

Vol. XXXVI No. 2

SUMMER-FALL 2020

the bulletin

of the National Tropical Botanical Garden



Planting hope for the future...

During this unprecedented pause, scientists, policy makers, and global leaders are highlighting the opportunity to safeguard our environment in new ways as the world reopens. In the midst of uncertainty, our core mission of saving plants is relevant, timely, and vital to a brighter future. Please consider joining us at this critical juncture by using the enclosed envelope to make your contribution today. To donate online, go to ntbg.org/donate.

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The endemic *Dubautia-Sadleria* shrubland-fermland below the summit of Kawaikini, Kaua'i's highest peak (5,243 ft.), is a prime example of healthy native Hawaiian habitat free of disease and invasive species. Photo by Ken Wood

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.

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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.



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Message from Janet Mayfield

We had scarcely entered the new year, with the tremendous loss and destruction from Australian wildfires seared into our consciousness, when a new global crisis emerged. Spreading like an invisible wildfire, the coronavirus pandemic fanned out across the planet, stealing precious lives, upending entire societies, and disrupting normal life as it cast fear and uncertainty everywhere.

Like everyone else, NTBG has been profoundly impacted. Our five gardens, offices, and workspaces have had to temporarily close to the public, forcing us to drastically change how we operate. Regrettably, we've had to reduce staff, cut hours, and postpone programs and events we'd been planning for months.

But as an organization whose mission is to enrich life through discovery, scientific research, conservation, and education, our work must carry on. Trees still need watering, seeds need storing, weeds need pulling, and the plants in our gardens and preserves haven't stopped growing.

Throughout the pandemic, we have worked from home or, when possible, remotely and in safe solitude, caring for our collections, reorganizing, reassessing, and preparing for the critical work ahead.

COVID-19, like other recent viral diseases — SARS, MERS, and West Nile virus — are all examples of zoonotic diseases that have spilled over from animal to human populations.

The Ebola virus, first identified in central Africa in 1976, is a prominent example of a zoonotic disease which many scientists believe is related to human encroachment into forests and increased direct contact with wild animals.

According to the Centers for Disease Control and Prevention, six out of ten infectious diseases in humans are zoonotic. There is an abundance of supporting evidence that indicates human activity such as certain types of agriculture, wildlife poaching, deforestation and habitat destruction, puts us at a much higher risk for exposure to these diseases.

Renowned primatologist Jane Goodall recently said, "It is our disregard for nature and our disrespect of the animals we should share the planet with that has caused this pandemic."

In 2019, the UN Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) warned that one million species are threatened with extinction within decades. When biodiversity declines, the survivors are often fast-breeding creatures associated with the spread of disease — rats, bats, mosquitos, and ticks, for example.

From the climate crisis and pandemics, to countless other challenges before us, we know that protecting our environment, preserving biodiversity, and advancing plant health offer tangible, long-term solutions in the face of a perilous and uncertain future.

At NTBG, we recognize that the health of plants, the well-being of people, and the overall state of our planet are closely bound together. In other words, without healthy plants, we won't have healthy people, or a healthy planet.



As we move forward, hoping for a sense of stability and normalcy, NTBG remains focused on our core mission. Like the climate crisis, the coronavirus and other zoonotic diseases serve as unforgiving reminders that our work is more urgent than ever and so, yes, we carry on. On behalf of all of us at NTBG, I want to thank you for your ongoing partnership and support.

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 \$75 to \$500 with a level to fit everyone from individuals to families. **Contact: members@ntbg.org**

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Sarah Fairchild and Adam Hait

NEW MEMBERS JAN-APR 2020

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Chelsey Aki
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ENDANGERED FLORIDA NATIVE *IPOMOEA MICRODACTYLA*

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Plants provide our food, our shelter, and the air we breathe. Your gift can help ensure the survival of the Earth's most endangered tropical plants and the people and animals that depend on them.

Thank you for your support!

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Please contact us if you have questions at donations@ntbg.org or call 808-332-7324 ext. 212.



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!

BREADFRUIT INSTITUTE

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Notecards, envelopes, and postage - \$300

KAHANU GARDEN

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MCBRYDE GARDEN AND ALLERTON GARDEN

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Kid's interpretative materials - \$750
Patio umbrellas - \$500

THE KAMPONG

Carved wood 6 panel room divider - \$ 400
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Oriental-design ceiling light - \$ 350
1-year Verizon cell phone service for senior horticulturist - \$600
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<https://ntbg.org/support/wishlist>

HOW NTBG CONTRIBUTES TO

PLANT HEALTH

As human beings, our own health is inextricably bound to the health of the planet. Healthy plants and animals, healthy ecosystems, and a stable climate all play a direct role in our own well-being. However, for many of us, our lives are increasingly dominated by technology and consumption and our connections to plants and nature have weakened.

Although our awareness and understanding of the natural world may change over time, fundamental truths do not. Humans and animals need plants to survive — and not just plants, but *healthy* plants which, like us, need clean air and water, and fertile soil.

The United Nations has declared 2020 as the International Year of Plant Health. In recognition of this timely and timeless theme, and with the understanding that the health that all life on this planet is dependent on plant health, we present the following passages, written by our staff, about how NTBG contributes to protecting and advancing plant health.

NATIVE MOSSES AND LIVERWORTS CAPTURE CLOUD MOISTURE, ALLOWING WATER TO PERCOLATE DOWN TREE BRANCHES INTO THE SOIL. PHOTO BY SEANA WALSH





PHOTO BY KEN WOOD



PHOTO BY KEN WOOD

This year, as the world is ravaged by a global pandemic, it may seem less urgent to worry about plant health, but in fact the health of plants, animals and humans is closely interrelated. The Hawaiian proverb, “I ola ‘oe, i ola mākou nei” (“my life depends on yours, your life depends on mine”) illustrates that interdependence.

In 2019, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) published an alarming report assembled by an international team of 455 experts and contributing authors from 50 countries.

The report concluded that ecosystems, species, wild populations, and local varieties and breeds of domesticated plants and animals are shrinking, deteriorating or vanishing. Our essential, interconnected web of life is growing smaller and increasingly frayed. The report further assessed that up to one million species of plants and animals are threatened with extinction.

The loss of biodiversity and ecosystems directly undermines efforts to meet UN Sustainable Development Goals related to poverty, hunger, health, water, cities, climate, oceans, and land. Loss of biodiversity is therefore not only an environmental issue, but also of great developmental, economic, security, social, and moral significance.

Conservationists report that nearly half of all new zoonotic disease spillover from animals to humans since 1940 is related to changes in how we use land, practice agriculture, or hunt wildlife.

But there’s also reason for hope.

The IPBES report stresses that it’s not too late to reverse environmental decline, but only if we start now at every level from local to global. Scientists and policy makers are beginning to discuss how the global pandemic-induced disruption in normal human activity presents a unique opportunity to bolster our efforts to address climate and environmental crises in a meaningful way. Many of us recognize that protecting wildlife and stopping biodiversity loss is critical to finding solutions.

Healthy plants are at the center of these issues and are the foundation of life on our planet, providing critical habitat for animals and people. The International Year of Plant Health couldn’t be more timely. Likewise, the mission of NTBG, to enrich life through discovery, scientific research, conservation, and education, is as relevant as ever. From the biodiversity hotspot of Hawai’i where we are based, throughout the Pacific, and to our garden in Florida and beyond, we are determined to contribute to global solutions by saving plants and saving people.”

– Dr. Nina Rønsted, NTBG Director of Science and Conservation



PHOTO BY KEN WOOD

One important element of maintaining healthy plant populations into the future is having a diverse stock of germplasm – in other words, plenty of seeds from many mother plants. Among the more than 16 million seeds stored at NTBG’s Seed Bank are some 8.3 million ‘ōhi’a (*Metrosideros* spp.) seeds.

‘Ōhi’a are foundation species in Hawai’i’s native forests with profound ecological and cultural importance. But the health of ‘ōhi’a is threatened by two newly described species of fungal pathogens.

These pathogens cause a disease colloquially known as Rapid ‘Ōhi’a Death (ROD) for the speed at which it kills trees. ROD has affected over 175,000 acres of ‘ōhi’a forest on Hawai’i Island since it was first identified in 2014. Subsequently, ROD was detected on Kaua’i in December 2018, followed by Maui in 2019, and O’ahu in 2020.

In early 2018, anticipating that ROD would continue to spread, NTBG sought funding to collect, bank and reciprocate ‘ōhi’a seeds with other facilities. At that time, NTBG’s goal was to collect seeds from individual trees of all four *Metrosideros* taxa on Kaua’i, spanning each seed zone in which they occur.

Seed zones are areas within which plant materials can be transferred with higher likelihood of survival. These

zones are a crucial tool used to guide plant collections and reintroductions. NTBG staff worked closely with the Kaua’i Island Botanist of the Hawai’i State Department of Land and Natural Resources, Division of Forestry and Wildlife (DLNR, DOFAW) to delineate these zones.

To date NTBG has collected nearly 9 million ‘ōhi’a seeds, retaining over 6.5 million on site with the balance sent to partners for reciprocal storage and ROD resistance testing. Our seed collection efforts have been successful, but the spread of ROD continues. In March, more ROD-infected trees were found at multiple locations on Kaua’i’s north shore, including one tree in the Limahuli Valley.

Fortunately, we were prepared to quickly remove the infected tree and contain the disease. Preserving ‘ōhi’a is essential to maintaining healthy Hawaiian forests and protecting the plants, animals, and humans that depend on them. In addition to saving seeds, we are more aggressively pursuing bio-sanitation measures like footwear cleaning stations and increased communication about the importance of protecting plant health.”

– Seana Walsh, NTBG Conservation Biologist and Dustin Wolkis, NTBG Seed Bank and Laboratory Manager



NTBG CURATOR OF THE HERBARIUM TIM FLYNN AT WORK. PHOTO BY SEANA WALSH

Protecting plant health can help alleviate hunger, reduce poverty, safeguard the environment, and boost economic development. However, protecting plant health depends on correctly identifying and naming plant species. If we don't know the correct names of plants, how can we know what we are conserving? This applies to all plants, not only to those cultivated for food, fiber, medicine, or as beautiful ornamentals, but also countless less well-known species that are essential to the health of natural ecosystems.

As our planet's biodiversity faces a grave, growing risk, centers of research excellence in systematics like NTBG have vital role to play. Natural history and plant collections in particular, play a crucial role in research, education, and public outreach. Collections of plant specimens (herbaria) are the foundation for all studies of plant diversity and evolution. A herbarium is a critical resource for biodiversity, ecological, and evolutionary research studies. Herbaria, like other natural history collections, are the essential resources for taxonomy (naming and classification) and the study of biodiversity.

A herbarium is like a library, but differs in that the information is stored in a biological form as pressed, dried, and accurately identified plant specimens.

A herbarium is a primary data source of dried and labeled plant specimens that are arranged for easy retrieval access and archival storage. Herbaria may be digitized (as we do at NTBG), making the label data and even images of the specimens available online through databases.

Collectively, herbarium specimens provide enormous economic and scientific returns to society and are irreplaceable resources that must be preserved for future generations. All fields of biological science, from the level of molecular biology to ecosystem science and species conservation, are dependent on natural history collections, not just for application of names, but as the basis for referencing all aspects of biodiversity. These are but a few of the ways that herbaria, and the work we do, help promote plant health."

— Dr. Dave Lorence, NTBG Senior Research Botanist

Breadfruit is a valuable source of delicious food providing many nutrients essential for human health. This long-lived tree contributes to the health and well-being of humans and the environment in countless ways. The majestic tree, with its large, glossy leaves and globular fruit, is both beautiful and calming. For many, it evokes fond childhood memories of home gardens and yards that contained but a single tree. There the families gathered in its shade, sharing meals made of this versatile fruit.

Gardens and farms planted with breadfruit benefit from lush canopies providing shade to other plantings and the ground below, while producing abundant leaf litter that builds soil health and fertility. On hillsides, breadfruit trees develop dense, tangled roots that support them on slopes. Their dense canopy provides a buffer against heavy tropical downpours and, with the interlocking roots, reduces runoff and erosion while creating pockets of nutrient-rich soil where other plants thrive.

The work of NTBG's Breadfruit Institute is the embodiment of "Protecting Plants, Protecting Lives," the theme of the International Year of Plant Health 2020. Central to our work is the preservation of 150 varieties of breadfruit from 34 Pacific Islands, the Philippines, Indonesia, and Honduras. These trees are grown in field gene banks at Kahanu Garden on Maui and McBryde Garden on Kaua'i. Many of the varieties we have collected were grown for centuries in their home islands, but changing lifestyles and climate change have led to dramatic declines and, in some cases, a complete disappearance.

Years of research in our conservation collection have allowed us to better understand breadfruit diversity and key characteristics such as seasonal productivity and nutritional attributes. This research informs our ongoing initiatives and international collaborations to promote the planting of high-quality breadfruit varieties around the world. Our goal is to advance greater food security, regenerative agriculture and agroforestry, and to create a source of income and financial stability that will cultivate healthy, resilient communities and environments."

— Dr. Diane Ragone, NTBG's Breadfruit Institute Director



PHOTOS BY JON LETMAN

Working in the Limahuli Preserve, one of Hawai'i's most biodiverse wild habitats, our crew is constantly thinking about how we address threats posed by plant pests and diseases. As in other isolated areas, native Hawaiian plants are especially vulnerable. Our plants are threatened by invasive species ranging from large Australian tree ferns and ungulates like sheep and goats to tiny insects and microbes which can be just as destructive, but are often more difficult to remove.

In the near-term, we continually monitor rare and endangered plants outplanted in our ex-situ (off site) restoration areas and treat those showing signs of disease. Our most important long-term strategy for preserving plant health is prevention.

The first component of this strategy is maintaining high biodiversity throughout Limahuli Valley, especially in ex-situ sites. Large patches of the same type of plant create big targets for pests, and also facilitate the spread of disease. Central to preserving Limahuli's existing biodiversity is the removal of incipient weeds like Himalayan ginger and destructive herbivores like rodents and pigs.

It's also essential to preserve as much wild and managed genetic diversity as possible. When rare and endangered plant populations dwindle, they have fewer genetic resources with which to adapt to new threats. It's critical that we carefully collect seeds and cuttings from wild populations to preserve as a safety net. Descendants of those plants live on in the garden, a restoration site, or seed bank, even if the wild population is lost or destroyed.

The final component of this strategy is minimizing accidental introductions and the spread of diseases. We do this by cleaning and sanitizing all tools, shoes, and gear before and after entering Limahuli Preserve. Furthermore, NTBG staff carefully inspect all plants before outplanting.

In many ways, individual plant health is dependent upon ecosystem health. When we cultivate high biodiversity, maintain ecosystem connections such as pollinators and soil microbes, collect and preserve genetic material, and prevent new disease introductions, we are helping to give the ecosystems that sustain us the resilient foundation needed in a changing world."

— Dr. Uma Nagendra, NTBG's Conservation Operations Manager, Limahuli Garden and Preserve



The roots of a healthy forest hold the land in place; her profound dominion is like a mother's arms giving sanctuary to the diversity of life. Let us not lose this natural gift. After all, many of our forest species have been on earth long before *Homo sapiens* wisely stood, and I believe we must strive to keep our remaining forests and plants healthy.

Looking deeper, the word health is intriguing and diverse in origin. Health, healing, whole, holy – they are words with genetic ties and have evolved from the same root. To me, healthy plants are intertwined in all these meanings, even being holy and healing.

By researching, mapping, and publishing on the floristics of Pacific island ecosystems, NTBG has adopted a holistic approach to scientifically document and preserve, through herbarium vouchers and seed collections, the distribution and abundance of both common and rare plant species. This includes the discovery of over 90 species new to science, along with the rediscovery of around 40 species previously thought to be extinct.

This is but one part of NTBG's contribution toward preserving plant health and there's always more to do. These endeavors reconnect us to the mystery of life's whole, holy creation. With so many threats to forest diversity today, it is fundamental to find and document where rare plants remain. With this in mind, NTBG continues to monitor, reproduce, and reintroduce rare Hawaiian plant species back into the wild.

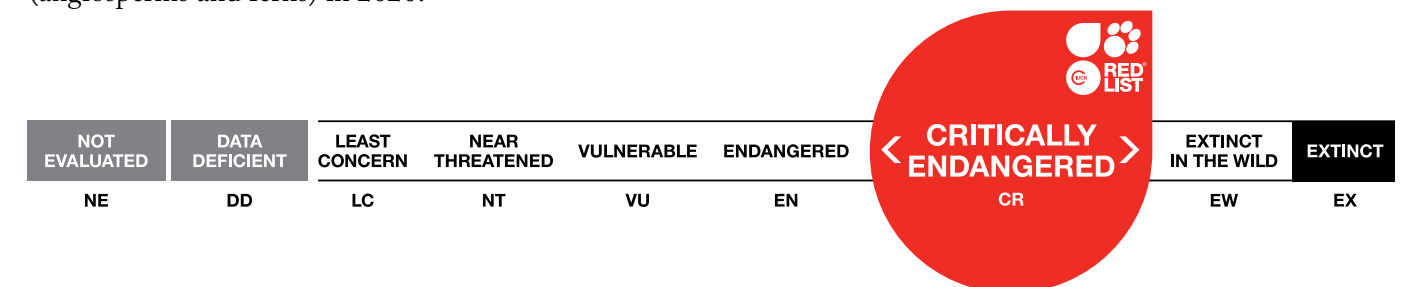
Perhaps it is a question of balance, a striving to preserve the beings around us, to show respect, and to bear witness. I believe this is what Aldo Leopold, the father of wildlife conservation, meant when he theorized that an intelligent approach to conservation was "to keep every cog and wheel." This is also why NTBG continues to document, map, and attempt to save as many individual plant species as possible."

— Ken Wood, NTBG Research Biologist

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 redoubled efforts to assess the more than 1,300 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 40,000 plant taxa published on the Red List worldwide. NTBG aims to complete assessments for the over 250 Kaua'i single-island endemic vascular plant taxa (angiosperms and ferns) in 2020.



Species: *Polyscias racemosa* (Araliaceae)

IUCN RED LIST CATEGORY: CRITICALLY ENDANGERED (CR)

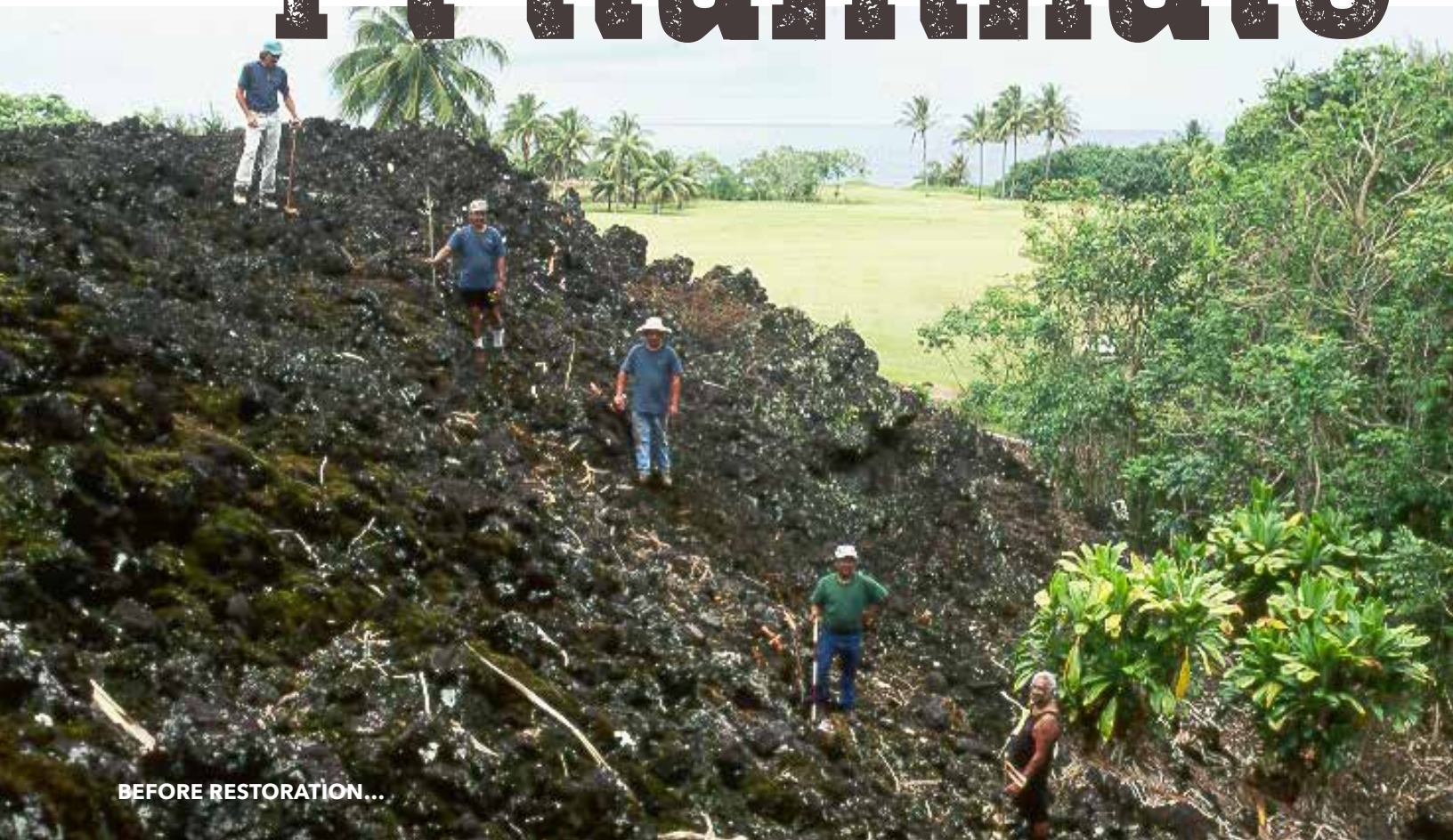
Polyscias racemosa is a Kaua'i single-island endemic tree found on steep cliffs or slopes of mesic forests. At the time the last assessment was done, in July 2016, 110 individuals among 11 subpopulations remained in the wild. This data was the result of three decades of research by NTBG, and included seed collections from more than half of the known individuals. Persistent threats to *P. racemosa* include predation and habitat degradation by non-native animals and competition by non-native invasive plant species.

From 2018 to 2019, through grant support from the Mohamed bin Zayed Species Conservation Fund, staff of NTBG and the State of Hawai'i Department of Land and Natural Resources, Division of Forestry and Wildlife continued NTBG's strategic seed collecting field work in order to build up additional ex situ conservation collections. In addition, seeds from NTBG's existing living collection of plants were used to investigate optimal protocols for seed storage and germination. From 2020 to 2022, new funding from Fondation Franklinia for the project titled 'Endangered Endemic Trees of Kaua'i' will support outplanting and monitoring of *P. racemosa* into fenced and managed areas of NTBG's Limahuli Preserve. — Seana Walsh

Two decades after restoration, reflections on

BY CHIPPER WICHMAN, PH.D., FLS, NTBG PRESIDENT
WITH MIKE OPGENORTH, DIRECTOR OF KAHANU GARDEN AND PRESERVE

Pi'ilanihale Heiau Rising



This is a story of restoration, reconciliation, and respect. It's the story of how NTBG grew as an organization, mended old fences, and built new relationships. This is the story of the restoration of the Pi'ilanihale Heiau, Hawai'i's largest ancient stone structure and a place of deep cultural and spiritual importance.

The Pi'ilanihale Heiau is a registered National Historic Landmark and, more importantly, it is the piko (cultural center) of Kahanu Garden on the Hāna Coast of Maui's north shore.

In the late 1990s, the Kahanu-Uaiwa-Matsuda-Kumaewa family, who along with Hāna Ranch, had gifted the land where Kahanu Garden was started, had grown frustrated because NTBG had not completed restoration of the heiau within the originally agreed to time frame.

In February 1997, I was serving as Director of the Limahuli Garden and Preserve on Kaua'i's north shore when news came of the sudden passing of NTBG's director Dr. William Klein. Within days, the Garden's Chairman of the Board of

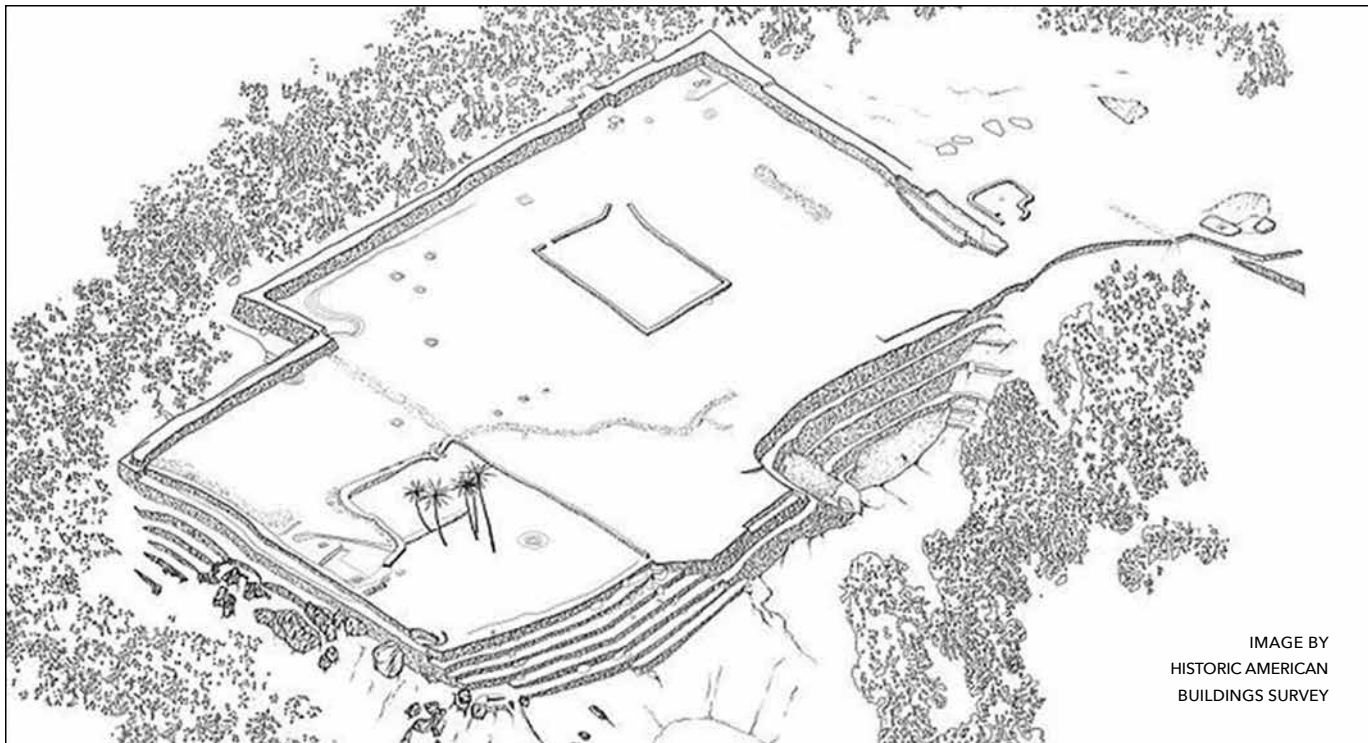
Trustees called and asked if I would accept the role of Kahanu Garden Director in addition to my duties as Limahuli Garden Director.

As both gardens were in remote communities on different islands, the decision was not easy. Simply commuting from Hā'ena on Kaua'i to Hāna on Maui would be demanding, but beyond the travel logistics, there was the question of addressing the complicated and strained relationship that had developed between the Garden and the Hawaiian community in Hāna over the past decade.

The Garden's promise to restore the heiau was the primary reason the property was given to NTBG and we had not fulfilled our commitment. Although the task before us was daunting, my wife Hau'oli and I felt as though a voice was calling us to accept the challenge and make things pono (right). Recognizing this unique opportunity to reconcile our relationship with the Hāna community and reassess the role of the Garden, I agreed to become the director. By accepting the position, I knew I



PHOTO BY BEN NYBERG



was committing to oversee the completion of the heiau restoration, a project that could take three to five years and which would require significant fundraising.

But the biggest challenge was finding the right people to work on this massive project. I immediately thought of Francis Palani Sinenci who I'd met years earlier when he visited Limahuli Garden with a group of Maui elders. After having seen how Francis, who was born and raised in Hāna, interacted with the community and could conduct the traditional protocols of a Hawaiian warrior, I knew Francis had the passion, dedication, and cultural foundation needed to restore Pi'ilanihale Heiau.

From the outset, Francis and I agreed it was critical for the heiau to be restored by stone masons who were from Hāna. Working with thousands of lava rocks, many weighing a hundred or more pounds, was physically grueling, but embracing this kuleana (responsibility) was also culturally empowering and fulfilling.

Francis put together a crew of men from Hāna that included Jack Kahanu-Uaiwa, and Tony Helekahi, along with two of Francis's brothers, Peter and Sebastian (Igot). The stone masons worked closely with archaeologists Dr. Yosihiko Sinoto of Bishop Museum and Dr. Eric Komori from the Hawai'i State Historic Preservation Division.

The restoration of the heiau, with lava rock walls rising 50 feet on the north side, was based on a five-phase

plan developed by Dr. Sinoto and bolstered by a quarter century's worth of initial restoration work conducted by Francis Kikaha Lono, affectionately called "Uncle Blue."

Uncle Blue was the first employee hired by NTBG to work at Kahanu Garden in 1972 and a direct descendant of the paramount Mō'i (High chief or King) Pi'ilani who lived on Maui in the 1500s. It is Pi'ilani who is credited with completing a major phase of the heiau's construction. He is also revered as establishing peace across the island of Maui during his reign.

Pi'ilanihale Heiau, which had been damaged by decades of grazing cattle trampling the site and the unchecked spread of wild vegetation, was badly in need of restoration. And even as dedicated as Uncle Blue and his family were to rebuilding dry stack lava rock walls, the effort would require the help of a full crew.

As Uncle Blue, Francis, and the crew began the monumental task before them, they carefully employed traditional cultural protocols when removing rubble, locating niho (foundation stones), and rebuilding the terrace walls. When the crew needed scaffolding, they built their own from material in the garden. As the months passed, the pace of work quickened and the crew's connection to their ancestors and the heiau strengthened.

Francis noted that only with laulima (many hands) could an undertaking of this scale be successful. In restoring the



heiau, he said, he could complete the fifth major stage of Hawaiian life (teaching, farming, building, combat, and heiau restoration) which was the final 'aho (lashing), that bound together a long life of cultural practices.

For Francis and the others, the restoration was not simply a job. The work was a manifestation of their cultural pride and a physical demonstration of their respect for their ancestors. Fueled by a quiet, inner pride, their work advanced at a rate no one could have foreseen and, in less than a year's time, the restoration was complete.



On April 10, 1999, Hāna's community gathered to celebrate the completion with traditional protocols and the chanting of the sacred genealogy of high chief Pi'ilani, culminating an effort that had begun nearly 30 years earlier. Today, some two decades after the restoration, we see how the project gave rise to a new period of growth and success. The restored heiau rises high above Kahanu Garden and the surrounding landscape, a silent symbol that reminds us of the sacredness of this most special of places.

Reflecting on all that has been achieved since the restoration, Kahanu Garden and Preserve Director Mike Opgenorth described the garden as a place cared for by generations of those dedicated to aloha 'āina (deep love of the land). "There is no mistake we are guided by those who came before us. The heiau restoration was the most significant accomplishment since NTBG began stewardship of Kahanu Garden," Mike said. "We will continue to care for the heiau in perpetuity and increase awareness of the biological and cultural resources that surround us. There is so much to still learn about Pi'ilanihale Heiau and all that grows here." 🌿

garden sprouts

News from around the Garden



PHOTO BY HAYLEY WALCHER

ESSENTIAL GARDEN FUNCTIONS

Beginning in mid-March though at least the end of May, NTBG gardens and other work spaces were closed to the public and most staff worked from home. But living plant collections can't be put on hold. Weeds need pulling, plants need watering, and other essential tasks can't be delayed so a handful of employees continued working on site, albeit alone and at a distance. Living Collections staff came to the Conservation and Horticulture Center daily, alternating work shifts to keep safe while caring for the plants.

Garden staff have used the time to plant ground cover, repair irrigation systems, and remove invasive plants. A temporary freeze on using volunteers and interns has meant reduced staff had plenty to do, monitoring irrigation lines, manually turning on and off pumps, setting timers, hand watering, weeding, delivering plants to conservation crews, and keeping grant obligations and contract projects on schedule. As Curator of Living Collections Mike DeMotta put it, "with live plants, there's very little room for error."



PHOTO BY MIKE DEMOTTA

RARE GARDENIA FLOWERS AT HORT CENTER

Gardenia remyi, a member of the Rubiaceae (coffee family) is endemic to the islands of Kaua'i, Maui, Moloka'i, and Hawai'i, known from just 82 individuals in 18 subpopulations. On Kaua'i, where only 11 known individuals remain, NTBG has been collecting and growing *G. remyi* since the early 1990s, most recently in the Upper Limahuli Preserve in 2016. Today, only two seed-producing trees are known on the island. With the presence of an active wild pollinator uncertain, Curator of Living Collections Mike DeMotta hopes to eventually pollinate flowers from different plants in order to increase genetic diversity. Because *G. remyi* is so rare, Mike has focused on trying to grow the plant using air layering. This spring he was successful in getting a cultivated plant to flower for the first time at the Conservation and Horticulture Center. Until recently, *G. remyi* was red listed as Vulnerable, but following a recent assessment by NTBG conservation staff and its state agency and private organization partners, the status will be updated to Critically Endangered.



PHOTO BY KEN WOOD

PACIFIC BOTANY LOSES A FRIEND

World-renowned botanist, naturalist, educator, and author W. Arthur "Art" Whistler passed away in Hawai'i in early April after contracting the coronavirus. A collaborator and friend of NTBG since the early 1970s, Art served as the Garden's first ethnobotanist. He was also an affiliate botanist at the University of Hawai'i. Throughout his career, Art explored Pacific islands, amassing a wealth of knowledge of useful plants and conservation methods which he shared with local communities, policy makers, scientists, students, and the public through his many publications.

A prolific author, Art wrote many books and papers on Pacific island plants, including several published by NTBG such as 'Ethnobotany of the Cook Islands: the plants, their Maori names, and their uses' (1990), 'Polynesian Herbal Medicine' (1993), 'Botanical Survey of the Ringgold Islands, Fiji' (2012), 'Annotated List of Tahitian Plant Names' (2015) and 'Plants of the Canoe People: An Ethnobotanical Voyage through Polynesia' (2009). His books 'Rainforest Trees of Samoa' (2004) and 'The Samoan Rainforest' (2002) are classic guides to the forests and vegetation of the Samoan Archipelago.

In recent years, NTBG worked closely with Art to prepare the manuscript and catalog thousands of herbarium specimens for the Flora of Samoa, which NTBG intends to publish in 2021 as part of NTBG's Pacific islands flora program. This flora, Art's magnum opus, and the collections which he deposited in NTBG's herbarium, will contribute enormously to our collective understanding of tropical species which will, in the years ahead, serve to help protect the people, plants, and places Art loved.



PHOTO BY JACKIE NIELSEN

NTBG DEVELOPS VR GARDEN EXPERIENCE

Working with Timelooper, a 360-degree VR (virtual reality) smartphone platform, NTBG has developed a VR Garden experience available through the Apple App Store and at www.ntbg.org. Think Google Earth meets YouTube to bring you a highly-detailed, interactive NTBG garden experience from the comfort of home or wherever you happen to be.

After downloading the app, anyone with a smart phone, iPad, or computer can access a 3D map of Kaua'i which can be expanded and explored using fingers or a mouse. The map allows users to "enter" Limahuli Garden, McBryde Garden, and Allerton Garden. Once "inside," users can navigate through the gardens, zooming in on specific points of interest such as a native Hawaiian plant collection, a traditional thatched hale house, the Horticulture Center, a breadfruit agroforest, and other areas of the Garden.

Narrated 3D photos, video, drone footage, slideshows and interactive landscape projections allow users to learn about plants, experience the gardens, and even view the Limahuli watershed, and remote Upper Limahuli Preserve, home to a native Hawaiian forest that is virtually pristine.



PHOTO BY HAUOLI WICHMAN

AHS HONORS NTBG'S WICHMAN

The American Horticultural Society (AHS) named NTBG President Chipper Wichman as its 2020 recipient of the AHS Professional Award for his achievements in cultivating widespread interest in horticulture. In presenting the accolade, the AHS cited Chipper's 40-plus year career at NTBG that has included his role in the discovery and conservation of endangered native Hawaiian plants, the advancement of NTBG's mission around the world, and his leadership role in helping secure Hawai'i as the host location of the first IUCN World Conservation Congress ever convened in the United States in 2016.



PHOTO BY BEN NYBERG

DRONE FINDS RARE HAWAIIAN MUSTARD ON CLIFF

NTBG continues to use drones to search for critically endangered or possibly extinct plants in sheer cliff habitat that is otherwise inaccessible. While conducting plant surveys in early 2020, NTBG Conservation staff and its partners at the Plant Extinction Prevention (PEP) Program, were able to locate three new sub-populations comprised of at least 130 individual *Lepidium orbiculare* in remote mountain terrain on Kaua'i. Previously believed to have been reduced to a single population of some 60 individuals (just above PEP's 50 specimen or less threshold), the discovery of this cliff-dwelling member of Brassicaceae (mustard family) would likely have been impossible without using new drone and camera technology.



PHOTO BY CRAIG MORELL

KEEPING UP WITH KAMPONG CARE

During the period when The Kampong was closed to the public due to the pandemic, staff remained productive keeping the garden well-watered during early spring 90°F rainless, windy days. Wracked by a record drought, Kampong Director Craig Morell and Senior Horticulturist Benoit Jonckheere began testing and repairing irrigation in areas of The Kampong where it hadn't been used before. Other pursuits, such as upkeep on the century-old Fairchild-Sweeney house, miscellaneous repairs, repainting, and researching plant introductions from the Fairchild-era (1916-1954), have kept staff busy and in good spirits.

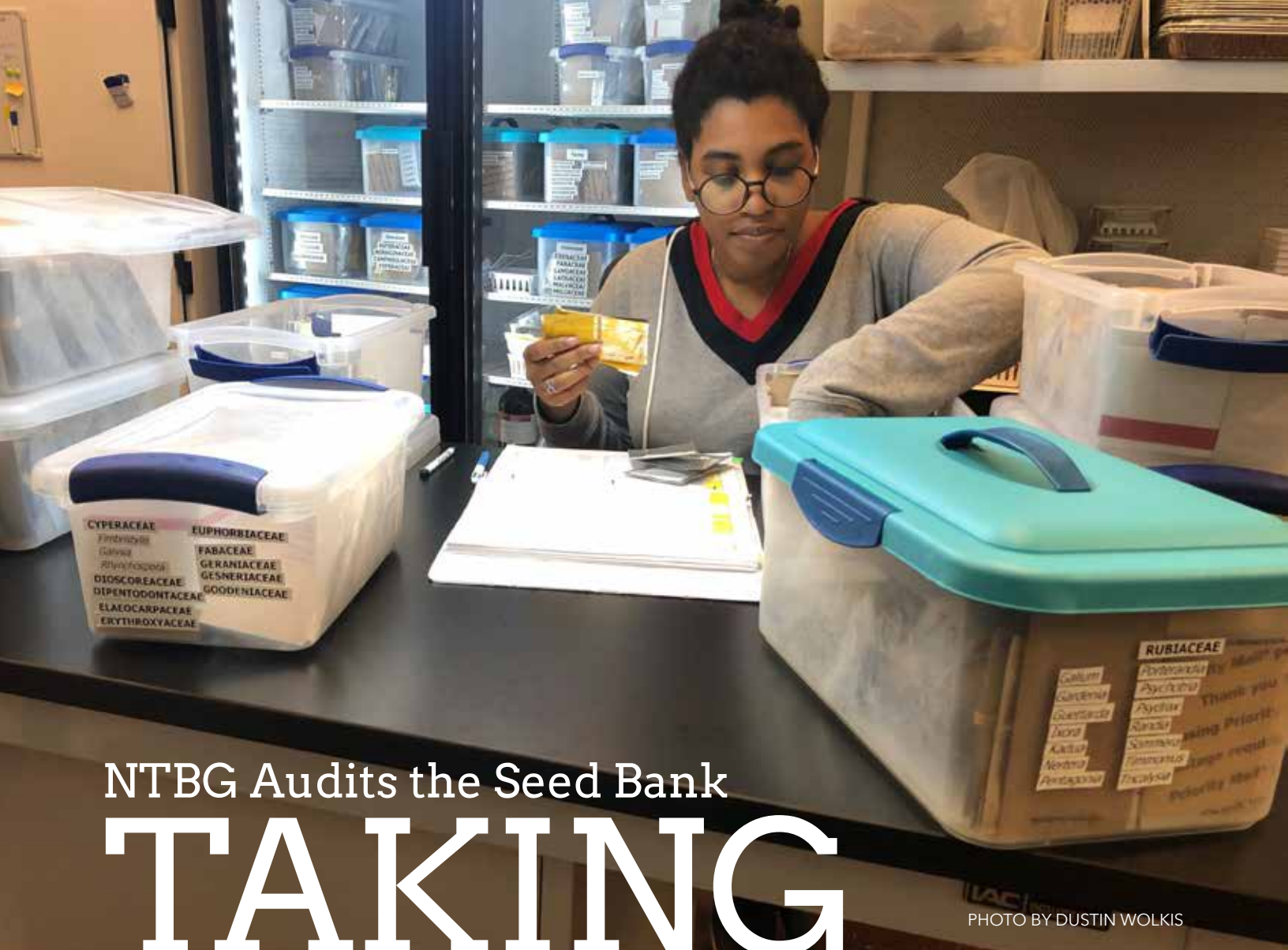


PHOTO BY DUSTIN WOLKIS

NTBG Audits the Seed Bank

TAKING STOCK

BY KELLI JONES, KUPU TEAM MEMBER

Have you ever tried to catalog, organize, and store 16 million seeds? It's not as easy as it sounds. Working at NTBG's Seed Bank and Laboratory as a team member with the KUPU program, I was tasked with taking the lead on conducting an inventory of NTBG's conservation seed bank collection.

At end of 2019, it felt like the seed bank was nearing its storage capacity. Pulling from the collection had become cumbersome and

needlessly complicated so, together with Seed Bank and Laboratory Manager Dustin Wolkis, we decided to restructure how cooled storage space was organized, conducting a complete inventory at the same time.

Seeds stored in the seed bank are kept at three temperatures (−80°C, −18°C, and +5°C) and had been organized by decade, starting with the first collections from the 1990s, followed alphabetically by genus, species, then chronologically by accession number.

Prior to this physical inventory and reorganization, when the collection was smaller, this simple scheme worked well for handling seed requests, but as the collection has grown by thousands of accessions annually, it became clear that a new system was needed to increase efficiency.

Overhauling our scheme and conducting an inventory began by creating a categorized list of every accession in the data base. The new list was reorganized so that accessions could be counted and used as a reference. Under the new system, the collection is arranged alphabetically by family, genus, species, and intra-species designations. This is followed numerically by accession number, similar to the how NTBG's herbarium and DNA collections are organized.

By standardizing how we catalog our collections of stored plant material, we've created a greater sense of cohesion while making the assets in our Botanical Research Center more user-friendly.

With this year's introduction of an additional subfreezing storage unit, we were also able to remedy overcrowded storage conditions while replacing seed containers with visible signs of wear.

In all, I spent nearly 300 hours hand-crafting materials for new storage containers and handling more than 4,000 individual accessions housed in NTBG's seed bank. Throughout the process, I had to address numerous unanticipated complications including everything from correcting inconsistencies in old data base entries to "phantom" accession numbers to the discovery of accessions once thought to be missing.

The millions of seeds NTBG stores in its seed bank include many rare and endangered taxa, including some not found in other seed banks. The seeds, representing 830 species, are regularly studied and requested for transfer to be propagated, so accurate record keeping is critical.

Part of the process of maintaining the seed bank is frequently assessing the seeds physical and physiological condition as well as regularly interacting with, and manually updating the corresponding digital records. As individual accessions are altered, their changes in condition and location are documented in the database, chronicling their life within the collection.

Once the physical portion of the inventory was complete, any remaining information gaps in the



DUSTIN AND KELLI. PHOTO BY NTBG STAFF

database had to be reconciled. Accessions which could not be found had to be removed and, along with these, the largest job in the data entry portion was updating the storage temperature entries and accompanying notes for each accession from all years prior to 2016 when those details were first added.

Updating the database added about 56 hours to the project, but the results were significant. While some plant taxa records remained unaccounted for, the seed bank still saw an overall increase of nearly 30 percent in taxa represented with an addition of 207 new accessions and a 12 percent increase in overall stored accessions.

Post-inventory, the most noticeable difference is in the interaction experience for anyone using the seed bank now that accession accountability has been improved. The task of pulling accessions, which previously took up to an hour, can now be done in minutes.

The new organization system is simpler, more logical, and more engaging, making it faster and easier to yield information and find the seeds that are needed, increasing the collection's value to botany newcomers and seasoned researchers alike. 🐡



VANILLA BARBELLATA. PHOTO BY NICK EWY

GOING NATIVE IN South Florida

BY CRAIG MORELL, KAMPONG DIRECTOR

NTBG's garden in Florida, The Kampong, is home to over a century's worth of horticultural history and exotic plant collections. What began as a pioneer doctor's farm in 1885, was transformed by botanist and plant explorer Dr. David Fairchild after he and his wife purchased the narrow strip of land fronting Biscayne Bay in south Miami in 1916. Over the nearly four decades Fairchild lived at The Kampong, he planted the property with many of the fruit trees, medicinal plants, and tropical ornamentals that he so famously collected from around the world during his tenure as the U.S. Department of Agriculture's chief plant collector.

Today, many of Fairchild's collections survive and have been augmented by hundreds of other plants introduced by successive directors and curators. With over a thousand species and varieties, The Kampong is Miami's garden oasis, a museum of exotic flora in the heart of Coconut Grove.

Much of our focus at The Kampong is caring for David Fairchild's heritage collections and preserving his horticultural legacy. Less well known, however, are our efforts to grow plants native to Florida, some of which are endangered. In doing so, we fulfill a dual role: conservation of native flora and public education.

Confined to a long, narrow eight-acre site already filled with mature plantings, limits what we can do, but we have chosen around ten species of endangered native Florida species to demonstrate the importance of local conservation. Our primary goal is to cultivate endangered species in a way that will inspire Kampong visitors and members of the community to practice plant conservation at home.

With the right education and resources, conservation can be done on a small scale in a botanical garden as well as in your own backyard. Our native conservation efforts began by working with the Institute for Regional Conservation, a local group of botanists, ecologists, and policy makers who understand how habitat loss has driven many species native to South Florida to extinction, leaving others with fewer than 50 individuals in the wild. In one notable case, the crenulate lead plant (*Amorpha crenulata*), a perennial shrub, has only five known wild specimens. Fortunately, several hundred exist in nurseries, available for replanting.

It's important to note the difference between conserving plants cultivated from wild-collected stock versus cultivated stock. Classic methods of conservation call for a plant collector to gather seeds from plants in their native habitat. The collector also records details of location, soil type, altitude, and nearby plant types. That information is then databased and can be shared globally.

Ideally plants are grown and repopulated into the wild. Seed is often stored for a long time so that wild genetic material is available to other gardens or for future outplanting.

Conservation using cultivated plants from wild collected seed is a newer tactic often practiced in areas where ethical and permitted nursery growers rescue seed of plants threatened by development and habitat loss. In Florida, this is sadly very common. Nurseries which specialize in native plant culture do a great job of introducing very rare native plants into local cultivation. Cultivating very rare species in nurseries also reduces the poaching of wild plants by offering an alternate source of planting material.

The prevention of poaching is one of the main reasons we chose to grow particular species of Everglades orchids. There's a mystique associated with the dark, dense flooded cypress forests of the Everglades that seems to fuel the poacher's hunger for orchids. As an avid orchid grower myself, I can testify to the interest orchid growers have in certain native species and the extraordinary demand they draw.

With advice from the Naples Botanical Garden and help from the Florida Fish and Wildlife Commission, we acquired half a dozen healthy cownose orchids (*Cyrtopodium punctatum*), one of our region's most heavily-poached native species. Seeds were legally collected from wild specimens in the Fakahatchee Strand Preserve State Park, sent to the Atlanta Botanical Garden to grow to near-adult plants, and then shipped back to the Commission staff in Naples.

Commission staff then climbed thirty feet into native trees to mount the orchids securely, beyond the reach of poachers. The Kampong now has a small population of this species as well as four other native Florida orchids mounted in carefully monitored locations where we use them for native conservation education and outreach. Among our newest acquisitions is a rare leafless vanilla orchid (*Vanilla barbellata*), native to a small area in the heart of the Everglades.

Orchids can be hard to grow from seed, but there are expert facilities and laboratories throughout the country which do so commercially. We've set out to show how easily these orchids can be acquired from cultivated sources and grown at home. We emphasize the point that endangered plants are not necessarily difficult to grow, just hard to find in their habitats.

One of our best examples of a South Florida native is the red stopper tree (*Eugenia rhombea*) which is quite rare in the wild, but common in landscaping. Easy to find, grow and maintain, it is a superior landscape plant for a wide range of conditions, both commercial and residential, as a stand-alone or hedge. Slow growing, pest free, and suitable as wildlife habitat, red stopper is a perfect example of the conservation-by-cultivation concept.

Educating our community about spending a little extra for the right plant can help save time and money later. Using endangered native species, either as an accent or as foundation plantings, can accomplish many goals at once. We strive to help visitors understand not only conservation on a regional scale, but in their home gardens as well.

One of our biggest challenges in promoting local landscaping conservation is the lack of knowledge of using the right native plant for the right location and where to find native plants.

As a small garden filled with a century's worth of mature heritage collections, we don't have the space for larger, more ambitious conservation efforts. What The Kampong does have is a dedicated staff who know how to incorporate native flora into appropriate parts of the garden. Taking advantage of our monsoon-Arizona climate extremes, and working with local native plant nurseries, we have been successful with our efforts in Florida horticultural conservation.

While NTBG's staff in Hawai'i carry out their own horticulture and conservation of the most endangered plants in the Pacific, here at The Kampong we practice native conservation on a scale commensurate with our size. In our urban setting, we provide a peaceful oasis where visitors can connect with nature, contemplate wildlife, and learn how to counter habitat destruction, invasive species, plant disease, and the loss of biodiversity. Our goals are modest, attainable, and usable by every visitor.



CRITICALLY ENDANGERED PSEUDOPHOENIX SARGENTII
V. SARGENTII, ENDEMIC TO ELLIOTT KEY, BISCAYNE BAY.
PHOTO BY CRAIG MORELL

At The Kampong, even as we preserve the heritage collection of the botanist who introduced many of America's favorite edible and ornamental plants, we also understand how native plants form the backbone of ecology and the importance of conserving and appreciating them. Ensuring the survival of native plants, whether in Florida, Hawai'i, or elsewhere is a critical task and an effort worthy of support. 🌿

supporting roots

Q & A with Harlan and Patti Amstutz



PHOTO BY JEFF MERCADO

Lifelong Los Angelenos Harlan and Patti Amstutz have been Garden supporters for 40 years. First drawn to Kaua'i for surfing and cycling, shortly after they purchased a home on Kaua'i in 1980, their closest neighbor, Mr. John Gregg Allerton (co-founder of NTBG's Allerton Garden), paid them a welcome visit. The ensuing friendship blossomed and grew into a fruitful, unwavering relationship with the Garden.

Harlan, an orthopedic surgeon and hip implant designer, plays an active role in the international orthopedic community and is today a Trustee Emeritus on NTBG's Board. Patti has passion for culture and the arts that has kept her busy as a docent at the J. Paul Getty Museum for four decades. The Amstutzs recently spoke from their home in Los Angeles about why they support NTBG.

What was the Garden like when you first got involved?

Harlan: It was still called the Pacific Tropical Botanical Garden.

Patti: Back then the entire McBryde Garden was nothing but weeds and leftover sugar cane fields, but the Allerton Garden was already a Shangri-la.

How did you become NTBG supporters?

Harlan: We enjoyed a comradery with staff and Trustees and initially became Fellows...

Patti: ... Then at a Board meeting in Chicago, Harlan was asked to become a Trustee. After that, we became very involved in all the meetings and details, watching the Garden grow magnificently over the years.

What most inspires you about NTBG's work?

Harlan: The way the incredible staff and scientists carry out the Garden's mission.

Patti: There's no doubt that trying to stop the extinction is an extraordinary necessity. The science of protecting and documenting plants and working with other groups is enormously important for our children and our grandchildren.

What do you say to people who don't recognize the importance of saving plants?

Harlan: Those folks are very short-sighted. Each plant has not only its own beauty, but a possible biological future.

Patti: One never knows what a plant, animal or insect holds for the future. There's no telling what information can be garnered for the future. So many of our drugs – even those produced in a laboratory – started as plant medicine. Who knows what we lose once they're gone.

What do you appreciate most about plants?

Harlan: I have my own interest in plants, specifically orchids, which I have been growing in Los Angeles since 1978. I have an orchid garden at my home on Kaua'i, too.

Patti: The two things about plants that always amaze me is the diversity in the plant world and the incredible beauty. Also, the tenacity of plants is absolutely extraordinary — a plant's ability to reproduce and continue — when you see a plant growing out of a crack in the sidewalk, even a weed, seeking the sun.

What do you see as NTBG's strengths as an organization?

Patti: I think it's important for NTBG to continue the variety of things it is doing. For example, the Breadfruit Institute is fabulous, but also the living collections, and the collaboration with other botanical institutions around the world. NTBG's programs should continue to have more than one goal.

What excites you about the future of NTBG?

Harlan: This is, of course, an exceptionally challenging time. The great thing about the Garden is that we've got very good, incredibly dedicated employees who see merit in what they are doing. This is a vibrant and growing organization and that's very encouraging.

an eye on plants

SELECT SPECIES IN FOCUS

Campanulaceae (Bellflower family)

Growing on every continent except Antarctica, Campanulaceae (the bellflower family), with around 85 genera and over 2,300 species, has covered the earth. From Australia's delicate lavender *Campanula* and clusters of *Asyneuma* in the sub-alpine meadows of the Caucasus, to sturdy *Lobelia deckenii* on the slopes of Kilimanjaro and tiny *Cyphocarpus*, endemic to Chile's Atacama desert, Campanulaceae is a vision of diversity.

In Hawai'i, where a lone colonizing species of *Lobelia* landed some 13 million years ago, the wide range of micro-habitats, as well as adaptations to seed dispersal and pollination by native animals, allowed it to branch and evolve into Hawai'i's most diverse clade (related plant group). An exceptional example of adaptive radiation, Hawai'i's Campanulaceae include native *Lobelia* plus five genera endemic to Hawai'i: *Brighamia*, *Clermontia*, *Cyanea*, *Delissea*, and *Trematolobelia*. The more than 150 endemic taxa are found on all the high Hawaiian islands except Kaho'olawe.

Among some taxa, the characteristic curved floral tubes indicate possible coevolution with curved-beaked native forest birds — mostly honeycreepers (Drepanididae) — while the long, tubular, fragrant flowers of *Brighamia* suggest adaptation to moth pollination.

Along with the loss of Hawai'i's native forest birds, genetic exchange and seed dispersal have declined. NTBG Research Biologist Ken Wood recalls frequently seeing *Cyanea* and *Delissea* in the 1980s, but says that populations lost in

tropical storms often couldn't reestablish themselves. Today, Hawai'i's Campanulaceae, Ken says, are in sharp decline. In addition to storm damage, competition with alien plants, damage from slugs, rats, and ungulates have reduced populations, adding to the problem of genetic inbreeding, resulting in less robust plants.

Over decades, NTBG scientists have discovered, rediscovered, collected, and cultivated Campanulaceae, most famously the moth-pollinated cliff-dwelling genus *Brighamia*, represented by just two species: *Brighamia insignis*, endemic to Kaua'i and Ni'ihau, and the closely related *B. rockii*, endemic to Lāna'i, Maui, and Moloka'i.

NTBG Conservation Biologist Seana Walsh has extensively studied the breeding system and floral biology of *B. insignis*, and continues to collaborate with staff at Chicago Botanic Garden to conduct molecular studies of genetic diversity within and among ex situ collections.

Another genus, *Cyanea*, includes some 70 or more fleshy fruit-bearing species such as *Cyanea dolichopoda*, endemic to the sheer cliffs of windward Kaua'i, it was discovered and co-described by NTBG staff but is now believed to be extinct.

Cyanea kubiherwa, previously known only from Limahuli Valley, was thought to have been wiped out by Hurricane 'Iniki (1992). It wasn't until 2017 that an NTBG-Nature Conservancy team rediscovered it on private land. Seeds were collected and sent to Lyon Arboretum at the University of Hawai'i where

they were grown into plantlets and carried back to Kaua'i in test tubes for NTBG to grow and outplant in the Limahuli Preserve.

NTBG has also successfully cultivated *Cyanea superba* (extinct in the wild) and *C. rivularis* which has been outplanted in Limahuli Preserve. Currently, Living Collections staff are also growing *C. sylvestris*, *C. hirtella*, as well as a number of *Delissea*.

In 2012, NTBG's Senior Research Botanist, Dr. David Lorence, co-named and described *Cyanea kauaulaensis* which grows in the mountains of west Maui. Presently, NTBG is also conducting survey work on Kaua'i with an undescribed perennial single-stemmed *Lobelia* which may eventually be identified as a new species.

To see Hawai'i's Campanulaceae in the wild, hike Kaua'i's Pihea trail leading to the Alaka'i Swamp where you may find multiple *Cyanea* species as well as *Clermontia fauriei* or *Trematolobelia kauaiensis* growing along the trail.

Currently, NTBG has more than 612,000 seeds from 370 accessions representing all six native genera in storage. Some of those seeds will be used to establish a breeding program for *Brighamia rockii* which represent populations no longer extant on Moloka'i. NTBG will try to germinate those accessions to grow *B. rockii* and cross-pollinate plants by hand to produce genetically diverse seeds that can be shared with the Plant Extinction Prevention program for outplanting in a restoration site on Moloka'i, the plant's home island.

CRITICALLY ENDANGERED *CYANEA GIBSONII*, ENDEMIC TO LĀNA'I.
PHOTO BY STEVE PERLMAN



National Tropical Botanical Garden

3530 Papalina Road
Kalāheo, Hawai'i 96741 USA



INTERNATIONAL YEAR OF
PLANT HEALTH
2020

 **REDUCE
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COLLECTING, IDENTIFYING, AND PRESERVING
PLANT MATERIAL IS AN IMPORTANT ASPECT
OF PROTECTING PLANT HEALTH. READ MORE
ON PAGE 6. PHOTO BY SEANA WALSH