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the bulletin

of the National Tropical Botanical Garden

Meet the Plants

How well do you know your neighbors? Not the people next door, but the plants in our yards, mountains, and along our streams and coastlines? Hawai'i's native flora is among the most threatened in the world, and as good neighbors, we all share a responsibility to protect it. NTBG invites you to join our **Meet the Plants** campaign to increase awareness about what threatens Hawai'i's native flora, and how together we can save plants and people. To get involved, visit ***ntbg.org/meettheplants***

MONITORING *POLYSCIAS BISATTENUATA* ON MT. HĀ'UPU, KAUA'I

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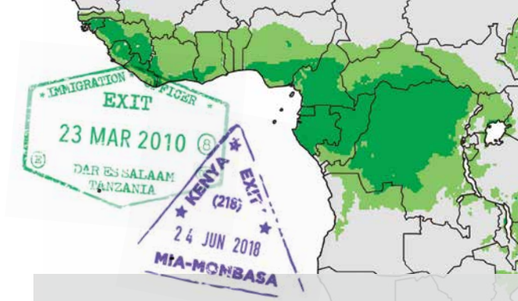

ON THE COVER

Passport stamps reflect breadfruit's travels under a collaboration that spans the globe. The map image was adapted from a breadfruit suitability study showing geographic regions with the best growing conditions, modeled from *WorldClim* data of rainfall and suitability (Matthew P. Lucas and Diane Ragone, *ArcNews*, 2012)

The Bulletin is a publication for supporters of the National Tropical Botanical Garden, a not-for-profit institution dedicated to tropical plant conservation, scientific research, and education.

We encourage you to share this publication with your family and friends. If your household is receiving more than one copy and you wish to receive only one, please inform our Development Office at our national headquarters at: members@ntbg.org.

National Tropical Botanical Garden
3530 Papalina Road, Kalāheo
Hawai'i 96741 USA
Tel. (808) 332-7324
Fax (808) 332-9765
members@ntbg.org
ntbg.org

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Editor: Jon Letman
Graphic Design: Merriam Fontanilla

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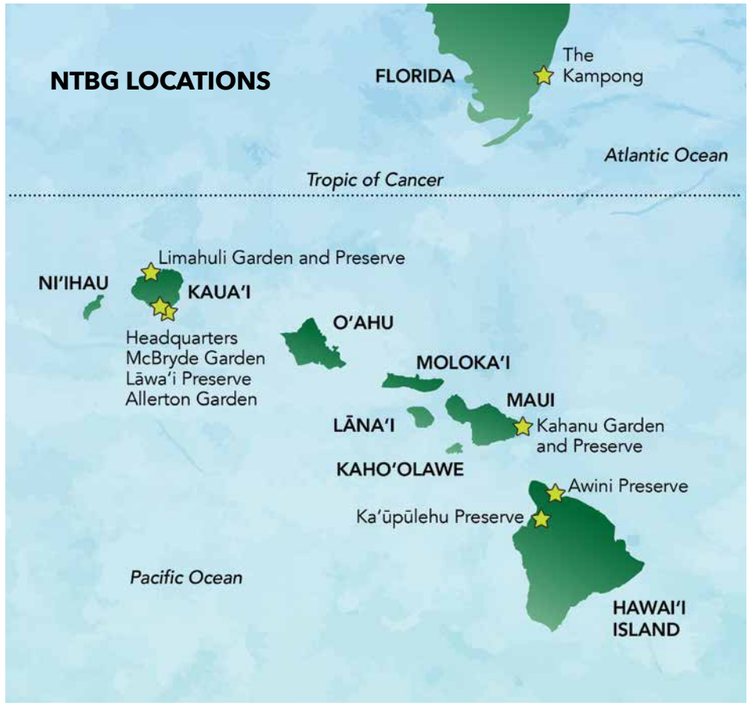
OUR MISSION

To enrich life through discovery, scientific research, conservation, and education by perpetuating the survival of plants, ecosystems, and cultural knowledge of tropical regions.

The National Tropical Botanical Garden was chartered by an Act of United States Congress in 1964. The objectives of the institution were set forth in the Charter:

- to establish, develop, operate and maintain an educational and scientific center, with libraries, herbaria, laboratories, and museums...to encourage and conduct research in basic and applied botany;
- to foster and encourage fundamental research in tropical plant life and study the uses of tropical flora in agriculture, forestry, horticulture, medicine, and other sciences;
- to share knowledge acquired relative to basic and applied tropical botany through publications and other media;
- to collect and cultivate tropical flora and to preserve for the people of the United States species of tropical plant life threatened with extinction;
- to provide a facility which contributes to the education, instruction, and recreation of the people of the United States.



National Tropical Botanical Garden
Chartered by Congress as a not-for-profit, non-governmental institution

Message from the CEO and Director

Visit any conservation or environmental website or magazine and the message is clear: our natural world is being decimated by the loss of biodiversity. Giant pandas, tigers, gorillas, and whales dominate our mental landscape of endangered species, and rightly so. We share our world with this charismatic megafauna and recognize the need for their survival.

But we also know that all animals and insects are inextricably linked with plants. Without the forests and meadows, the flowers, trees, and grasses that provide habitat and food, animals—like humans—cannot survive. As an institution dedicated to the study and conservation of plants, we at NTBG are acutely aware of the disparity between the public's understanding of the need to protect animals versus the need to save plants.

The tendency to see plants as a uniform "sea of green"—or worse, to not see plants at all—is known as "plant awareness disparity." This lack of awareness of the critical role of plants has been called one of our greatest conservation challenges. NTBG Science and Conservation director Dr. Nina Rønsted has written of the dangers of undervaluing and underfunding plant conservation, even as two in five of the world's plant species are threatened by extinction.

As a Garden supporter, I know that you appreciate the need to protect endangered plants.

At NTBG, our tagline *"Saving Plants, Saving People,"* reflects our mission-driven work to perpetuate the survival of plants and ecosystems that directly benefit animals and insects. In this issue of *The Bulletin,* Limahuli Garden and Preserve conservation operations manager Dr. Uma Nagendra writes about NTBG's leading role in the restoration of riparian and aquatic habitat in the Limahuli Valley. Uma paints a rich portrait of the native fish, birds, insects, and other creatures that rely on a healthy stream habitat for survival. Read Uma's article on page 12.

Nearly five thousand miles away at NTBG's Miami garden, The Kampong straddles essential habitat for the beloved but vulnerable manatee. From the edge of The Kampong, manatees and other wildlife can be seen feeding and resting in and around a scenic inlet of Biscayne Bay. The site is populated by mangroves which is a keystone species along this coast, providing food, shelter, and reducing land erosion. The vegetation lining the channel is largely salt and drought-tolerant, and home to several native plant and animal many species.

But after the reported deaths of more than 1,100 manatees last year alone, the urgent need to preserve healthy plant-based habitats, on land and in the water, is obvious and alarming. The gentle manatees which rely on seagrass beds, like the moths, bats, birds, and fish which live in the Hawaiian Islands, are all imperiled if the plants that sustain them die off. Climate change, pollution, invasive species, and habitat loss all play a destructive part in the loss of biodiversity.

If we really want to "Save the Whales" and "Protect the Pandas" or just know that tiny freshwater snails, leaf-mining micromoths, and countless other rarely seen life forms will remain on Earth, we need to start by saving plants. This, I believe, is something we cannot afford to overlook.

With gratitude and aloha,

Janet Mayfield
Chief Executive Officer and Director

A special **thank you** to our new Fellows and Members!

Become an NTBG Fellow and join a special group of tropical plant enthusiasts

The Council of Fellows was established in 1985 as NTBG's leadership membership group to advance NTBG's core programs in tropical plant conservation, research, and education. This exceptional group of philanthropists has been instrumental in helping NTBG to become one of the most important tropical botanical gardens in the world. Annual membership dues begin at the $1,500 level and continue up to the $20,000 Chairman's Circle level. In addition to enjoying general membership benefits, Fellows are invited to NTBG's bi-annual Board of Trustees meetings and also have the opportunity to participate in specially arranged travel programs, which include visits to private and public gardens and explorations of botanical hotspots around the world.

Become a Member of NTBG and support tropical plant conservation

Your membership dues directly support tropical plant conservation and research, provide the resources to protect and cultivate our living collections, and educate the public about the importance of tropical plants at NTBG's five gardens and preserves. Membership levels range from $90 to $500 with a level to fit everyone from individuals to families. **Contact: members@ntbg.org**

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Marjorie F. Gifford
Edmund M. Herrold and Ellen J. Yamaguchi
Wendy and Thomas Kelly
Mark Levine and John Keppeler
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Kathy and Kenneth Schwarz
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A GLOBAL PARTNERSHIP *that feeds*

BY JON LETMAN, EDITOR

FARMER NATE OLIVE CHECKS ONE OF HIS BREADFRUIT TREES ON ST. CROIX IN THE U.S. VIRGIN ISLANDS. PHOTO BY RIDGE TO REEF FARM

Posted on a wall in the office of the Breadfruit Institute at National Tropical Botanical Garden headquarters, a world map is marked by a bright green band indicating where breadfruit grows best. That band represents the potential to improve food security, increase reforestation, and bolster economic self-sufficiency.

One of the Breadfruit Institute's most successful partnerships is with the Trees That Feed Foundation ("Trees That Feed"). Co-founded in 2008 by wife and husband Mary and Mike McLaughlin, two Jamaican-born breadfruit enthusiasts, Trees That Feed was established as a non-profit organization with the encouragement and support of NTBG Trustee Emeritus Douglas McBryde Kinney who also introduced Mary and Mike to Dr. Diane Ragone, director of the Breadfruit Institute.

Mike and Mary wanted to do something about climate change, environmental degradation, and global hunger, while creating economic opportunities. With breadfruit, they found they could address all.

As Trees That Feed grew, two promising breadfruit varieties—the Samoan Ma'afala and Tahitian Otea—caught Mary and Mike's attention. After years of collaboration between Diane Ragone and Dr. Susan Murch, a plant chemist and tissue culture researcher at the University of British Columbia – Okanagan, Ma'afala and Otea were identified for their vigor, nutritional

BARNEY GIBBS TEACHES CUB SCOUTS ON BARBADOS ABOUT USING BREADFRUIT FOR 'FRUITSCAPING' ON A PUBLIC TRAIL. PHOTO BY ANDREW CLARKE

value, and suitability for mass micropropagation and global distribution.

Diane, who has spent more than 30 years studying and collecting breadfruit varieties from 50 Pacific islands, built the largest, most diverse collection of breadfruit varieties in the world. Since establishing a partnership with the Breadfruit Institute, Trees That Feed has distributed tens of thousands of micropropagated breadfruit trees originating from NTBG's conservation collection to at least 18 countries and territories.

Since 2018, Trees That Feed has purchased breadfruit treelets from Tissue Grown, a California-based plant tissue culture company which grows the Breadfruit Institute-sourced Ma'afala that Mary and Mike have mostly donated to growers in Central America, the Caribbean, and Africa. A portion of the trees are sold commercially which helps support NTBG and the countries of origin.

SOUTH PACIFIC VIBE

Tissue Grown's president Carolyn Sluis explains how the tissue culture-raised breadfruit treelets are grown in peat and vermiculite plugs without soil. After acclimatizing in the greenhouse for six weeks, they are distributed around the world in flats of 72 saplings. Before the plants can be shipped, Tissue Grown must complete complicated and time-consuming shipping protocols through their local agriculture department. Once approved, the trees are sent by air and hand-delivered to overseas destinations by operations manager Karin Bolczyk.

Despite two years of the COVID-19 pandemic, Tissue Grown grew more than 100,000 Ma'afala and Otea in 2020-21. Last December, they shipped 1,800 Otea to Kenya with another shipment of three flats to Guinea in January 2022.

Calling Diane Ragone's enthusiasm "infectious," Carolyn hopes breadfruit will gain a foothold in more countries. For a company more accustomed to growing walnuts, pistachios, and cherries, breadfruit is somewhat unusual, but Carolyn and Karin agree that Ma'afala and Otea, with their "South Pacific vibe," make breadfruit an irresistible feel-good crop.

PACIFIC CONNECTION

One of the farmers Karin has delivered breadfruit to was Nate Olive, owner of the 130-acre Ridge to Reef farm on St. Croix in the U.S. Virgin Islands. In the aftermath of the category-5 Hurricane Maria which devastated the region in 2017, Nate shifted his focus to growing breadfruit to replace lost trees and which he says proved to be a great morale booster.

Coordinating with Trees That Feed and Tissue Grown, Nate has already distributed some 3,500 donated trees on St. Croix, St. Thomas, and St. John. In addition to local Caribbean White and Yellow varieties, Nate grows Ma'afala which he distributes to farms, home owners, and government properties in order to improve food security and local economic development.

Breadfruit was introduced to the Caribbean in the 1790s and has long been used in traditional dishes like *callaloo, tostones,* and *monfongo*. Although breadfruit is considered a local crop, Nate says, "We're very respectful of the food and its identity...we feel connected with our brothers and sisters in the Pacific."

BREADFRUIT FOR ALL

Five hundred miles southeast of St. Croix, on the island nation of Barbados, breadfruit is eaten with flying fish as a mash called *coucou*. Barney Gibbs, chairman for the Future Centre Trust, one of Barbados's oldest environmental NGOs partners with Trees That Feed to provide for urban reforestation. Barney says importing breadfruit has allowed him to introduce greater horticultural variety to the island.

Since 2015, Barney has received three shipments of around one thousand Ma'afala which, he says, has proven to be popular for its compact, easy-to-manage size. He adds that the pandemic has only made breadfruit more popular as a nutritious, reliable crop, and for use in value-added products like flour, chips, and other foods.

Barney's main project is urban reforestation along a nineteenth-century railway line that was converted into a biking and walking trail. The Barbados Trailway project is being lined with breadfruit and other fruit-bearing trees, providing food for anyone who needs it. Other trees are given to local schools and community centers.

NEW TO AFRICA

Meanwhile, across the Atlantic, Catholic nuns in Kenya are harvesting what they call in Swahili *shelisheli* (breadfruit). Unlike in the Caribbean, breadfruit is a recent introduction. Joseph Matara, founder and executive director of the non-profit Grace Project (and

MARY AND MIKE MCLAUGHLIN HAPPEN UPON A WILD BREADFRUIT TREE GROWING IN A COSTA RICAN FOREST. PHOTO BY BRENT DUTCHER

NG'ANG'A AND IVY (YELLOW SHIRT) CARE FOR A YOUNG BREADFRUIT TREE ON A FARM IN MOMBASA, KENYA. PHOTO BY MARY KIBAI

BREADFRUIT IS GROWN BY THE TENS OF THOUSANDS AT THE TISSUE GROWN NURSERY IN CALIFORNIA. PHOTO BY KARIN BOLCZYK

TISSUE GROWN'S KARIN BOLCZYZYK PREPARES SHIPPING LABELS FOR BREADFRUIT BEING SENT TO KENYA. PHOTO BY DIANA RIOS

Trees That Feed board member) welcomes the new crop. Joseph works closely with Mary and Mike to ship Otea and Ma'afala trees to Mombasa, Kenya, Dar es Salaam, Tanzania, and Uganda's Jinja district, north of Lake Victoria.

Like a handful of breadfruit trees believed to have been imported to Zanzibar from Goa long ago, breadfruit is proving to be best suited along East Africa's coastal regions. Joseph has coordinated the donation of young trees to schools and other places where they are most needed. The high nutritional value and versatility of breadfruit make it ideal for improving food security. "For some of these children," Joseph says, "what they eat at school is their only meal for the day."

Other projects in West Africa (Ghana and Liberia) are taking root and Joseph sees great potential for breadfruit in Mozambique too.

SAVING LIVES IN HAITI

At its core, the Trees That Feed Foundation is about helping people. Mary recalls shipping one thousand breadfruit trees to Haiti in July 2021. Those trees arrived less than 24 hours before Haiti's president was assassinated, an event that led to great instability. One month later, Haiti was rocked by a 7.2 earthquake and powerful tropical storm which soaked the nation already upended by political violence, poverty, and COVID.

Mary says that after last summer's earthquake, trees they had imported in 2012 proved to be a lifesaver when other food sources were cut off. "The work of NTBG helped us get established to where we could feed thousands of people in the area immediately around the epicenter of the earthquake."

Mike adds the network between the Breadfruit Institute, Trees That Feed, and other partners is a testament to the power of breadfruit. "We are ecstatic about being able to collaborate with NTBG. We couldn't do what we've done if they hadn't helped us so much."

Mary too says she's grateful for the partnership. "If breadfruit can be the source of a job, an environmental benefit, and feed the world's poorest people, then I think we've done a pretty damn good job."

supporting roots

Q & A with Julie Spielman

PHOTO BY BENOIT JONCKHEERE

Even after 50 years in Miami, Dr. Julie Spielman still feels like an Australian at heart. Like the tropical plants around her, however, she has adapted and made South Florida her home. Following a career in anatomy and cell biology and teaching at the University of Miami's medical school, today Julie enjoys traveling and volunteering at The Kampong. Doing so gives her the chance to get her hands in the dirt and experience the flora and fauna of Coconut Grove.

How were you introduced to The Kampong and how did you start volunteering?

It goes back a long time. We had a friend who was a professor of tropical botany at Harvard (Prof. P. Barry Tomlinson) who used to come down to teach a tropical botany course and stay at The Kampong. Mrs. Sweeney (The Kampong's previous owner) was always away in the summer when we visited. Even though it was the center of Miami, it was such a different space. That must have been 40 years ago. When my kids had all grown up and I was looking to volunteer, I thought "hmm...?" I had an attachment to The Kampong already. I talked to Barry and Larry Schokman (Kampong director emeritus) and did it that way.

What do you do as a volunteer at The Kampong?

I visit once a week on Wednesday mornings with another volunteer, Eleanor. We do a little bit of everything – a lot of weeding, trimming, pruning, and that sort of thing. Last week I was mending a fence and transplanting.

So you like to get your hands in the dirt?

Absolutely! I live in a townhouse now. Not enough dirt!

What most draws you to The Kampong?

I think it's the chance to get a bit of peace and quiet. Once you get inside and away from the gate, you don't hear the traffic. It's just peaceful. I don't have to go to the gym – I get plenty of exercise at The Kampong. I don't have to go to yoga because I can meditate, it's so quiet. On Wednesdays, I come home exhausted, but it's fun.

What kind of wildlife have you seen at The Kampong?

Yesterday there was a pair of hawks calling back and forth. I haven't heard them before. There's always lots of parrots and racoons and foxes.

Foxes?

Yes! Foxes. And manatees in the canal. When it's cold the manatees like the warm water closer to shore. Also, the occasional crocodile.

The Kampong is famous for fruit trees. Do you have a favorite?

Mangos! Lots of mangos. My friend goes for a preliminary graze before we work. She picks up all the fruit off the ground.

Can you describe the contributions of The Kampong and why you think it's important to support NTBG?

Well, David Fairchild used it for introducing all sorts of things. These days it gives children a chance to see food growing on trees. Kids have no idea where their food comes from. That's very useful. For adults it offers a bit of peace and quiet.

Also, a huge amount of the world's biodiversity is in the tropics. There's an awful lot we don't know about those plants even now. Opening one's eyes to the possibilities is a major role for NTBG. With the International Center for Tropical Botany at The Kampong going up next door, it will be an invaluable resource. I think that will be very important.

RESTORATION EFFORTS IN LIMAHULI VALLEY SHOW

How a Garden Can Save a Stream

BY DR. UMA NAGENDRA, CONSERVATION OPERATIONS MANAGER, LIMAHULI GARDEN AND PRESERVE WITH PUAKEA MO'OKINI-OLIVEIRA, CONSERVATION TECHNICIAN

PUAKEA MO'OKINI-OLIVEIRA SNORKELING IN THE LIMAHULI STREAM TO GATHER DATA. *OPPOSITE PAGE:* MATTHEW KAHOKULOA JR. TAKING NOTES ALONG THE LIMAHULI STREAM. PHOTOS BY KASSANDRA JENSEN

> “In many ways, the health of the stream indicates the health of the rest of the valley.”

NTBG STAFF AND VOLUNTEERS CARRY NATIVE PLANTS USED AS PART OF THE HĀʻENA ʻOʻOPU RESTORATION PROJECT. PHOTO BY UMA NAGENDRA

LIMAHULI STREAM CLEARED OF INVASIVE SPECIES. PHOTO BY PUAKEA MOʻOKINI-OLIVEIRA

In the middle of Limahuli Stream, cold mountain water cascades down boulders into a hip-deep pool. I am grateful for the wetsuit keeping me warm. Small river stones slick with algae slip beneath my tabis (water shoes). If I stay still, I might feel the dull pinch of Tahitian prawns nibbling my toes. Looking up at Limahuli Valley, I can see both sides of the cliffs where koaʻe (white-tailed tropic birds) dart into their nests. I don my snorkel mask, nod to lead technician Puakea Moʻokini-Oliveira, who is standing on the bank with a timer and waterproof datasheets, take a deep breath, and dunk myself into the frigid water to enter the aquatic world of freshwater fishes.

Immediately, several ʻoʻopu nākea[1] dart away along the stream bottom, leaving silty clouds in their wake. As I step in their direction, I can see an ʻoʻopu alamoʻo resting on a dark stone, its bright orange tail curled slightly against the rock contours. I almost miss the crowd of ʻoʻopu nōpili grazing on a patch of green algae because they are so close to the waterfall cascade.

This underwater survey is a component of The Hāʻena ʻOʻopu Restoration Project, a two-year project funded by the Hawaiʻi Fish Habitat Partnership in order to enhance stream health and ʻoʻopu population numbers in Limahuli Stream. Freshwater aquatic species like ʻoʻopu were once a major food source, although now few Hawaiʻi residents have ever seen one.

While this underwater world may feel completely removed from the terrestrial world we inhabit at NTBG, they are actually intricately intertwined. Limahuli Stream is the thread connecting all parts of the watershed from mauka to makai (mountains to the sea). From

[1] ʻOʻopu are species (*Awaous* sp.) of goby native to Hawaiʻi. The three most common ʻoʻopu in Limahuli stream are ʻoʻopu nākea (*Awaous guamensisi*), ʻoʻopu alamoʻo (*Lentipes concolor*), and ʻoʻopu nōpili (*Sicyopterus stimpsoni*).

the mist caught by the ʻōhiʻa (*Metrosideros* sp.) canopy in the uppermost valley, filtered down through moss, leaf litter and soil, flowing underground through porous rock, or overland in rivulets and gulches, all the valley's water eventually follows Limahuli Stream to the ocean.

Streams carry carbon, nutrients, and silt to the reef. Riparian ecosystems (streams and stream banks) offer unique habitats for plants and animals that are adapted to constantly moist, periodically flooded conditions. In many ways, the health of the stream indicates the health of the rest of the valley. Healthy streams also provide critical ecosystem services such as clean water, erosion prevention, and food.

NATIVE HAWAIIAN PLANTS USED IN THE RESTORATION PROJECT. PHOTOS BY UMA NAGENDRA/NTBG STAFF

With the abandonment of traditional stream management practices and introduction of invasive species, stream health has declined throughout Hawaiʻi. Stream diversions, blockages, and invasive species overgrowth have adversely transformed many riparian systems that were once highly productive and biodiverse ecosystems.

Although Limahuli Stream is considered "pristine," with high levels of biodiversity and among the least disturbed stream systems on Kauaʻi, it is home to far fewer ʻoʻopu than neighboring Hanakāpīʻai Stream. A past comparison of the two suggests that the amount of sunlight reaching the streams could be a major contributing factor to the lower population in Limahuli. Native green algae are the foundation of the riparian food web, and thrive in high light conditions. A promising pilot study led by NTBG research associate Kawika Winter[2] several decades ago tested this idea on a small scale. The Hāʻena ʻOʻopu Restoration Project expanded that study in order to see if opening up longer sunny stream corridors (as would have been maintained with traditional stream management) would also increase green algae growth and ʻoʻopu populations.

One of the main activities of this project was the selective trimming of *Schefflera actinophylla*, a highly-invasive tree species that threatens the health and resilience of the riparian ecosystem by preventing sunlight from reaching the stream, which limits green algae growth. The tree's high evapotranspiration rates and inhibition of understory growth reduce groundwater penetration and storage, contributing to flash floods and erosion. *Schefflera's* sprawling growth forms also threaten the integrity of valuable cultural resources. For this project, invasive trees were trimmed by an experienced local arborist crew (Haleleʻa Tree Service), with the help of Limahuli Garden staff.

Afterwards, Puakea and I started planting on the freshly cleared stream banks, with the help of many other Limahuli staff, KUPU service members, and volunteers. We hand-carried and planted over 4,742 native plants like kokiʻo keʻokeʻo (*Hibiscus waimeae hannerae*), hala (*Pandanus tectorius*), and many others[3].

The mix of species was selected in consultation with previous restoration managers and living collections experts at NTBG. These included species sourced from northwest Kauaʻi, quick to establish and grow in riparian areas, and which have strong root systems that will help

[2] Dr. Kawika Winter was director of Limahuli Garden and Preserve from 2005 to 2018.

[3] Including koaia (*Acacia koaia*), māmaki (*Pipturus kauaiensis*), ʻākia (*Wikstroemia oahuensis*), koʻokoʻolau (*Bidens forbesii forbesii*), and ground covers such as ahuʻawa (*Cyperus javanicus*), makaloa (*Cyperus laevigatus*), pili (*Heteropogon contortus*) and ʻaeʻae (*Bacopa monnieri*).

ʻOʻOPU ALAMOʻO IN LIMAHULI STREAM. PHOTO BY GRAHAM TALABER

SETTING UP A STREAM CROSS-SECTION TRANSECT TO MEASURE HABITAT CHANGES. PHOTO BY KASSANDRA JENSEN

prevent future erosion on a now-vulnerable stream bank. We also chose a few species that are likely pollinated by moths (scented, white, night-blooming flowers) in order to further promote moth habitat, including endemic *Hyposmocoma* and the ʻōpeʻapeʻa (Hawaiian hoary bat) that feeds on them.

Throughout the project, Puakea conducted stream surveys to assess how the aquatic wildlife were responding to this change. The entire 1,500-foot restoration area was divided into three 500-foot sections where we swam for an underwater census of the aquatic animals. We also surveyed a cross-section of different parts of the stream to document the algal growth, substrate composition, and stream characteristics like water temperature, flow rate, and canopy openness.

Spending so much time along the stream banks allowed us to observe just how many other species enjoy this area as well. By investigating the lower stream, Puakea was able to note how hīhīwai[4] migrated up the stream into our restoration zone – and even spotted their small pink eggs on the rocks. While we planted or weeded, we were often joined by an aukuʻu (Black-crowned Night Heron) standing statue-like to fish on a nearby boulder, or a pair of Koloa maoli ducks playing in the current.

One of the best parts of this project was working with school groups, volunteers, and partnering community organizations. Although COVID precautions limited our interactions after the first six months of the project, we were able to welcome two recurring classes from Kanuikapono Public Charter School, a work-exchange with the Waipā Foundation, and a new stream research collaboration led by the non-profit Nā Maka Onaona.

Our results indicated that canopy openness alone was not enough to boost ʻoʻopu population numbers within the time frame of this project. Aquatic animal diversity remained high, however, and indicators of stream health such as temperature were unchanged. By restoring the stream banks to native habitat, the stream corridor should now be even more hospitable to native birds, bats, and invertebrates, and safer from the invasive tree falls that exacerbated flood impacts in 2018.

The completion of this project is just the start of this important new restoration area. In order to sustain those benefits, we will need to continue maintaining the stream corridor. Ongoing collaborative stream monitoring will also help improve our understanding of watershed resilience both in the Limahuli Valley and in freshwater systems all across Hawaiʻi.

Editor's note: The author wishes to thank those who contributed significantly to this project: Kawika Winter, Ashley Ramelb, Saori Umetsu, Moku Chandler, Noah Kaʻaumoana, Pelika Andrade, Mackenzie Fugett, Lauren Pederson, Matthew Kahokuloa Jr., Kassandra Jensen, Joshua Diem, Emma Stauber, and others. Funding for this project was provided by The Hawaiʻi Fish Habitat Partnership, which is coordinated by the U.S. Fish and Wildlife Service.

[4] Endemic freshwater snail (*Neritina granosa*)

red listed

The International Union for Conservation of Nature (IUCN) publishes the online resource, The IUCN Red List of Threatened Species, ranking taxa (species, subspecies, or varieties) in one of nine categories from 'Not Evaluated' to 'Extinct'. The Red List is an invaluable tool for not only scientists, educators and policy makers, but for anyone seeking a better understanding of the conservation status of plants and animals around the world.

In recent years, conservation agencies, institutions, and organizations including NTBG have increased efforts to assess the nearly 1,400 native plant taxa in Hawai'i. To date, nearly half have been assessed, reviewed, and published on the Red List, adding to the more than 58,000 plant taxa published through the latest update of the Red List worldwide.

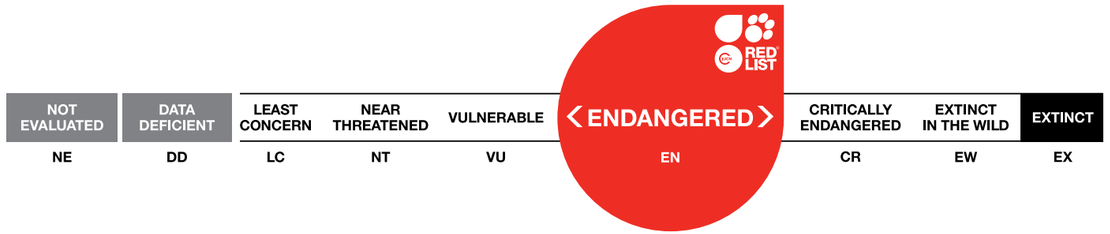


PHOTO BY SEANA WALSH

Species: *Pipturus ruber* (Urticaceae)

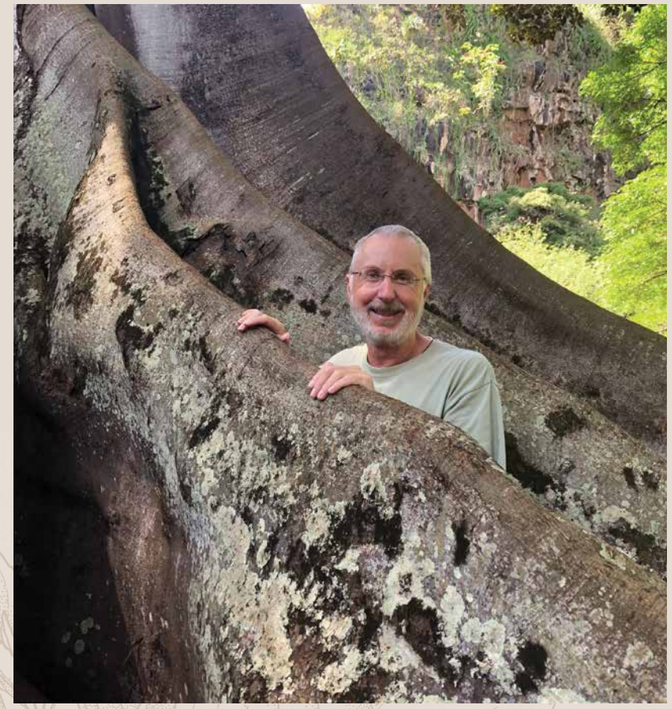
IUCN RED LIST CATEGORY: ENDANGERED (EN)

Pipturus ruber is a strikingly beautiful Kaua'i single-island endemic shrub in the nettle family that occurs in montane wet forest, bogs, and riparian habitats. An estimated 38,400 individuals occur among 12 subpopulations. Although those numbers are higher compared to most of the other Kaua'i single-island endemic plants, *P. ruber* faces the same threats as all of our native plant species such as habitat degradation by non-native animals and competition by non-native invasive plant species.

Species of *Pipturus*, called māmaki in Hawaiian, have numerous documented uses including the fruits and leaves as medicines and the bark in making tapa, rope, and cordage. Tea made from māmaki leaves is enjoyed regularly by many today for its health benefits and taste. The Hawaiian endemic Kamehameha butterfly relies on māmaki as a host plant.

Field botanists of NTBG have made seed collections of *P. ruber* over the years. Seeds are stored in NTBG's Seed Bank and plants are maintained in NTBG's McBryde and Limahuli Gardens and utilized in Limahuli's restoration projects. *—Seana Walsh, Conservation Biologist*

Leaving a Legacy



When I first came to Kaua'i, some 30-odd years ago, you couldn't get me off the beach or out of the water. After the grey skies and freezing water of England, this was paradise, indeed. I had no inclination when my friends suggested we go hiking up in the cold mists and clouds of Koke'e, but they insisted.

As we climbed the road along Waimea Canyon, I began to understand why they had been so keen; the scenery was spectacular. We eventually arrived at the Kalalau Valley look and I was awestruck. I had never seen anything so beautiful, so grand — from the jagged cliffs, all the way down to the sparkling blue ocean. It was like a cathedral. It took my breath away. After drinking in the view, we continued along Pihea Trail to the Alaka'i Swamp "trail." (This was long before the boardwalk, and to call it a trail was an extreme exaggeration!)

In the Alaka'i, I was struck again by the beauty, power, and mystery of the place. Since then, I have returned to Kalalau and the Alaka'i many times, and they have never lost their magic for me. Sadly, I have also noticed a decline, especially in the native forest birds and the flora on which they and so many other animals depend.

I became engaged in learning more about the issues facing Hawai'i and other tropical ecosystems. This naturally led me to NTBG. On a visit to Limahuli Garden, Kawika Winter, former Limahuli Garden Director, explained the deep connection between the Native Hawaiians and the land and sea. They were able to live in balance, each benefiting from the other. He explained how these principles could be applied to solve many of the environmental and social challenges facing our world today, and how NTBG was furthering these efforts.

NTBG works to preserve remaining wild populations of native species, and to provide a "bank" against future extinction. This work is so important if these remarkable, unique tropical ecosystems are to survive. I have also seen that every dollar donated to NTBG is a dollar spent on the mission itself; it is used wherever it will do the most good.

My love for what I have experienced on Kaua'i, and what I hope others will be able to experience a hundred years from now, has led me to leave a planned gift to NTBG. Even if I may not be around to see it, I know the money will go towards preserving these unique plants.

— Keith Evans, NTBG member

IUCN World Conservation Congress and NTBG's role

ON THE WORLD STAGE

BY MIKE DEMOTTA, CURATOR OF LIVING COLLECTIONS,
DR. SAM 'OHU GON, III, NTBG TRUSTEE,
AND CHIPPER WICHMAN, PH.D., FLS, PRESIDENT

Marseille is France's oldest city. It may also be its most patient. When the International Union for Conservation of Nature (IUCN) named the Mediterranean metropolis to host its World Conservation Congress (WCC), it was scheduled for June 2020, but as the COVID-19 pandemic swept the globe, the event was put on hold.

NTBG's involvement with the WCC goes back to 2008 when the congress was hosted by Barcelona. At the time, those of us in Hawai'i's conservation community felt strongly that we had much to share with the world. Working with the Hawai'i Conservation Alliance (HCA) Steering Committee, we urged our local leaders to pursue closer involvement with IUCN.

The movement gained momentum in 2012 at the WCC hosted by Jeju Island, South Korea. Following that congress (and eight years of hard work by many groups and individuals), we rejoiced when Hawai'i was selected to host the 2016 WCC[1] —the first time the event would be held in the United States.

[1] More than 10,000 delegates from 192 countries participated in the 2016 WCC in Honolulu, the largest attendance since the first congress in 1948.

HAWAI'I WORLD CONSERVATION CONGRESS DELEGATES MIKE DEMOTTA AND SABRA KAUKA (SEATED) ADDRESS A GLOBAL CONSERVATION AUDIENCE. PHOTO BY SAM GON

MEMBERS OF HAWAI'I'S WCC DELEGATION PRESENT A HULA DEMONSTRATION IN MARSEILLE. PHOTO BY MIKE DEMOTTA

Buoyed by this success, we knew Hawai'i had many important contributions to make and so, like everyone in Marseille (and around the world), we waited patiently, and we planned. After being postponed twice by the pandemic, Marseille was finally able to host a hybrid in-person/virtual congress in September 2021.

When Hawai'i's 36-person delegation arrived, we were a fraction of what we had planned to send, and we knew we had a lot to do. The three of us were representing not only NTBG, but all our colleagues, partners, and the IUCN Hawai'i Hui (group) which includes around 100 conservation organizations and individuals who played a key role in planning our contribution to the WCC.

With so many other global events canceled or delayed, we recognized the congress's importance as an in-person opportunity to exchange ideas, strategies, and knowledge. In Marseille we were able to meet with the world's most environmentally engaged scientists, conservation practitioners, policy makers, Indigenous leaders, and members of civil society. This was also our chance to stress the need for a comprehensive plant conservation strategy on the world stage. Those of us working at NTBG were committed to preparing the groundwork for UN member states to adopt the post-2020 Global Strategy for Plant Conservation (GSPC) framework during the Conference of Parties (COP15) meeting in Kunming, China where the Convention on Biological Diversity would be updated in 2022.

Despite intense competition to be awarded one of the limited IUCN forum sessions, NTBG's proposal for a session on the post-2020 GSPC (prepared in collaboration with Botanic Gardens Conservation International and France's National Museum of Natural History) was accepted, giving us a two-hour slot on the world stage to discuss the urgency of this issue. Meanwhile, the HCA lead team agreed that top priorities for our Hawai'i delegation would include: the creation of a new IUCN commission devoted to a coordinated climate crisis response, the need to incorporate Indigenous cultural knowledge and community engagement in conservation agendas and actions, and the long overdue necessity of addressing the destructive legacy of the colonization of Indigenous people and biodiversity.

The congress also allowed us to share the beauty and joy of Hawaiian culture and customs, especially as they relate to plants. Cultural activities such as weaving lauhala (pandanus leaf) bracelets proved to be immensely popular and we were thrilled there was so much interest in Hawai'i.

MĀLAMA 'ĀINA CULTURE

In preparing for Marseille, the Hawai'i Conservation Alliance leadership committee studied the successes of the 2016 WCC. We recognized the importance of demonstrating Hawai'i's biological and ecological diversity as well as its unique cultural foundations that evolved in an island system, itself a microcosm of Earth. Importantly, our delegation contributed to a strong Indigenous global presence at the WCC.

One of our goals was to convey how Hawaiian culture flourished even as it maintained a remarkably low ecological footprint and developed a reciprocal relationship with the environment, regarding all life on land and sea as family.

Because of Hawai'i's culture of mālama 'āina (caring for the land), many cultural practitioners are also stewards of natural resources. This allowed us to offer Hawaiian protocols for the opening of the Oceania-Hawai'i Pavilion where we prepared authentic Hawaiian mementos for IUCN partners. Our key message was one of biocultural conservation, rooted in the work of NTBG and like-minded partners across Hawai'i.

Recognition of the critical role of Indigenous people in preserving the well-being of the world into the future was reflected in a motion to include Indigenous people's representation in IUCN leadership. Also of note was the renunciation of the 'Doctrine of Discovery' which asserts lands were "discovered" by European powers from the 1500s onward, using the claim to justify the subjugation and genocide of Indigenous peoples. Both motions were crafted or supported by the Hawai'i delegation.

Additionally, we proudly wrote and submitted Motion 003 which calls for the creation of an IUCN Climate Crisis Commission to address sea level rise, increasingly powerful storms, and droughts that threaten our homelands. Although the motion faced strong opposition by some IUCN leadership over concerns of limited financial resources and redundancy, in the end the vote was overwhelmingly approved, thanks to islanders around the world.

BIOCULTURAL CONSERVATION

One of our most important functions in Marseille was to demonstrate how biocultural conservation is primarily driven by the deep connection between Hawaiian culture and the natural world. Ancient wisdom guided Hawaiians to live within the means of their environment. We shared how this wisdom continues to guide conservation and restoration work at NTBG, as exemplified in the documentation of native flora, fauna, and ecosystems in Limahuli Garden and Preserve and across the Hawaiian Islands.

HAU'OLI WICHMAN TEACHES A LAU HALA (PANDANUS LEAF) WEAVING WORKSHOP AT THE WCC. PHOTO BY CHIPPER WICHMAN

In presenting NTBG's conservation activities to international delegates, we shared how our work contributes to biocultural conservation through the demonstration of mo'olelo (stories) and mele (chants) passed down over generations. This rich biocultural heritage helps perpetuate the understanding and appreciation of Hawai'i's deep ties between people and nature. By finding and describing kino lau (physical manifestations of natural deities), NTBG strengthens links from ancient stories to modern cultural practitioners.

KUMU (TEACHERS) MARQUES HANALEI MARZAN, SAM ʻOHU GON, AND KATHRYN MĀHEALANI WONG IN THE OCEANIA-HAWAIʻI PAVILION AT THE WORLD CONSERVATION CONGRESS. PHOTO BY MIKE DEMOTTA

NTBG PRESIDENT CHIPPER SPEAKING AT THE WCC IN MARSEILLE. PHOTO BY DIEGO RIVERA

We shared the notion that daily acknowledgement of ancestral wisdom makes a positive difference in the perpetuation culture within the framework of NTBG's conservation efforts. Doing so requires an intentional and deep knowledge, both inherited and learned. Sharing our heritage and putting these relationships in context resonated with WCC attendees from other parts of the world, many of whom recognized our struggle to preserve our own ancient Indigenous knowledge as a familiar theme. It was a valuable forum to bring the stories, culture, history, and the world views of Native Hawaiians to a global audience.

BEYOND MARSEILLE

Today we face a world inexorably headed to a tipping point marked by a dramatic loss of biodiversity. Many scientists believe this will result in a cascading impact on the climate, imperiling human civilization and our fundamental well-being. Looking beyond Marseille, guided by the compass of wisdom and experience, we must act with speed, clarity, and vision.

The scale and complexity of the challenges before us demand global commitments. As the world's largest conservation organization, the IUCN is positioned to help shift the current trajectory toward a more sustainable future. Between now and the next congress in 2024, NTBG, our partners throughout Hawaiʻi, as well as all who share the same values, hold the opportunity and responsibility to play a positive and influential role helping chart the course ahead. Our ability to listen, learn, and lead has never been more important. The time for patience is over.

SOLANUM SANDWICENSE

wish list

Would you like to make a difference today? Purchase an item from our wish list and your donation will go directly to meet immediate program needs. Please send your contribution with the enclosed envelope, including a specific description of the item. If you have any questions or would like to make your donation by phone, call Chelsey Aki at (808) 332-7324 Ext. 209. To make your donation online, go to ntbg.org/support/donate. Mahalo for your support!

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To see the complete Wish List, please visit:
https://ntbg.org/support/wishlist/

garden sprouts

News from around the Garden

PHOTO BY YUKI REISS

THROWING A BALL (OF SEEDS) ON LEHUA

Late last year, Garden staff and volunteers partnered with the Kaua'i Native Plant Society (KNPS) and the Division of Forestry and Wildlife, all part of the Lehua Restoration Committee, to assemble seed balls for distribution on the islet of Lehua, west of Kaua'i and north of neighboring Ni'ihau Island. The balls, composed of seeds collected by KNPS and NTBG, are roughly the size of a hockey puck. Each contains eight native coastal species including sedges like ahu'awa *(Cyperus javanicus)*, 'aki'aki *(Fimbristylis cymosa)*, and the hardy shrub alahe'e *(Psydrax odorata)*, in the coffee family. A special clay formulated to aid dispersal was used to bind the 300 seed balls which were hand-scattered in select restoration sites on the remote islet. The dispersal was timed to coincide with the winter rainy season. Conservationists hope the seeds will take root and produce new plantings to create a more inviting habitat for seabirds which are now returning to the crescent-shaped (now rat-free) islet.

PHOTO BY BOB NISHEK

INTERN EMBRACES COASTAL CAPER

Hike along the most arid, sunbaked stretches of Hawai'i's coastline and, if you're lucky, you may find native Hawaiian caper *(Capparis sandwichiana)*, a sprawling bush with showy white flowers. Maiapilo, as it's called in Hawaiian, is red listed as Vulnerable and in decline. This relative of the common caper produces smelly fruits, but the dazzling flowers left NTBG science and conservation intern John Steinhorst "spellbound" when he first encountered the plant.

Last year, John embarked on a seven month-long study of maiapilo, working with Garden staff to study the plant's germination and best propagation techniques. Under the mentorship of seedbank manager Dustin Wolkis, John also studied maiapilo seed dormancy, viability, and storage protocols for better conservation and possible use in native landscaping. As part of the Red List assessment, John planted and monitored six maiapilo in Allerton and McBryde gardens and more than 300 seeds in the nursery. John, who first volunteered at Limahuli Garden in 2016, later worked as a garden tour guide. Today he is pursuing a Master of Science degree at the University of Hawai'i's Department of Tropical Plant and Soil Sciences. Currently, four maiapilo planted in the garden are becoming established with dozens more growing in the nursery.

SANDRA KNAPP AWARDED FAIRCHILD MEDAL

Dr. Sandra Knapp, a research botanist at the Natural History Museum (London), has been selected as recipient of the David Fairchild Medal for Plant Exploration for 2022. Dr. Knapp specializes in the taxonomy of Solanaceae (nightshade family), which includes the mega-diverse genus *Solanum* (tomatoes, potatoes, eggplants). Since the 1980s, Dr. Knapp has conducted extensive field work in Central and South America as well as in China and Uganda, with a focus on indigenous crop diversity, phylogenetics, and traditional uses of Solanaceae and other plant families.

In addition to describing more than 100 new plant species, Dr. Knapp has served as president of the Linnean Society of London since 2018, a position she holds through May 2022. She is the author of more than 270 peer-reviewed scientific articles and has written, edited, or contributed to 30 scientific and popular books about plant exploration, discovery, and botany. Dr. Knapp is also a major contributor to Flora Mesoamericana and founder/curator of the website Solanaceae Source, a global taxonomic resource for the nightshade family. She says Solanaceae is "absolutely fascinating" because it is well-known for plants we love to eat (tomatoes, potatoes, eggplants) but also for plants that can kill us (nightshades, tobacco). She readily admits she favors the former.

PHOTO BY NATURAL HISTORY MUSEUM

Upon learning of her selection to receive the Fairchild Medal, Dr. Knapp said, "it was a real surprise. I thought, 'What? This is crazy, there must be some mistake!'" adding that she felt incredibly honored. Dr. Knapp, the 23rd recipient of the Fairchild Medal, follows Dr. Ruth Kew (2002) and Dr. Jan Salick (2020) as just the third woman to receive the medal since it was first awarded in 1999.

Born in California and raised in New Mexico, she said that her chance selection of a field botany elective as an undergraduate at Pomona College changed her life. After her first trip to examine plants under a microscope in the desert, she was hooked.

Reflecting on four decades of botanizing, Dr. Knapp says the increasingly collaborative nature of field work has been a force for good, strengthening relationships among colleagues, and making for a more inclusive approach to science. In response to the suggestion that scientists should avoid political or societal issues, Dr. Knapp disagrees. "Scientists are part of society and need to be concerned with societal issues," she says, "even when it is uncomfortable, which it often is."

As seasoned public speaker and ardent supporter of science communication, she says it's important that science spurs conversations rather than monologues and that being open to considering differing points of view is critical. "The conversation is the really important thing, because that's where you begin to look at the world through somebody else's eyes and that then changes your own world view," Dr. Knapp said.

The David Fairchild Medal for Plant Exploration recognizes exceptional individuals who have explored remote areas of the world to discover new plant species, played crucial roles in the ex situ cultivation of rare or endangered plant species, and/or helped preserve threatened and endangered habitats and natural communities. The 2022 Fairchild Medal will be presented on April 6th at The Kampong, NTBG's garden in Coconut Grove, Florida, and former home of legendary botanist and plant explorer Dr. David Fairchild.

To read NTBG's full interview with Dr. Knapp, visit *https://ntbg.org/news/sandraknapp_interview*

an eye on plants

SELECT SPECIES IN FOCUS

Kō (*Saccharum officinarum*)

Among the two dozen or so 'canoe plants' introduced to Hawai'i by the first Polynesian voyagers, sugarcane is one of the most widely grown in the tropical world. Called kō in Hawaiian, elsewhere sugarcane is known as *tō* (Marquesas, Tonga), *tolo* (Samoa, Tuvalu), and *dovu* (Fiji). This sturdy member of the Poaceae (grass family) may have been first cultivated in Papua New Guinea, possibly originating as *Saccharum spontaneum*, a relative of *S. officinarum*.

Kō is valued for its sucrose-rich fibrous pulp which is used to sweeten food, drinks, and medicine or (as old-timers will tell you) cut fresh with a cane knife and chewed in the field. For early Hawaiians, kō was more than a sweetener. It provided thatching, mulch, compost, an ornamental wind break, and served as a soil stabilizer.

NTBG senior research botanist Dr. David Lorence first encountered sugarcane as a Peace Corps volunteer in 1970, working in a program of agricultural diversification with the Mauritius Sugarcane Industry Research Institute. Like Hawai'i, the southwest Indian Ocean island nation supported a vibrant sugarcane industry before it turned toward tourism.

Dave Lorence notes that while sugarcane has played a central role in the economies and development of many tropical countries, it also bears a darker history based on slavery and indentured laborers. Fortunes were made and empires built on the backs of laborers who toiled in cane fields doing back-breaking work, cutting and stacking cane by hand in dirty, sometimes dangerous conditions.

Furthermore, the industry was known for its insatiable (and often destructive) thirst for water, waste runoff, heavy fertilization, and industrial pollution. During harvest time, when drier, lower leaves were burned off the cane, Hawai'i's skies blackened with soot and ash.

Hawai'i's own industrial sugarcane industry began on Kaua'i in the town of Kōloa and quickly spread across the islands, fueling the migration of workers from Asia, the Caribbean, and beyond, leading to cultural and societal shifts that remain today.

Despite its checkered past, many in Hawai'i harbor deep affection for kō, and rue wistfully for the recent past when the days grew shorter, the cane grew taller, and its silvery tassels blew in the wind, signaling autumn harvest, the rising of the Pleiades (Na huihui o makali'i), and return of the Hawaiian Makahiki season.

Earlier this year, NTBG hosted Dr. Noa Kekuewa Lincoln, a Hawaiian crop specialist at the University of Hawai'i. Noa worked closely with NTBG staff to verify the provenance and identity of the Garden's kō collection. Presently, NTBG has 11 sugarcane cultivars in McBryde Garden, eight at Limahuli Garden, and an estimated 27 at Kahanu Garden.

Kahanu Garden director Mike Opgenorth worked with Noa to verify cultivars and identify duplicates among the garden's collection. Mike says that Hawaiian kō varieties have adapted to thrive in very specific microclimates which can make growing them together in one collection a challenge. With its mix of traditional Hawaiian cultivars and other, more recent ones, Mike says Kahanu Garden is a great place for people to experience the splendor of sugarcane growing in robust clumps.

On Kaua'i, NTBG curator of living collections Mike DeMotta, stresses the importance of NTBG's kō collection as a repository of living scientific and cultural germplasm where scientists and educators like Noa Lincoln can do research and teach others. In January, Noa and Mike presented a kō workshop in McBryde Garden.

Mike spoke of the importance of the plants in perpetuating cultural knowledge, naming a little-known variety called Kō'eli lima a 'o Halāli'i which translates as the *hand-dug cane of Halāli'i*, a rare white-stalked cane known to grow in the sandy dunes along Halāli'i, a seasonal lake on the island of Ni'ihau. When exposed to the sun, the cane's stripes turn lime green and iridescent pink. Nourished by Ni'ihau's freshwater springs and periodic rainfall from Mt. Pānī'au, the legendary kō is mentioned in the centuries-old stories and chants of Ni'ihau.

"The Hawaiians name everything and have a reason for doing that. Every wind and every rain has a name. Every cultivar of every canoe plant also has a name," says Mike. "But if you don't know the name, you don't know what you can do with it."

HĀPAI SUGARCANE PHOTO BY JON LETMAN

National Tropical Botanical Garden
3530 Papalina Road
Kalāheo, Hawai'i 96741 USA

Saving Plants, Saving People

REDUCE
REUSE
RECYCLE

NTBG STAFF, VOLUNTEERS, AND COMMUNITY PARTNERS CAME TOGETHER TO IMPROVE THE HEALTH OF THE LIMAHULI STREAM, ONE OF THE MOST BIODIVERSE IN HAWAI'I. READ MORE ON PAGE 12. PHOTO BY UMA NAGENDRA