NAPLES BOTANICAL GARDEN Jonserve

The undeveloped beachfront of Delnor-Wiggins Pass serves as a laboratory for the study of native plants and their post-hurricane comeback. Here, species such as railroad vine (*Ipomoea pes-caprae*) sprawl across the sand and help rebuild the dunes. *Photo by John Eder*

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ON THE COVER

A beach elder (Iva imbricata) sprouts along the beach at Delnor-Wiggins Pass State Park and will help the natural sand dune rebuilding process.

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From Our Leadership

In my short time in Florida, I've twice witnessed nature's brutal force. Hurricane Irma initiated me to the Sunshine State: Hurricane lan tested whether I had retained and expanded upon my emergency response skills. Thanks to my tireless and fast-thinking team, I think I passed.

Like you, I would be happy to avoid a third go-round with an angry Mother Nature. But I know that's unlikely. We may not be able to prevent the damage we sustain in storms, but we can mitigate it.

Naples Botanical Garden is playing a lead role in the protection of our shorelines. For the past several years, our experts have studied coastal ecosystems to better understand the role plants play in building and maintaining beach dunes. Our pilot planting sites on Naples Beach rebounded beautifully after Ian. Now, we're partnering with researchers from The Water School at Florida Gulf Coast University to delve deeper into the science of beach dunes and make recommendations on what and how to plant to build resilience.

We're working in far-flung places, too. In this issue, you'll discover how the Garden was tapped to save five endangered trees from a runway expansion project on the other side of the globe. And you'll hear about the collaborations among our Garden and fellow botanical institutions in the Caribbean to save the tropical plants unique to our part of the world.

Thank you for supporting these and our many other conservation endeavors.



Donna McGinnis President & CEO Naples Botanical Garden

When we think of supply-chain issues, we typically think about the difficulty in getting things like essential parts or goods. Rarely do we think about plants. Yet, at a national level, we have a critical need for the native seeds and plants required for ecosystem restoration and reforestation. That significant finding comes from a new National Academies of Sciences, Engineering, and Medicine report.

The report urges a comprehensive approach to amassing the native seeds necessary to restore ecosystems now and in the future. Over the past several years, we have seen a significant increase in devastating floods, droughts, hurricanes, and fires as a result of a rapidly changing climate. These disasters not only impact our communities, but they also impact our ecosystems. When these extreme events damage ecosystems, we turn to native plants, those which have adapted to their local environments over long periods of time, to restore their function.

It takes time to collect, learn to grow, and produce the volume of plant material we need to ensure that we can restore the biodiversity, function, and resiliency to these ecosystems. Our work here at Naples Botanical Garden and collaborations with regional partners ensure that we are addressing this gap. Whether it be through collecting seeds of wild plants related to the food we eat, or seeds and cuttings of the plants necessary to rebuild our coastline, the Garden is hard at work ensuring we have the plants available to meet the environmental challenges of today and the future.



Chad Washburn Vice President of Conservation Naples Botanical Garden

Questions and letters to the editor may be sent to email@naplesgarden.org



High-tech conservation

THE GARDEN'S NATIVE

nursery houses a collection of wild-collected swamp bay trees (Persea palustris). We maintain it because Persea populations, namely red bay and swamp bay, have been decimated by an invasive beetle that carries a deadly fungus and because swamp bay genetics may prove useful as a "crop wild relative" to the avocado, a related Persea species. Increasingly, scientists are introducing favorable traits from wildgrowing plants into cultivated crops to help our food survive drought, resist pests, and build

resilience. The Garden is part of a crop wild relative working group led by the United States Botanic Garden.

But our collection presents a challenge. The swamp bay must be maintained as living trees because their seeds do not survive the drying and freezing process necessary for long-term seed bank storage. Maintaining such an important collection in the nursery is risky because the trees are vulnerable to hazardous weather, disease, and the like. The other alternative for safely banking this species is through tissue culture and cryopreservation, a deepfreeze capability we do not yet have at our Garden.

A botanical partner has stepped in to help. Raquel Folgado of The Huntington Library, Art Museum, and **Botanical Gardens in California** is highly experienced in cryopreservation techniques. She offered to process and store genetics from our collection.

To grow a plant in tissue culture, a small stem cutting from a mature plant can be sterilized and placed in a nutrient medium within a sealed container. The plant will continue to grow but cannot be maintained in a glass jar forever. The plant will produce new growing tips called meristems, which can be excised, dissected, and placed

into liquid nitrogen. The cryopreserved plant tissue can be maintained without intervention for decades. To awaken the plant from its deep freeze, conservationists place it back into a tissue culture medium where it will grow into a mature plant.

It was challenging to send living plant cuttings across the country to Los Angeles! We collected young growing shoots from each of 10 accessions and cauterized the cut ends to prevent water loss during transportation. We placed the cuttings in sealed plastic bags inside a cooler and then shipped them overnight to California.

Nine of the 10 accessions survived into tissue culture. Now, the genetics of this important crop wild relative are more available for future research and use.



The swamp bay cutting is placed in a cooler until it is ready to ship to California for long-term cryopreservation storage.



Garden conservationists have found 150 netted pawpaw shrubs (Asimina reticulata) throughout the Preserve.

Botanical hide-and-seek

ANOTHER PLANT in

our collection may have potential as a crop wild relative. The netted pawpaw (Asimina reticulata) is related to the edible version of the fruit (Asimina triloba). But before we could collect and conserve its seed, we had to find it.

For over a year, the **Conservation Horticulture** Team has been scouring the Preserve to locate it. As of June, we have discovered more than 150 deciduous flowering shrubs throughout the pine uplands and scrubby flatwood habitats, scattered among slash pines, myrtle oaks, and saw palmettos. The

geolocation data allows us to monitor the health and size of the population and to predict where and when the plants will flower or produce seed.

Tracking down the plants' location is only a first step. Flies or beetles, their natural pollinators, don't appear to be pollinating the species, and our team is required to hand pollinate it instead. Thankfully, we collected ripe seeds from a plant in May that we had hand pollinated.

In addition to its potential as a crop wild relative, the netted pawpaw provides ecological benefits for our upland and scrub habitats. It is a larval host for zebra swallowtail butterflies and sphinx moths, and its fruit is a favorite summertime snack for many birds and small mammals.



White smoke indicates a nearly extinguished blaze along the lakes during a prescribed fire in July 2023.

Land management heats up

FOLLOWING ITS FIRST

successful prescribed burn last February, the Garden's Natural Resources Team intends to spark a regular fire regimen, fueled in part by a \$45,000 grant from a donor who wishes to remain anonymous.

The inaugural burn involved about 2 acres of pine uplands, set ablaze under rigorous controls. The objective was to renew the land and reduce the buildup of organic material such as pine needles and leaves, which can create a wildfire hazard. Natural Resources Director Eric Foht says he was somewhat worried about damaging pine tree roots because of the amount of organic matter accumulated over time. The trees fared well.

"It's promising," Foht says. "We learned we can reintroduce fire to a longunburned area in a way that's relatively safe for the pine trees."

In June, we ignited the lake perimeter to burn invasive torpedograss that had outcompeted native species and pave the way to restore the waterfront with native plants. In July, the team burned a 6-acre parcel with goals similar to the first 2-acre fire.

Conservation Associates Daniel Agis and Sam Amodeo contributed to these reports.



An Eclectic Education Yields a Unique Plant Conservation Opportunity

By Lina Ramirez Granada



hat job merges conservation, communications, marketing, event planning, development, and facilitation? Mine!

I'm the Regional Conservation Initiatives Coordinator for the Caribbean and Central American Botanic Garden Network, an organization that brings together key regional players, exchanges knowledge, coordinates conferences, offers trainings, and establishes partnerships. Naples Botanical Garden acts as the secretariat, or administrator, and I'm the first person to hold the coordinator position.

We have more in common, plant-wise, with the Caribbean than we do with Central Florida.

While I stumbled into this role by chance, my journey was a result of deliberate training in environmentalism and communications during my undergraduate studies at Florida Gulf Coast University (FGCU). I had unique experiences that included: assisting with a documentary film project about sustainable development in Puerto Rico following Hurricane Maria; creating public service announcement videos on water quality; and coordinating the 2019 Conserving



Biodiversity Conference at FGCU. These experiences, along with my multicultural background, aligned perfectly with a job Chad Washburn, the Garden's Vice President of Conservation, had envisioned. He was featured in a panel I had coordinated and subsequently invited me to join the Garden.

So, here I am, coordinating this far-reaching network, which includes gardens, Here, conservationists rappel off a cliff in Belize to reach native plants for collection. Lina Ramirez Granada, the Regional Conservation Initiatives Coordinator for the Caribbean and Central American Botanic Garden Network, connects key organizations and facilitates collaboration, so knowledge gained from conservation efforts, like the one pictured, is shared.

arboreta, and conservation organizations. You may wonder why it's based in Southwest Florida. While our region is part of the continental United States, our plant palette, climatic threats, and growing conditions are similar to those directly to our south. In fact, we have more in common, plant-wise, with the Caribbean than we do with Central Florida, and Naples is closer to Cuba than it is to Tallahassee.

Collaboration and partnerships are crucial in the Caribbean, a biodiversity hotspot teeming with unique and endangered plant species found nowhere else. The region faces challenges including funding, sealevel rise, hurricanes with increasing frequency and intensity, invasive species, development, data collection, and accessibility to that data. Collaboration is especially important as many of our





regional partners work with limited resources. Through shared strategies, expertise, and assets, we aim to address environmental challenges and make a positive impact. Our work supports the Global Strategy for Plant Conservation and the Caribbean Regional Strategy for Plant Conservation. You can read more about those on page 19.

One key initiative is an online gathering we regularly host, our Technical Talks (TechTalks). During one recent session, we featured

Rodrigo De Sousa from Osa Conservation in Costa Rica. He focuses on restoring ecosystems by reconnecting forest patches previously separated by farmland. Prior to that, we heard from Maria Paula Contreras of Jardín Botánico de Cartagena "Guillermo Piñeres" in Colombia. She shared her insights on utilizing native plants in urban and suburban landscapes to enhance their populations and deepen our understanding of their reproduction. These virtual talks attract partners from various countries, eager to learn and implement new knowledge.

Within the Network, we also collaborate on shared conservation efforts, including a partnership between Jardín Botánico de Cartagena "Guillermo Piñeres" and Naples Botanical Garden to

support the conservation of piñuelo (Pelliciera benthamii), a type of mangrove. In addition, the Garden has collaborated with the Virgin Islands Rare Plant Initiative (VIRPI) to support the conservation of native plants in the U.S. Virgin Islands. Together, we are identifying and studying the islands' rare, threatened, and imperiled native plants. Our aim is to develop propagation protocols, essentially a guide for producing plants.

The Caribbean region faces challenges in data collection due to its technology infrastructure; still, working as a collective, we've made notable progress. This includes a joint effort of the Jardín Botánico Rafael Moscoso in the Dominican Republic, Montgomery Botanical Center in Florida, and Leon Levy Native Plant

Preserve in the Bahamas to study and protect Caribbean palms. The researchers focused on preserving the palms' genetic diversity and developing a breeding plan. Similarly, Ian Anderson's **Caves Branch Botanical**

collaborated to study bromeliads in the region.

Garden in Belize. Marie

Selby Botanical Gardens

in Florida, the University

of Belize's Environmental

Thrity Vakil, Director of Puerto Rico's Tropic Ventures Sustainable Forestry & Rainforest Enrichment Project, visits the Garden's Preserve with Conservation Horticulture Manager Jessica DeYoung and GIS Specialist Kate Talano.

The participating experts increased documentation of this tropical plant family, conducted extensive Research Institute, and the collections and observations, **Belize Forestry Department** and published a field guide. In recognition of their outstanding efforts, the American Public Gardens Association (APGA) awarded them the Program Excellence

Award in 2020.

Partnerships such as these are critical, considering the incredible responsibility our regional partners carry protecting the rich biodiversity of the Caribbean. Personally, I couldn't be happier that my seemingly odd combination of skills and duties helps save unique plant species and secure a sustainable future for this incredible region.

Lina Ramirez Granada is the Garden's Regional Conservation Initiatives Coordinator.

Rebuilding the Dunes, Protecting the Coast

Naples Botanical Garden and Florida Gulf Coast University study the workings of beach dunes and develop a restoration formula

By Jennifer Reed Photos by John Eder

he plant is a botanical jackpot. Vice President of Conservation Chad Washburn approaches a 7-foot-tall shrub on a Keewaydin Island beach. "This is perfect," he exclaims. "It's covered in seed."

The plant is wild Suriana maritima, or bay cedar, a coastal species that plays an important role in stabilizing beach dunes.

"I would say it's arguably gorgeous," Washburn continues. The foliage resembles succulent leaves, and the seeds are a pale green with blueberry-like crowns. When in bloom, the plant produces tiny yellow flowers. Washburn stations a staff member to gather ripe seeds.

The Garden, along with several Florida Gulf Coast University faculty, has undertaken a major beach dune research and restoration project to chronicle the plant species along our shoreline, understand the roles they play in the ecosystem, and develop a restoration strategy that replicates what's found in nature. The intention is to create a natural line of defense against wind and water damage. The Garden began the research about five years ago and ramped it up following Hurricane lan, inviting the university's involvement and soliciting the support of the Collier Community Foundation, Second Chance Foundation, and other individual donors to provide funding for some initial costs.

Beach dunes can't fully prevent the destruction of storms like lan, but the mounds of sand and plants can dissipate energy and blunt the blow. What's more, a strategically planted beach dune can protect investments in beach renourishment and related projects, such as a berm in Collier County costing approximately \$20 million and requiring an estimated 400,000 tons of sand. Plants limit the sand lost to erosion from wind and water.

While the Garden favors nature-based solutions, Washburn doesn't rule out human-made structures like



Conservation Horticulture Manager Jessica DeYoung gathers multiple beach dune plant species during a collecting trip to Keewaydin Island. berms and walls, if they are done in tandem with green projects. "We need to look at every tool in the toolbox," he says.

The dune restoration starts with gathering seeds and cuttings from area beachfronts. The team brings these back to the Garden with the intention of multiplying them by the thousands for future restoration plantings. There, in labs and nurseries, specialists work to determine the best growing methods. Most pre-existing coastal botanical research involves plants from other regions.

In fact, there are many unknowns about the beach ecosystems in Southwest Florida. That's why this initiative began with long, slow walks on the beach, detailed observations, and questions that only plant people might ask.

Plants sprout along the Gulf side of Keewaydin Island, where the Garden team studies beach dunes and collects seeds and cuttings of coastal species.

Natural Resources Director Eric Foht collects cuttings of dune plants on Keewaydin Island.



Vice President of Conservation Chad Washburn, and FGCU's Christopher Daly, an assistant professor of coastal geomorphology, and Jeannine Richards, an assistant professor of restoration ecology, examine plants on Keewaydin Island.

n early May, Delnor-Wiggins Pass State Park bears the feels-like-yesterday scars of Hurricane lan even eight months later. The beach's long closure, starting with lan's landfall in September 2022 and lasting through May 15, makes it an ideal, undisturbed research site.



Native inkberry (Scaevola plumieri)

"Native Scaevola," notes Washburn, pointing to the thick-leaved, low-growing Scaevola plumieri. "Those are the first two I've seen on the beach." With him this morning are Jeannine Richards, FGCU Assistant Professor of Restoration Ecology, and Britt Patterson-Weber, the Garden's Vice President of Education & Interpretation, who will develop public education programs about the importance of beach dunes and the Garden's restoration work.

"And here is *lva imbricata*. It's our 'rockstar plant,'" Washburn continues. On several excursions to various beaches, the team has noted how a "disturbance" such as a storm appears to invigorate this bushy shrub, commonly known as beach elder. It's among the first to rebound and plays a big part in stabilizing dunes.

The team records which species re-emerge most quickly after a storm and jumpstart the natural rebuilding process. They investigate which plants invite the sprouting of other species and question why that is: Because they hold moisture? Provide shade? Catch seeds? They note the plants' locations on the dunes and study the roles each species appears to perform.

"It's really interesting to see how these different species are responding," Richards says. "The *lva imbricata* is doing wonderfully. The beach sunflower (Helianthus debilis) is coming back all over the place. Some things come back quickly. Some things that were present in abundance are no longer there or no longer abundant."

She continues: "When we have a disaster, it basically wipes the slate clean. We need all of the skills of all of those different plants to come back and bring (the ecosystem) together again." In short: Biodiversity matters.

Typical beach restoration practices usually don't take that into account. Generally, coastal managers install one or two species along the dunes; sea oats (*Uniola paniculata*) are the most common.

"If you just have sea oats, you're not going to have that ability to recover quickly from a storm," Washburn says. New populations of the tall, grain-like grasses had started to sprout but not as swiftly or robustly as other species.

To emphasize his point, Washburn returns to one of the Garden's beach dune pilot project sites. In spring 2021, the Garden partnered with the City of Naples and planted three access points along Naples Beach using a range of native plants. The patches the Garden planted had recovered to a greater degree than adjacent areas.

"This came back on its own," Washburn says, pointing to an *Iva imbricata*. "And this dune mound here is because of this plant." Nearby, a cluster of beach sunflowers brightens the beach with yellow blooms. They are nearly buried in sand, and that's a good thing. It means they're holding onto granules from the existing beach and the county's new berm.

Washburn proposes using about 15 species in the eventual dune replanting, tightly clustered and installed either at the fore dune (the side closest to the water), rear dune or the dune's crest, depending on plant type. In nature, Washburn explains, one might see multiple beach dune complexes. In much of Naples, waterfront development narrows the land available for dune formation.

"We have less area for a diversity of species, and that's why it's so important we rebuild with the right ones," he says.

Biodiversity is not just for the sake of coastal resilience — a plethora of plant types provides habitat for coastal wildlife, including sea turtles, and food for critters and pollinators. "Dunes are almost like a linear wildlife corridor," Washburn says.





nce a collection trip ends, Conservation Horticulture Manager Jessica DeYoung and her team retreat to a potting shed for an all-hands-on-deck effort to process the newly gathered seeds and cuttings. They are experimenting with everything from seedling trays to growing media to determine the recipe for prompting these plants to sprout quickly and grow to maturity. (See next page.)

As of July, DeYoung tallied about 2,000 plants representing 21 species and more than 50 maternal lines collected from various beaches to ensure genetic diversity. Using homegrown plants from Southwest Florida genetics complicates the project (it would, naturally, be easier to order commercially grown nursery stock), but the conservationists say plants that are adapted specifically to our region are more likely to thrive and will better support the area's pollinators and wildlife.

"I'm exceptionally excited about this," DeYoung says. "This is putting the science into practice. I'm very happy we're finally going to be able to take this step that we've been talking about for so long."

A timeline for replanting is to be determined. Washburn is in close conversation with Collier County and the City of Naples, which manage the coast and ultimately will determine when and how the beaches are to be restored.

In 2022, Collier County saw 1.6 million visitors who contributed nearly \$2.8 billion to the local economy. The coast — the beaches and the many establishments situated along them drive tourism.

"Beach dunes are a vital part of our coastal community's resiliency," Washburn says. "They are the basis of our thriving tourism economy and provide a protective barrier against storms and hurricanes."

Jennifer Reed is the Garden's Editorial Director.



DON'T TRAMP THE PLANTS

Coastal plants build beach dunes by trapping and amassing sand and preventing it from blowing or washing away. These sandy structures, in turn, help break up wind and wave energy and lessen the damage to waterfront homes, businesses, and public amenities.

Help plants do their job! Avoid stepping on them on your way to the water. Keep beach chairs, blankets, and umbrellas strictly on sand. And, please, no hand-picked coastal flower bouquets. These plants are made for far more than décor.

"We need to shift from the view that it's just the mound of plants or a mound of sand that you've got to walk over," says Chad Washburn, Vice President of Conservation. "It's actually an ecosystem." Conservationists Crack the Code for Growing Shoreline Plants at Inland Nursery

By Jaycie Newton

team member intercepted me one afternoon and thrust a bunch of gallon-sized baggies full of plant material into my arms.

"Here, I was told to give these to you to propagate. They're beach dune plants. I've got to run!" he said and dashed off. I stared at the bags and thought, how am I going to replicate a coastal environment in our inland, ground-clothed nursery?

When it comes to beach dune restoration, there is no manual I can reference to identify what kind of soil or conditions promote optimal growth for these plants. I need to figure it out for myself.

I start by hitting the beach so I can see firsthand how these plants grow. I observe that some species prefer the side of the dunes closest to water and can tolerate salt spray or salt intrusion. An example is bushy seaside oxeye (*Borrichia frutescens*), which also has extensive root structures that help stabilize the dune. Others, like seaside dropseed (*Sporobolus virginicus*), are rhizomatic, which means their roots



travel laterally underground. This species can withstand being continuously buried by sand, so it prefers the swale side of the dunes. These considerations are important to note as I determine how I'm going incorporate them into a nursery environment.

I test all sorts of factors that affect the plants' survival, from the size of the pots to the type of substrate, or material, in which I grow them. The work gets my creative juices flowing. You would think the most obvious soil type would be sand; however, as we have found through trial and error, sand tends to harden like concrete when you put it into pots, resulting in weak roots. For the rhizomatic grasses, we tried growing them in long trays, intending to spur horizontal root growth. We found instead that the shallow

trays stunted their growth and we changed to use deeper pots.

Sometimes we need failure to lead us to success. In the case of Iva imbricata, or beach elder, we tested two rooting hormones and found that when exposed to the gel form, the plants did not survive, while those treated with the powder version flourished! Even on the days when I come to the nursery and see that most of a tray of cuttings has died, I know that the few survivors will give me insight into how to successfully care for the next batch of propagations.

As a Southwest Florida native who grew up on the beach, it's incredibly rewarding to be a part of a project that will replenish our beautiful coastal ecosystems.

Jaycie Newton is a Conservation Associate.

Charting a Course for Caribbean Conservation

By Jennifer Reed

he Caribbean is one of the world's biodiversity hotspots — a place that teems with some 11,000 plant species. More than half are endemic; they occur only on the islands on which they are found. Some 44 million people call the Caribbean home and rely on this diversity of plants and native ecosystems to provide food, clean water, and storm protection.

This rich botanical life is deeply at risk. Devastating hurricanes, sea-level rise, development, pollution, invasive plants and pests, lack of awareness, lack of government cohesion, development, and habitat loss are among the challenges these island nations face.

Now, a regional plan, years in the making, seeks to stem the loss of plants. Botanical garden professionals began developing a comprehensive strategy in 2018, finalized it in late 2022 at the Botanical Bridges conference in Eleuthera, and are working toward implementing it today. The plan lays out four objectives and 20 targets. It encourages conservationists to take actions that range from monitoring their region's plant life to restoring ecosystems to managing invasive plants to working with government officials on policy matters.

The plan's authors set an ambitious deadline — 2030 — but the Caribbean and Central American Botanic Garden Network, a coalition of conservationists, is working more closely than ever. Naples Botanical Garden serves as the group's secretariat, or administrator.

Here, we speak to five botanical leaders to learn more about the challenges of plant conservation, their efforts to protect plants and restore ecosystems, and why this new strategy matters. Their comments have been condensed and edited for clarity.



On the Caribbean's challenges:

CW: With islands, there's not opportunities for these endemic plants to easily move between islands ... If it were a contiguous land, there would not be as many barriers for natural movement.

NC: Specifically for Bermuda, one of the top challenges definitely would be invasive species. Bermuda, as a whole, is being overrun right now with a lot of the invasive species that have gotten out of gardens and personal homes and have just been distributed around the island, either through birds or wind or other methods ... Our main landscape right now is 99% invasive species.

DS: There is a lack of general understanding about the impact of invasives. They have an economic and social impact. I'll give you an example. I'm on a project right now where the roots of invasive plants are exerting pressure on some fairly erodible cliff faces that are adjacent to public areas. That represents a potential damaging and a potentially life-threatening (situation) That underscores one aspect of the importance of managing (invasive plants) properly.

TV: (A challenge in Puerto Rico) is that there is no overall (government) coordination ... It's alarming that in this day and age we are dealing with such a level of fragmentation of the agencies tasked to protect natural resources in Puerto Rico. And I think that is a key thing we need to address.

EF: The largest overall challenge for us is climate change. And the Bahamas faces climate change as an

Hear from leading experts in plant conservation



Nick Coelho, Micro Forest Officer, Bermuda Zoological Society



Ethan Freid, Botanist, Bahamas National Trust



Thrity (3t) Vakil, Director, Tropic Ventures Sustainable Forestry & Rainforest Enrichment Project (Puerto Rico)

Danny Simmons,

Landscape Architect,

Government of Bermuda

Chad Washburn, Vice President of Conservation, Naples Botanical Garden

Interns with the Leon Levy Native Plant Preserve in the field

existential threat. We have very low-lying islands, and a lot of our endemic species occur in coastal areas ...

After Hurricane Dorian (2019) hit Grand Bahama, the entire island just about was flooded with about 20 feet of water.

On the region's strengths and opportunities:

TV: We have so many great botanists in Puerto Rico! I've been doing my best to build a team, and I have 13 of the best botanists ... Our greatest resources, I think, are the people who are really interested in plants.

EF: I think one of our most prominent promising initiatives is getting our conservation horticulture program up and running. It doesn't remove the threat, but it gets us in a position so that those species that are at risk are not at risk of complete extinction. [Conservation horticulture is the practice of growing and maintaining genetically diverse collections of plants so that the species persist even if they are lost in the wild.]

CW: Ethan, can you say

internship program? You're

getting the message out there

something about your

to the public and then offering students who are interested a chance to get into roles like this.

EF: We started an initiative at the Leon Levy Native Plant Preserve focused on university-aged Bahamians that are enrolled in the sciences. We run a six-week plant taxonomy course that's focused on the flora of the Bahamas to give them the training to be able to go out and identify plants. And now we're starting to see the fruition of that. Some of these individuals are now in positions with environmental assessment firms and moving into some parts of government as well.

On the importance of the new Caribbean Strategy:

EF: You don't have to think about, "What are the things we should be doing?" It gives you a checklist of things to be done ... And it doesn't have to be done in a way that says, "This one is more important than that one or the other one." If you can work on any of these, it moves us in a forward direction.

TV: Having a well-defined Caribbean strategy for plant conservation is of paramount importance. Not only does it provide a roadmap for

HOW TO SAVE PLANTS

The Plant Conservation Strategy for the Caribbean Region includes these strategies:

- Identify and document the plants within the 1 Caribbean, determine which are most at risk, and make plant databases widely available to conservationists.
- 2 Determine how climate change could jeopardize areas that harbor multiple native plant species and plants that are listed as threatened or endangered.
- Ensure that at least 50% of the threatened plants in 3 the Caribbean are conserved outside of their native habitat. Those safeguards include seed banking and growing the species in botanical collections.
- Protect habitats. Ensure at least 70% of threatened 4 plants are protected in conserved areas.
- Quell the illegal poaching and unsustainable 5 harvesting of native plants.
- **Develop regionwide and national restoration** 6 programs that use native plants to support plant conservation and carbon sequestration.
- Develop economic models that help halt the loss 7 of plant diversity while ensuring food security, creating financial opportunities, and supporting sustainable forest and ecosystem management.
- Incorporate education and awareness of plants and 8 their habitats in school curricula.
- Create public-awareness campaigns and citizen-9 science opportunities regarding plant diversity and the imperative for conservation.
- **10** Understand, support, and expand upon indigenous and local practices, knowledge, and innovations pertaining to the use of plants.

AN IMPERATIVE TO ACT

Of the world's 400,000 known plant species, 100,000 are now threatened with extinction in the wild. Unless effective conservation measures are put in place soon, up to two-thirds of the world's plant species are predicted to become extinct by the end of the century.

The Caribbean Strategy is a subset of a bigger Global Strategy for Plant Conservation, a document which reminds us: "Without plants, there is no life. The functioning of the planet, and our survival, depends on plants."





tackling the challenges we face, but it also serves as a powerful tool to raise awareness and accountability among government agencies. When there is a clear plan in place, it becomes evident that there are watchful eyes observing the implementation of strategies. This heightened awareness can lead to stronger government agencies and more robust legal frameworks, as they become conscious of the need to align their actions with the conservation goals outlined in the strategy.

DS: It is one thing to have something developed at a local or national level; it's another thing to have a regional voice, speaking from various perspectives in a consensus document like this, that you can bring to decision makers and policymakers and say, "This is what is deemed to be of regional and global priority" ... It's a powerful advocacy tool. And it helps to send the message that plants need our help. And here are some practical ways that we can do this.

On the most difficult targets to achieve:

DS: [The target related to strengthening legal frameworks for the protection of plants] could be difficult. In Bermuda it's a bit more challenging and will probably take a bit more time. ... We are a United Kingdom overseas territory.

TV: One of the things that is not really being achieved is [the target addressing] the creation of economic incentives to help people to protect their land and/ or to support sustainable management of forests ... It would help, you know. Economics is a key driver for many people's actions.

CW: Ethan had referred to conservation horticulture. That is a big, I guess, maybe barrier or hurdle to conservation, just because we don't always know how to grow these plants. Sometimes we struggle. We can collect seeds, but how do you grow them? That's something that



Ravenia urbanii, an endangered plant found only in Puerto Rico

all of us are working toward in some way. Quite often, it's trial and error. [The Caribbean and Central American Botanic Garden Network is working to make such research widely accessible.]

On notable advancements to date:

EF: The Caribbean Strategy is really a derivative of the Global Strategy for Plant Conservation, which came out more than 15 years ago. As for us in the Bahamas and at the Leon Levy Preserve, we utilize the Global Strategy as the backbone for our science and conservation program. So, we've been implementing a lot of these programs now for upward of nine years at our site, and we have made substantial progress on a lot of them.

DS: The target that relates to building a network is something I think we're able to move toward. That relates to building a network. The fact that we're all here in a Caribbean and Central American Botanic Gardens Network talking about conservation of plants is tremendously exciting.

TV: Over the next several years, and beyond, my primary focus will be on team building and fostering collaboration within the larger organization of plant enthusiasts to achieve our shared goals.

On why education and public engagement are key:

NC: The more that you educate the public in a broader sense, the more that they have an interest in wanting to bring back some of these natives and endemics. The father of conservation in Bermuda, Dr. David Wingate, always said that if one out of five households adds at least two cedar trees, we will get reforested within 10 to 15 years. [An invasive pest killed most of Bermuda's cedar trees.] It's not that we need to plant all these trees at once. It's just that these little minute efforts add up to something greater.

TV: To get the public to care, you know, we just have to keep at it. It's not just in the science realm, it's in the artistic realm. I'm also an artist, and I pay particular attention to that whole way of making people aware through artistic interventions, paintings, sculptures, writing, and also philosophical discussions about why we care about our natural world.

DS: I appreciate the young people ... it was exciting to work with (a school group). They were fully on board. They were interested in learning. But I want to throw in a word for the old folks in Bermuda, too. We have an aging population, and they have an important role to play. They're retired, they've got a bit more time. And they are storytellers to bring knowledge of what we've lost culturally, back when grandma and grandpa had a garden and knew how to grow things.



These projects highlight two key provisions in the new Plant Conservation Strategy for the Caribbean Region: Preserving plant genetics before species are lost in the wild and restoring ecosystems with native plants.





On an island overrun with non-native and invasive species, the Bermuda Zoological Society launched a restoration plan to reintroduce the native and endemic species that once dominated the landscape. Led by Nick Coelho, the Micro Forest team in partnership with school

and community groups plants small, dense plots with native and endemic species anywhere they find space, from schoolyards to private gardens. These areas increase the population of native plants, combat invasive species, serve as wildlife habitat, and absorb carbon, a key driver of climate change. The project is supported by the insurance firm RenaissanceRe, HSBC, and the United Kingdom government.

"What gives me the most hope is having some of these school students get so involved, so ready to plant this one tree and then turn to their parents who are on site and say, 'Why can't we do this every weekend?" Coelho says. "It's a great, great feeling, seeing some of these students and adults plant these trees and step back and have a smile on their face. That gives me hope."



Preventing extinction

The 29,000-acre El Yungue National Forest in Puerto Rico is one of the smallest in the U.S. Forest System but also one of the most biologically diverse. There are 830 native plant species known to exist within its boundaries. Among them are two flowering shrubs, Brunfelsia portoricensis and Brunfelsia lactea, both of which are considered critically imperiled at a global level, according to NatureServe, an organization that tracks biodiversity data. This fall, conservationists from Naples Botanical Garden will join an ecologist from



El Yungue and a Puerto Rican botanist to trek the tropical rainforest and collect these species' seeds. The team hopes to propagate 20 to

30 of each, increasing the population of living plants, and then store remaining seeds in the Garden's seed bank.

Why Maps Matter

The Garden's GIS specialist explains how to gather, organize, and utilize data to advance plant conservation and land management

Story and maps by Kate Talano Photos by John Eder

here are an infinite number of ways to see the world. From the perspective of a bird, a bumblebee, or another person, how we navigate physical space and understand a place is immensely unique and complex. What helps us understand these spaces and make sure we're all on the same "page?" Maps! On a simple level, maps help us to situate ourselves in a space, whether it be a new city or botanical garden. Maps also help us navigate around a place, from finding a coffee shop to tracking the route of a hike. Increasingly, the Garden has been using GIS (geographic information systems) technology

and sophisticated data collection to advance our conservation mission.

Broadly, there are two categories of maps: reference and thematic.

Reference maps focus on the location of a phenomenon in space — they help us see where things are in relation to one another.

Thematic maps depict a topic or theme across space — they help us understand patterns and conditions.

We at Naples Botanical Garden utilize reference and thematic maps daily to help support our mission. Here are a few examples and how members of our staff view their significance.

REFERENCE MAPS

PREPARING FOR OUR PRESCRIBED BURN

Back in January, our Conservation Team conducted the Garden's first prescribed fire on 2 acres of land in our Preserve. As part of the planning process, our team mapped the location of critical elements: the boundary of the burn unit, firebreaks, roads, escape routes, water hydrants, etc. These maps were delivered to state officials, our staff, and volunteer firefighters assisting with the burn.





The map is an essential and required document for conducting a prescribed fire.

It gives you information like the locations of firebreaks and safety zones, water refill stations, and special hazards to watch out for — like dead-end roads or heavy fuel buildups.

It can also show where the test fire will be lit, the planned ignition sequence for the day, and the surrounding areas outside of the burn unit, which are used for contingency planning. The map could display sensitive wildlife areas, for instance, an eagle's nest or a gopher tortoise burrow that is near a firebreak



where vehicle traffic would pass. Each member of the team keeps the map with them during the fire to reference and make informed decisions.

- Eric Foht, Natural Resources Director



MAPPING OUR NATURAL HABITAT TYPES

Botanist George Wilder has been diligently conducting a floristic inventory of Naples Botanical Garden's natural areas and has identified some 570 unique native and non-native plant species. In addition to documenting the array of species and their "vulnerability status," a key component of this study was to characterize the Garden's natural areas. In collaboration with Garden conservationists, Wilder identified and mapped seven unique habitat boundaries. This was no small feat, as accurately delineating such lines required our staff to trek through dense vegetation and waist-high waters for hours on end.

THEMATIC MAPS

LOCATING INVASIVE SPECIES

Our team created an interactive survey map that allows its users to upload the GPS location, name, and treatment status of invasive species on site. Since it is web-based, our staff can use their phones to input, update, and record information on the map in real-time.



The question is not if there are invasives in our natural areas, it is where and what they are.

Southwest Florida has an impressive diversity of invasive flora, which requires active and effective management. Our team has started to use this tool to survey areas and record locations and species data so that we can eliminate these plants in a systematic and targeted manner. We have the tools and understanding of how to eliminate them, but where they are and what they are is the most important and often most unknown factor.

– Ian Talty, Natural Resources Manager

This mapping project allows us to show where certain habitats occur and what they are.

By doing so, the relative sizes and proportions of the different habitats are revealed. Together, this information indicates the ecological value and ecological diversity of the area being mapped. Maps also allow us to make available to scientists and conservationists information or clues as to where to locate particular species.

– George Wilder, Curator, Herbarium of Southwestern Florida





MAPPING COLLECTIONS

Our Conservation Horticulture Team is hard at work surveying, monitoring, and collecting plant species within our Garden, local, and global community. An interactive survey map was created so that the team could identify the location, date, and detailed information for each plant collected.

Mapping the locations of individual plants can help us assess the diversity in our collections.

Since diversity equates to a broader range of genetics, we can directly enhance the resilience of our plant collections from future threats. This impacts our work in several ways. We can easily comprehend where collections are lacking from a visual map and can also use aerial land images to identify habitats where the plant can be potentially found.

> – Jessica DeYoung, Conservation Horticulture Manager



ASSESSING CHANGE OVER TIME - CYPRESS DOME

Since Hurricane lan, our team has been monitoring the cypress dome on site using our multispectral drone. "Multispectral imaging" collects the light reflected from the plants' surface (something invisible to the human eye), which indicates water retention and plant health. Once a month, our team flies a drone over the site to record the vegetation change over time.

Kate Talano is the Garden's Geographic Information Systems (GIS) specialist. Vice President of Horticulture Brian Galligan (left) and a team from Mauritian Wildlife Foundation dig a trench around a tree slated to be relocated to a nearby wildlife preserve. Getting supplies to the remote island is extremely difficult; these tools were made by hand.

Bald cypress trees are one example of several species of deciduous conifers.

We have observed that bald cypress lose their leaves in response to drought or hurricane events and produce new leaves shortly after if soil moisture conditions are appropriate. We do not know how these responses impact tree or wetland functioning, or how they affect animals in these systems. By studying these processes in the cypress systems at Naples Botanical Garden, we will gain a better understanding of how these wetland ecosystems may respond to hurricanes, climate change, and other human impacts on these systems.

> – Brian Bovard, Associate Director, Florida Gulf Coast University Water School



Discover more about Garden native habitats waiting to be explored. Scan the QR code to access a multimedia map showcasing the ecosystems that make Southwest Florida unique.

Saving the Last of Their Kind

A Garden vice president travels to the other side of the world to rescue five historic trees from a runway expansion

Story and photos by Brian Galligan

ur reputation for moving trees like furniture came from the hundreds of epic relocations or "saves," if you will, from the early years of building our gardens. This was back in the 2000s when developers bulldozed little ranch houses to make way for big, showpiece homes. We acted as tree hunters, chasing the demolition permits and scouting for doomed trees that we could rehome. These giant rescues formed the backbone of our initial display. We were able to create immediate interest to make for a great guest experience, the shade needed for a lush tropical understory, and the essentials

to keep even the most begrudged grandpa happy.

Word of our tree-moving escapades obviously got out. **Colleagues at Botanic Gardens** Conservation International, an organization representing botanical gardens from over 100 countries, connected us with the Mauritius Wildlife Foundation. Mauritius is an island in the Indian Ocean about 500 miles off the coast of Madagascar. Its territories include Rodrigues, a 42-square-mile volcanic island located 344 miles to its east. On this little speck are five great specimen trees in the way of a major runway expansion, needed for the

sake of transporting supplies and boosting tourism. These five trees are among the few holdouts remaining in situ, or in habitat, since pre-human civilization. My colleagues at Mauritius Wildlife Foundation call them "Legacy Trees." Their ancient genetics are critical for maintaining biodiversity on the island. Like our Naples residential saves, we hoped to salvage these priceless specimens before they went to the chipper. This effort was funded as part of a large partnership between the Mauritian Wildlife Foundation and the Rodrigues Regional Assembly.



The team has to work through and around jagged calcarenite rock, weathered by millions of years of rainfall, to access the tree roots.

Over many Zoom calls, we hatched a plan. We would visit in March 2023, their rainy season, train a field team, and begin the complicated root pruning process. We would then transplant the prepared trees in the following year's rainy season to a nearby nature reserve. The island's logistical challenges would test my MacGyver skills to their limit. I packed propagation kits to back up propagules from each tree, pruners and saws for root and canopy work, and much more. My extensive travels to islands and jungles seemed amateur when considering this island with its remoteness and its



many endangered species. Little remained of the preman ecosystem. The endemic tortoise and flightless birds were long extinct. That's why conservationists are so eager to protect the species that remain, like these legacy trees.

After what seemed like days of air travel, I was revived by the beautiful island of Rodrigues. The small-town character with its lush tropical panorama and surrounding coral reefs was captivating. My excitement grew as I met our cheerful and competent field team and set out to see the trees.

We walked through ancient farm fields, reminiscent of Ireland with stacked stone livestock corrals, tethered or loose sheep and cattle, derelict fence remnants and condemned structures. These were once-thriving farms passed down since habitation hundreds of years ago. Now, livelihoods are in the way of the new and crucial airstrip. Our five legacy specimens were the only native species that farmers had saved to provide shade and fodder for livestock. All others were introduced exotics intended to provide the essentials required of island life. Many, unfortunately, now dominated and outcompeted these companions of extinct species, such as the tortoise. As I approached our trees

for the first time, I noted how much wilder and more daunting the habitat was in person compared to the

photos I'd seen on Zoom. The trees are all located directly on the emerald coast, elfin from the environmental conditions, and wildly windswept. A moonscape of jagged shark tooth calcarenite limestone surrounds them. Loose spherical boulders are strewn everywhere. The trees are locked in soil and rock to keep grounded and nourished in the brutal habitat. This survival tactic would make root pruning very difficult. But they had to be saved for biodiversity's sake, and any attempt was better than burying them under the monotonous concrete that would soon cover the land on which they are found.

Each tree had unique challenges and would require a root pruning recipe specific to each location. Root pruning is the art of strategically cutting root systems so that trees can eventually be lifted and moved with an intact root ball. Remember I mentioned logistical challenges? With no Amazon next-day delivery, my island colleagues had creatively fabricated shovels and trenching instruments so they could perform the delicate task of exposing the roots by hand so that we did not accidentally damage them. There are no freshwater sources on Rodrigues - all the irrigation water must be desalinated and trucked to the site in makeshift tanks.

On Day One, the process started by taking cuttings for genetic backup and setting

up the propagation system I had brought. Then, we began the painstaking process of root pruning. The new cuts would sprout fibrous roots, which we in turn would wall off with large, plastic tarps. Now downsized, the tree and its doughnut-like wrapped root ball can be lifted next year. We would then follow with regular watering and strategic canopy pruning and leaf stripping to reduce transpiration, or water loss through the leaves. In all, we spent a week together, working in the trenches from sunup to sundown to save these precious trees.

The team and I are back to Zoom calls, exchanging updates and discussing next steps. Things look promising. The Rodrigues team is observing root initiation, a sign that the root pruning procedure worked. This is a slow and arduous process and in a year's time, I plan to return and help guide the tree relocation to the neighboring Anse Quitor Nature Reserve. I'm grateful to have had this opportunity to form a relationship with these trees and the islanders so dedicated to saving them. Finally, it seems, we are learning the lessons of past exploitation and ensuring that these trees don't join the unfortunate story of the island's extinct tortoise and flightless birds.



Vice President of Horticulture Brian Galligan and Nature Reserve Officer Sweety Shan Yu work in the nursery.



The team wraps a root-pruned tree with plastic, forming a doughnut-like ring around the remaining roots and making the tree easier to eventually lift and move to a neighboring wildlife refuge.



A Painstaking Process

Inside the delicate work of <u>moving</u> these endangered trees



Diospyros diversifolia



Foetidia rodriguesiana

This tree is listed as Endangered under the International Union for Conservation of Nature's Red List, which monitors plants and determines their status. It is the only one of our trees that has the characteristics of a typical neighborhood tree with a beautiful, rounded (though lopsided) canopy and a straightish trunk. It is located in an ancient pasture with deep, dark soil and free of the toothy moonscape stone in the adjacent fields.



Terminalia bentzoe subsp. rodriguesensis



Polyscias rodriguesiana

Further up the landing strip and through a maze of jagged pillars, you could see the isolated Terminalia from a mile away. It stood out like a crooked, one-sided bonsai. Finding the way through this ancient, weathered ecosystem was dangerous and extremely difficult.. The razor rock varied in size from a few inches to taller than a person. The entire area was littered with caves. Not only did the tree show the ravages of nature, but it was also locked in, with a scarred trunk bulging out of a crack in thick, deteriorated calcarenite base rock. We had to break this rock apart just to root prune. How and where, and without damaging the precious cambium (the cell layer responsible for growing new bark and wood), was the challenge.

High on an adjacent farm hilltop proudly stood the impressive Polyscias — one of nine mature ones left in the wild, according to the IUCN. Its giant, lush, and shiny leaves stood out against the jagged cradle of stone that it had grown into and against over many generations. The giant tree was windswept from constant ocean exposure to its large cruciferous-like leaves. Once we painstakingly dug a trench in the accessible root zone, we found few roots. This was not good. It appeared the fist-sized roots climbed into that porous stone outcrop and hid from the hazards of island life. We needed to break the jagged and giant outcrop without damaging too many roots.

Brian Galligan is the Garden's Vice President of Horticulture.

This is the one I feel best about moving, in terms of simplicity. There are two of these trees located on the side of a basalt mountain littered with beach ball- to car-sized boulders. The IUCN lists this species as Critically Endangered with just 57 mature trees known to exist in the wild. Pruning was a painstaking process that involved strategically following each shallow root, excavating them, and wrapping them with plastic.

Garden intern Joe Graziano, Conservation Administration Manager Esther Chiddister, and Jared Franklin (opposite page), Environmental Specialist at Rookery Bay National Estuarine Research Reserve, collect seeds on Keewaydin Island for the beach dune restoration project. *Photo by John Eder* WANNADE



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