecting nature. Preserving life.

PROJECT		Total Acres
Coral Cove Dune Restoration Project		20 acres
Snook Islands Natural Area Habitat Enhancement Project		70 acres
John U. Lloyd Beach State Park Dune Restoration Project		2.5 acres
West Lake Park Mitigation and Restoration Project		27 acres
Miami Beach Dune Restoration and Enhancement Project		54 acres
Virginia Key North Point Ecosystem Restoration Project		17 acres
Florida Keys Coral Restoration Project		1 acre

ICON KEY

Coastal Wetland
Breaks waves along the shoreline, provides critical habitat for fish, invertebrates and other wildlife

Coral Reef
Breaks waves offshore, provides critical habitat for fish and invertebrates, provides tourism and recreational opportunities

Oyster Reef
Breaks waves offshore, provides critical habitat for fish and invertebrates, improves water quality via filtration

Structure
Riprap or other constructed shoreline features that protect from waves and erosion

Beach/Dune
Breaks waves along the shoreline, provides habitat for turtles, birds and other wildlife, and provides tourism and recreational opportunities

Coral Cove
Dune Restoration Project

Published by
The Nature Conservancy
Protecting nature. Preserving life.
Southeast Florida Regional Compact Climate Change

Healthy dunes are a vital component of the coastal ecosystem that naturally protects shorelines from storm erosion. Native salt-resistant dune vegetation traps windblown sand and collects it around plants, which builds dunes and surrounding beaches. Dunes also provide a reserve supply of sand to replenish beaches during times of severe erosion. This process is critical to maintaining beautiful beaches that are attractive to residents and tourists alike. In 2013, more than 1.5 million people visited Palm Beach County's beaches. While there, those visitors spent an estimated $160 million.

Coral Cove is a popular beachfront park on Jupiter Island. Its shoreline has one of the highest density nesting beaches in the state for threatened and endangered sea turtles and is part of the 31 miles designated as critically-eroded in Palm Beach County. The dune there has been impacted by storm erosion over the past twenty years. In 2012, the dune suffered severe erosion as a result of Hurricane Sandy, putting upland infrastructure and private homes at risk. The eroded beach-dune system also restricts visitors from accessing and enjoying the park, and detrimentally affects the abilities of sea turtles to safely nest.

In order to maintain a healthy beach-dune system, periodic dune restoration projects must be constructed in eroded areas. Beach compatible sand is trucked in from an inland mine and added to the dune. Heavy equipment then grades the sand into a natural dune profile. Finally, native dune vegetation is planted to create habitat and help hold the sand in place. Over 83,000 cubic yards of sand and more than 150,000 native dune plants have been placed as part of five different restoration projects within the park since 1989.

Completed dune planted with sea oats ©Palm Beach County Environmental Resource Management

FAST FACTS:

Project cost: $775,000

Project size: 20 acres

Additional information about Coral Cove can be found by visiting:
http://www.co.palm-beach.fl.us/erm/coastal/shoreline/dune-restoration.htm
www.nature.org/southeastfloridareport

Coral Cove Dune Restoration Project

Dune Damaged by Hurricane Sandy, October 2012
©Palm Beach County Environmental Resource Management

Dune restoration in progress
©Palm Beach County Environmental Resource Management

Completed dune restoration ©Palm Beach County Environmental Resource Management

PARTNERS

Snook Islands Natural Area Habitat Enhancement Project

Published by
The Nature Conservancy
Protecting nature. Preserving life.
Southeast Florida Regional Compact Climate Change

The Lake Worth Lagoon (LWL) in Palm Beach County was previously a freshwater lake fed by water from the Everglades to the west. In the 1870s, a permanent oceanic inlet was established near Palm Beach converting the freshwater lake into an estuarine system. Mangroves and other estuarine flora and fauna took over the lagoon. Over the next 100 years, however, the Lake Worth Lagoon experienced a significant assault on its natural resources. Dredging, filling and bulkhead construction eliminated over 80 percent of the mangrove fringe and much of the lagoon's intertidal and shallow sub-tidal resources. Productive fish and wildlife habitat was almost completely eliminated. Currently, approximately 65 percent of the lagoon shoreline is bulkheaded, and less than 20 percent of the shoreline remains fringed by mangroves.

In an effort to reverse the damage to the LWL, Palm Beach County Environmental Resource Management has initiated a number of enhancement projects to recreate some of the lost fish and wildlife habitat. One of these is the Snook Islands Natural Area habitat enhancement and erosion control project completed in 2005. Approximately 1.2 million cubic yards of spoil were mined from the Peanut Island spoil stockpile, transported 10 miles by barge (1,560 barge loads), and used to raise the elevation of a deep dredged hole created in 1925 when a nearby golf course was constructed. This hole had accumulated very fine organic sediments (muck) and created an anoxic environment providing little fish and wildlife habitat value onshore, major sections of the golf course's seawall had failed, and the upland was eroding into the LWL.

Project construction resulted in creation of 10 acres of red mangroves, 2.8 acres of Spartina marsh, 2.3 acres of oyster reef and nearly 50 acres of seagrass recruitment area. Constructing the offshore mangrove islands and oyster reefs created valuable fish and wildlife habitat and provided a buffer against waves and boat wakes precluding the need to construct a new seawall for shoreline protection.

A seagrass survey conducted in 2010 revealed that seagrasses had covered more than 87 percent of the project area at an average density of 30.4 percent. The mangroves and smooth cordgrass are thriving and provide excellent fish and wildlife habitat. Oysters are recruiting to the riprap and reef pods—limestone rock piles intentionally placed at the optimum elevation to recruit oysters—at densities equaling the naturally occurring reefs in the lagoon. A pair of rare American oystercatchers has nested at Snook Islands every year since construction. They have produced 12 fledged chicks in the past nine years, and a new pair began nesting this year.

Snook Islands, 2011 ©Palm Beach County, ERM

FAST FACTS:

Project cost: $17,000,000

Project size: Approximately 70 acres

Additional information about Snook Island can be found by visiting:
www.co.palm-beach.fl.us/erm/lakes/estuarine/snook/
www.nature.org/southeastfloridareport

Snook Islands Natural Area Habitat Enhancement Project

Snook Islands shoreline, 2011©Palm Beach County, ERM

Fill being placed and graded at Snook Islands, 2004
©J.E. McAmis Inc.

Snook Islands mangrove island at high tide, January, 2013
©Palm Beach County, ERM

Snook Islands shoreline, 2011
©Palm Beach County, ERM

PARTNERS

US Army Corps of Engineers

John U. Lloyd Beach State Park Dune Restoration Project

Published by
The Nature Conservancy
Protecting nature. Preserving life.

Broward County has a total of 24 miles of shoreline, 21 miles of which is designated as critically eroded. The shoreline at John U. Lloyd Beach (JUL) State Park is of particular concern because it is subject to the influences of Port Everglades Inlet channel and jetties. These navigation features form a complete barrier to sand transport. Consequently, the beaches at JUL are severely eroded. A series of expensive and short-lived beach renourishment projects were undertaken along the park's shoreline to offset that erosion. Accordingly, the community is looking to implement more lasting shoreline management strategies, such as the restoration of sand dunes, to make their beaches resilient.

The goals of the project were to improve community awareness about the importance of dune features as part of a regional shoreline management strategy and to demonstrate the power of teamwork and community engagement in the restoration of sand dunes at JUL. The involvement of community youth fostered a sense of personal accomplishment and awareness of the importance of environmental stewardship, and helped instill an appreciation for shoreline resilience strategies. To undertake this project, local students and community volunteers were provided with instruction and hands-on training in shoreline resiliency, beach erosion, beach and dune ecology and proper dune vegetation planting. Afterwards, Broward County staff, Youth Environmental Alliance (YEA) and the park service worked with the volunteers to prepare and fence off the sites to be restored.

Over the course of four events, volunteers planted more than 7,000 sea oats in the fore dune to mitigate future beach erosion. Additionally, more than 1000 native dune plants of 14 different species were planted in the mid and back dune to diversify the plant community and improve the ecological function of the dune.

The success of the JUL Beach State Park Dune Restoration Project continues to resonate in the community. YEA has formed partnerships with the Town of Lauderdale-By-The-Sea in Broward County, the Town of Surfside in Miami-Dade County and Boca Raton in Palm Beach County to conduct additional community volunteer-based dune restoration projects.

The JUL Beach State Park Dune Restoration Project is an example of a successful partnership between government, a non-profit and corporate sector who share common goals in promoting sustainable environmental programs and developing resilient communities.

The project was funded by a 2013 Keep America Beautiful/Waste Management ThinkGreen® Grant.

Dunes and Rainbow ©David Stout

Victor Suarez and Sea Oats ©Broward County EPCRD, 2013

New Sea Oat Plantings ©David Stout

FAST FACTS:

Project cost: $10,000

Project size: 2.5 acres

Additional information about John U. Lloyd can be found by visiting:
www.broward.org/NaturalResources/BeachAndMarine/Pages/KeepBrowardBeautiful.aspx
www.yeafrog.org/news.htm
www.nature.org/southeastfloridareport

John U. Lloyd Beach State Park Dune Restoration Project

PARTNERS

West Lake Park Mitigation and Restoration Project

Published by
The Nature Conservancy
Protecting nature. Preserving life.

In 2011, Broward County completed a $10 million mitigation and coastal habitat restoration project to replace 15 acres of wetland habitat lost when Fort Lauderdale-Hollywood International airport expanded their facilities. To offset the impacts of the airport development, new habitat was created and degraded habitat was improved at nearby West Lake Park.

The first step of this project was the removal of invasive, non-native Australian pines that were brought to this area at the turn of the 20th century. Over the past hundred-plus years, the invasive, fast spreading trees overtook natural habitats and displaced native wildlife within the park. Hydrologic improvements were then made by grading restoration sites to specific depths that created five ecotones: channels, mangroves, mudflats, hammocks and tidal pools. This facilitated natural recruitment and germination of mangroves and other aquatic vegetation. The installation of a 4,700-foot riprap (rock) crib reduced wave action, protecting the shoreline from erosion while still allowing water exchange. Additionally, the riprap crib provides habitat for juvenile fish, marine invertebrates and the birds that prey on them.

Overall, the coastal habitat restoration included:

- Removal of 3.5 acres of invasive vegetation and planting of native vegetation
- Creation of 13 acres of mangrove wetlands
- Stabilization and enhancement of seven acres of mangrove through riprap crib structure
- Acquisition and preservation of 4.25 acres of additional park land

The unique nature of this mitigation and habitat restoration project received widespread attention from environmental groups and regulatory agencies nationwide. The project has been so successful that it is now used by the University of Florida in its Master Naturalist Program training classes.

West Lake Park is the largest remaining mangrove system in the 85-mile, highly developed urban coastal zone from Miami Beach to West Palm Beach. This vital coastal habitat provides valuable natural resource functions and significant recreational opportunities to urban residents and visitors.

Riprap crib and hammock planting ©Paul Krashefski, Broward County, EPCRD, 2011

FAST FACTS:

Project cost: $10 million

Project size: 27 acres

Additional information about West Lake Park can be found by visiting:
http://www.broward.org/Parks/WestLakePark/Pages/Default.aspx
www.nature.org/southeastfloridareport

West Lake Park Mitigation and Restoration Project

Riprap crib mangrove hammock close up ©Paul Krashefski, Broward County, EPCRD, 2011

Riprap crib ©Paul Krashefski, Broward County EPCRD, 2011

PARTNERS

BROWARD COUNTY FLORIDA

Miami Beach Dune Restoration and Enhancement Project

Published by
The Nature Conservancy
Protecting nature. Preserving life.
Southeast Florida Regional Compact Climate Change

Between 1975 and 1980, the United States Army Corps of Engineers (USACE) and the Florida Department of Environmental Protection (FDEP) fortified the City of Miami Beach's eastern shoreline as part of the Beach Erosion Control and Hurricane Protection Project. The scope of the project included using offshore sand to nourish the beaches and to construct a non-vegetated levee. In the mid-1980s, the sand levee, or sand dune, was vegetated by FDEP to improve its protective function, creating the vegetated dune that exists today. In the past, the city's dune system was not on a dedicated maintenance schedule, so vegetation in certain areas became overgrown and created favorable conditions for homeless encampments and illicit activities. In addition, non-native invasive vegetation grew aggressively and crowded out native species, increasing the potential for erosion and decreasing the system's ability to withstand sustained wind and wave action.

In 2013, the city, in coordination with a professional dune ecologist, developed a citywide dune restoration and enhancement project to restore the health and structural integrity of the entire dune system and to fortify it in advance of the 2014 hurricane season. The project consisted of removing non-native dune vegetation and replanting cleared areas with native species in South Beach (Government Cut to 3 Street and 14 Street to 23 Street), Middle Beach (23 Street to 47 Street), and North Beach (64 Street to 79 Street). Additionally, the city trimmed select native vegetation in order to foster low growth and stabilize existing vegetation. The city retained two landscape contractors through an open bid process to complete this work. Areas not addressed by this project will be restored in the future during the construction of the adjacent beachwalk or as part of continued volunteer dune restoration efforts.

The project maximized the dune's ability to protect inland properties from storm surge and provide critical erosion control to the beach. The healthier dune system also provides better habitat for native plants and animals and is more structurally sound. Resulting conditions in the dunes have also greatly reduced security and crime concerns that had previously plagued the city. Moving forward, the city will place the dunes under a maintenance contract, in which a landscape contractor will maintain the entire system 30 times per year to prevent it from returning to its pre-project state.

South Pointe Park dunes before the project ©Ariel Moger.

South Pointe Park dunes after the project ©Ariel Moger.

FAST FACTS:

Project cost: $300,000, with an on-going maintenance cost of approximately $111,000 per year.

Project size: approximately 54 acres, with 1.34 acres for continued volunteer restoration projects and 1.92 acres to be restored as part of future capital projects.1.92 acres to be restored as part of future capital projects.

Additional information about Miami Beach can be found by visiting:
web.miamibeachfl.gov/publicworks/environmental/scroll.aspx?id=78915
www.nature.org/southeastfloridareport

Miami Beach Dune Restoration and Enhancement Project

City of Miami Beach: CItywide Dune Restoration Services Project

PARTNERS

MIAMIBEACH

Florida Coastal Management Program

NOAA

BLUESKIES WHITESANDS GREENCITY

Virginia Key North Point Ecosystem Restoration Project

Published by
The Nature Conservancy
Protecting nature. Preserving life.

Virginia Key is a 1,000-acre barrier island containing a variety of upland and wetland plant communities including sea-grass beds and inter-tidal sand/mud flats, mangrove wetlands, beach dune communities and coastal maritime hammock. The island is located in Biscayne Bay, south of Fisher Island and bordering the Atlantic Ocean. The City of Miami is the present landowner of the north point of Virginia Key, and the Park and Recreation Department manages the park site for the City. On July 22, 2010, the City of Miami approved a comprehensive master plan for Virginia Key that is guiding the development of public park space and natural areas on the north point of the island.

Through mitigation and environmental grant funds already secured, the City of Miami, in partnership with Miami-Dade County (MDC), the Miami Science Museum (MSM) and other City Park nonprofit partners will restore and enhance approximately 17 acres of coastal habitat consisting of hammock, coastal strand, beach dune, and freshwater wetlands communities on the northern end of Virginia Key. While the island is non-residential and most of it is undeveloped, the Miami-Dade County Central District Wastewater Treatment Plant is located southwest of the project site. This project will enhance a segment of the coastal buffer which provides the front line of defense against erosion and other storm impacts on the facility.

The island contains more than 300 acres of mangroves, approximately 18 acres of coastal hammock (one of the rarest plant communities in the county due to coastal development), and 16 acres of beach and dune communities. Virginia Key provides habitat for ten endangered/threatened plant and animal species. Virginia Key and all of the barrier islands along South Florida have historically provided prime turtle nesting habitat due to the prevalence of sandy beach habitat. However, due to coastal development and light pollution, limited historic sea turtle habitat remains in South Florida. Invasive non-native plants, such as Australian pine have colonized landward swaths of beach where turtles historically nested, thereby limiting the width of beach available for nesting females to lay their nests. The proposed restoration effort will significantly enhance endangered species habitat on Virginia Key for endangered reptiles, insects, plants and birds. The restoration will involve the selective clearing and grubbing of all non-native vegetation, the creation of beach dune and coastal hammock habitat by moving and grading existing fill, the enhancement of an existing isolated freshwater wetland on-site through non-native vegetation eradication and control, the planting of appropriate native vegetation within each of the restored plant communities by volunteers from the local community, and the creation of trails with interpretive signage through the restored habitats to provide passive recreational opportunities.

The project will be phased and conducted over a two-year period to allow for the outreach, education, and volunteer planting during two rainy seasons. The objective of the project is three-fold 1.) to restore and enhance the ecological habitats for a wide variety of native fauna, 2.) to provide environmental education to the local community, 3.) and to provide additional recreational opportunities on the North Point of Virginia Key. As stipulated by the Virginia Key Master Plan, Virginia Key's North End will be one of the few multi-use spaces of its kind in South Florida by providing recreational and conservation spaces.

Nonnative and invasive vegetation dominate the landscape prior to restoration and the beach area located landward of the MHW has been altered by placement of dredged fill, solid waste, and the subsequent colonization by invasive plants ©Josh Mahoney, Miami-Dade County RER/ DERM.

Virginia Key Restored Dune ©Josh Mahoney, Miami-Dade County RER/ DERM

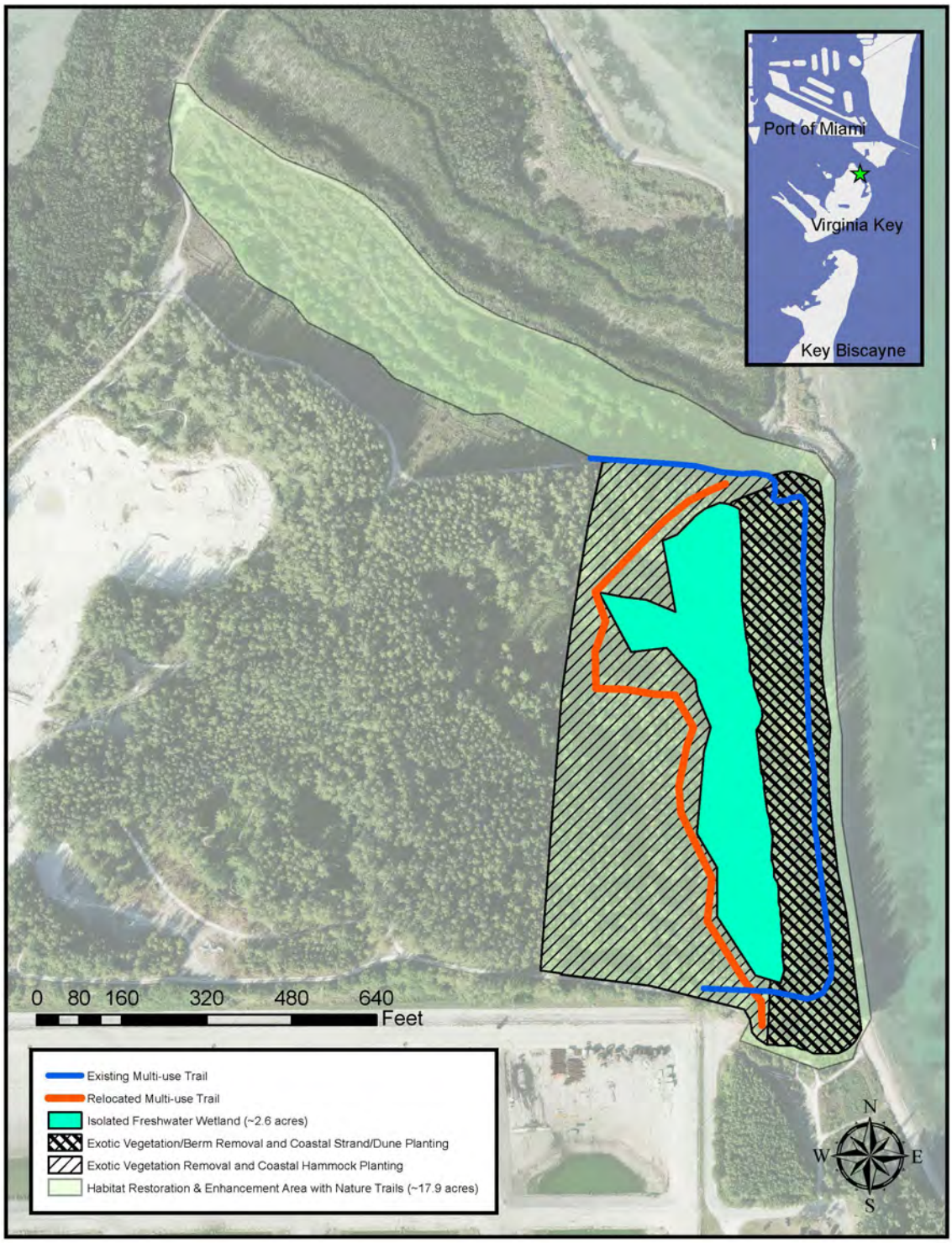
FAST FACTS:

Project cost: $400,000

Project size: Restoration and enhancement of approximately 17 acres of coastal habitat. To date, 4.4 acres of dune have been restored.

Additional information about Virginia Key can be found by visiting:
www.miamigov.com/parks/virginiaKey.html
www.nature.org/southeastfloridareport

Virginia Key North Point Dune and Coastal Hammock Restoration Site



PARTNERS

THE CITY OF MIAMI FLORIDA

MIAMI-DADE COUNTY

PATRICIA AND PHILLIP FROST MUSEUM OF SCIENCE

Florida Keys Coral Restoration Project

Published by
The Nature Conservancy
Protecting nature. Preserving life.
Southeast Florida Regional Compact Climate Change

Healthy coral reefs provide benefits to marine life and people alike. Reefs provide essential habitat to commercially and recreationally important fish species as well as thousands of species of invertebrates. They also are frequented by larger marine predators such as sharks, sea turtles and dolphins. Because of their beauty, high diversity and abundant marine life, reefs attract people for fishing, snorkeling and diving. More than 33,000 jobs in Monroe County are supported by ocean recreation and tourism, accounting for more than half of the local economy.

Intact reefs also provide a barrier for ocean waves, causing them to break offshore rather than on the coast. A global study by The Nature Conservancy shows that coral reefs that crest at the surface reduce up to 97 percent of wave energy and are a cost effective option when comparing natural reef enhancements to other options like breakwaters and seawalls. This has important implications for South Florida, which has the longest reef tract in the continental United States.

Coral reefs in the Florida Keys have been in decline since the 1970s due to stresses including coral bleaching, disease outbreaks, hurricanes and cold snaps, as well as acute impacts such as ship groundings. Populations of elkhorn and staghorn coral underwent a region-wide decline with losses of up to 97% in some areas. Measures are being taken in Monroe County to help protect the healthy coral that remains. However, habitat protection and threat reduction may not be enough to stop the decline of reefs. Active restoration of coral populations is now a feasible and cost-effective way to reestablish live coral to reefs.

A collaborative effort funded by NOAA and The Nature Conservancy and implemented by a consortium of project partners is working to restore genetically diverse, breeding populations of threatened staghorn and elkhorn corals to degraded reefs throughout South Florida and the U.S. Virgin Islands.

Tens of thousands of staghorn corals are being grown and propagated in underwater nurseries, and then outplanted to degraded reefs off Monroe County. The project's primary restoration and recovery approach is to take small fragments of live tissue from healthy coral colonies of known genetic stock, grow them in nurseries over time to create multiple colonies of each genetic type, and then outplant genetically distinct individuals in proximity to one another so they spawn and help reseed surrounding reefs. Each outplanting site directly enhances live coral cover, wave-breaking structure, fisheries habitat and tourism value. Nearly 10,000 colonies have been reestablished on reefs since 2004, with first-year survival rates for these corals averaging above 80%.

A coral 'tree' in the Coral Restoration Foundation nursery ©Tim Calver

Healthy wild staghorn coral colony ©Tim Calver

FAST FACTS:

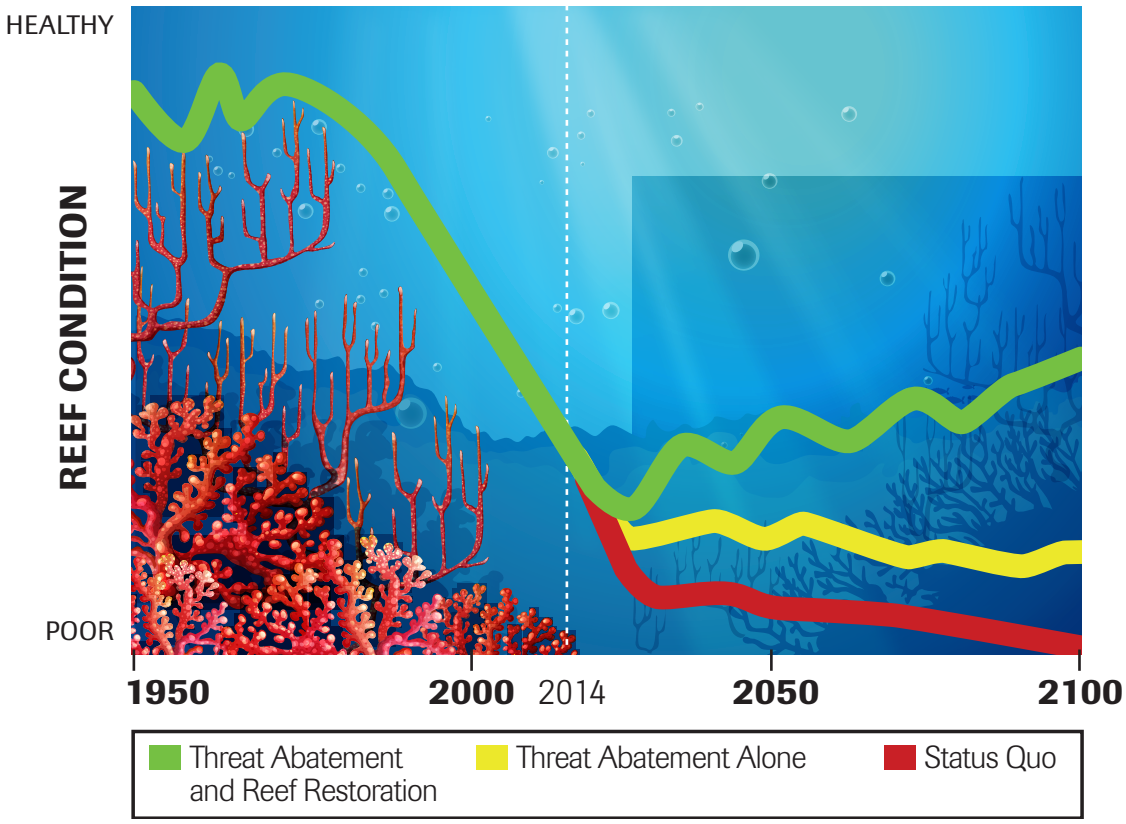
Project cost: $3.3 million

Project size: Just one acre of staghorn coral restoration spread across 37 reefs has the potential to impact 6,700 acres via subsequent reproduction.

Additional information about Florida Keys Coral Restoration can be found by visiting:
www.frrp.org/coral-restoration
www.nature.org/southeastfloridareport

Florida Keys Coral Restoration Project

Conceptual diagram of the state of the Florida Reef System with and without active reef restoration



Restored staghorn corals after one year on the reef ©Erich Bartels, Mote Marine Lab

Coral Restoration Foundation divers check up on staghorn corals restored to a Keys reef ©Tim Calver

PARTNERS

The Nature Conservancy
Protecting nature. Preserving life.

Coral Restoration Foundation

MOTE MARINE LABORATORY

UNIVERSITY OF MIAMI
ROSENSTIEL SCHOOL of MARINE & ATMOSPHERIC SCIENCE

NOVA SOUTHEASTERN UNIVERSITY
NCRI
NATIONAL CORAL REEF INSTITUTE

NOAA

Nature-Based Coastal Defenses in Southeast Florida

Published by
The Nature Conservancy
Protecting nature. Preserving life.®

ABOUT

Nature-Based Coastal Defenses in Southeast Florida is a collaborative publication of the Southeast Florida Regional Climate Change Compact's Shoreline Resilience Working Group. The working group is coordinated by The Nature Conservancy with participation from Broward County, Palm Beach County, Miami-Dade County, City of Miami Beach, Youth Environmental Alliance, Florida Fish and Wildlife Conservation Commission, City of Ft. Lauderdale, City of Key West, Florida Atlantic University, Institute for Sustainable Communities, South Florida Regional Planning Council, and City of West Palm Beach.

The Shoreline Resilience Working Group focuses on identifying and promoting healthy natural systems, engineered "living shorelines" and hybrid "grey-green" approaches to increase coastal resilience in southeast Florida and the Florida Keys.

The Shoreline Resilience Working Group is part of the Southeast Florida Regional Climate Change Compact, a four-county initiative established in 2010 to coordinate climate mitigation and adaptation activities across Broward, Miami-Dade, Monroe, and Palm Beach Counties, their municipalities and other stakeholders. The Compact represents a new form of regional governance designed to allow local governments to set the agenda for adaptation and provides an avenue for state and federal agencies to engage with local municipalities and assist with technical support.

In 2012, the Compact published the Regional Climate Action Plan, which contains 110 recommendations for a more sustainable southeast Florida. In addition, the Compact is widely recognized as one of the nation's leading examples of regional-scale climate action. For more information about the Southeast Florida Regional Climate Change Compact, visit **www.southeastfloridaclimatecompact.org.**

SOUTHEAST FLORIDA
REGIONAL COMPACT
CLIMATE CHANGE

AUTHORS

Nature-Based Coastal Defenses in Southeast Florida is published by The Nature Conservancy and the Southeast Florida Regional Climate Change Compact. The Conservancy's mission is to conserve the lands and waters on which all life depends. The Conservancy has worked for more than 50 years to protect 1.2 million acres of Florida's best lands and waters. In southeast Florida, the Conservancy is working on multiple fronts to help people adapt to sea level rise and to the impacts of natural disasters. Natural infrastructure, such as oyster reefs, mangroves and coral reef systems, helps protect coastal lands and communities from erosion and flooding while creating healthy habitats for fish, birds and other coastal species.

Nature-Based Shoreline Resilience in Southeast Florida is made possible with support from Broward County, Palm Beach County, Miami-Dade County, and City of Miami Beach. For digital access to Nature-Based Shoreline Resilience in Southeast Florida, visit **www.nature.org/southeastfloridareport.**

The Nature Conservancy
Protecting nature. Preserving life.®

CONTACT

The Nature Conservancy
127 Industrial Road, Unit D
Big Pine Key, FL 33043
Phone: 305-872-7071