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FALL-WINTER 2020

the bulletin

of the National Tropical Botanical Garden



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ON THE COVER

With a pinkish-red piko (junction of petiole and blade on leaf surface), this Mana 'Ulu variety of kalo (taro) grows at the Limahuli Garden "farms" parcel. When cooked, this variety turns yellow, the color of 'ulu (breadfruit), indicated in its name. Read more on page 26. Photo by Jon Letman


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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NATAL PLUM
Carissa macrocarpa

ILLUSTRATION BY VERONICA FANNIN

*From all of us at NTBG, we wish you and
your family the very best this holiday season
and thank you for your continued support.*

We hope you will consider making a difference in the new year ahead. For as little as \$10 a month, you can help NTBG continue our vital work saving plants, even during uncertain times. To make a monthly pledge, contact us at (808)-332-7324 Ext. 209 or email development@ntbg.org.



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

This year will be remembered as a time of great sacrifice and uncertainty. As I contemplate the challenges we face, I've been thinking about the role of botanical gardens in an age of global stress. Since 1964, NTBG has been saving plants. Central to our mission is the conservation of endangered species and the advancement of a greater understanding and appreciation of all plants.

As the coronavirus rages and flares around the world, I've been pondering another important, sometimes overlooked, role of botanical gardens. As plant sanctuaries, we have great capacity to preserve and promote edible plants. Beyond growing food crops, botanical gardens can serve as a compelling stage from which to tell the story of farming. We can encourage crop diversity, sustainable growing practices, and also curate and disseminate knowledge of how to grow edible plants and conserve rare crop varieties of cultural, scientific, and economic importance.

At NTBG, we have been doing this for years in a manner that is both consistent with our mission, and with broader global ambitions such as the United Nation's Sustainable Development Goals, specifically Goal 2 "End Hunger, achieve food security and improved nutrition, and promote sustainable agriculture."

The pandemic has shone a spotlight on vulnerabilities to food scarcity and supply disruptions, but our efforts offer hope. With the world's largest breadfruit conservation collection at Kahanu Garden on Maui and the Regenerative Organic Breadfruit Agroforest in McBryde Garden on Kaua'i, NTBG's Breadfruit Institute preserves crop diversity and centuries-old Indigenous knowledge. Based on traditional farming practices, the institute is advancing an agroforestry revival. Read more on page 12 of this issue of *The Bulletin*.

NTBG's Allerton Garden, primarily a historical garden of landscape beauty, includes a World War II-era "victory garden" started by NTBG founding Trustee Robert Allerton which not only produces edible fruit, but is an ideal place to discuss tropical horticulture and the value of home gardening and local produce.

On Kaua'i's north shore, Limahuli Garden is known for its kalo (taro) collection and outstanding taro patches. For decades, Garden staff have been building collections of kalo and other Hawaiian heritage "canoe plants." You can read about these efforts and how Limahuli Garden is helping feed the community on page 26.

On Maui, Kahanu Garden also maintains important Pacific Island food crops like bananas, sugar cane, and coconuts, and houses the primary conservation collection of the Breadfruit Institute. Kahanu Garden shares crop varieties through community plant sales and partners with neighboring Mahele Farm to distribute breadfruit we donate to help feed community kūpuna (elders).

In Miami, The Kampong preserves the legacy of renowned botanist and plant collector Dr. David Fairchild in what he established as his home and garden. Among the thousands of varieties of edible plants — mangos, avocados, dates, figs, kale, and countless other commonly eaten foods introduced to the United States by Dr. Fairchild, some specimens still grow at The Kampong nearly a century later. In 2010 The Kampong propagated all of its avocado varieties and sent them to a USDA grove on Hawai'i Island as a safeguard against the laurel wilt disease in Florida.

Reflecting on how, for over half a century, NTBG has been contributing to the conservation of vital food crops that promote healthy soil, healthy environments, and healthy people, gives me a welcome boost of hope for the future.

At a time when all our lives have been disrupted and our livelihoods upended, NTBG remains a sanctuary for sustenance, and a refuge for the plants and the people that care for them. I want to thank you for being part of NTBG's 'ohana (family), and for your unflagging support of the Garden. With gratitude and aloha, I send you best wishes during the holidays and in the New Year ahead.



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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THEY'RE
ENDANGERED.

THEY'RE ENDEMIC.



AND THEY'RE
COMING
BACK.

BY DR. NINA RØNSTED, NTBG DIRECTOR
OF SCIENCE AND CONSERVATION



THIS PAGE: *OCHROSIA KAUAIENSIS* SEEDS BY KEN WOOD. PREVIOUS PAGE, FROM TOP:
CHARPENTIERA DENSIFLORA BY KEN WOOD; *OCHROSIA KAUAIENSIS* FLOWER BY KEN
WOOD; *CYANEA HARDYI* BY SEANA WALSH

Building on more than half a century of experience, NTBG has become an international leader in the conservation of endangered tropical plants. Partnering with local, state, federal, and private conservation agencies and organizations, our success stories are possible because our field botanists routinely botanize the mountains and valleys of Hawai'i, other Pacific Islands, and tropical regions on foot, by helicopter, rappelling over cliffs, and using drones to locate, collect, and bring back important field observations and plant collections.

Maximizing the talents of our dedicated staff, volunteers, and like-minded partners, NTBG propagates and grows rare and endangered plants at our conservation nursery on Kaua'i. Each year we outplant thousands of endangered and endemic species in our gardens and preserves where we can monitor and protect them. Seeds are collected, studied, and stored in our seed bank, and shared with other conservation bodies.

NTBG has collected or co-collected at least 19 endemic taxa which are believed to be extinct in the wild, but still grow in cultivation. Hawaiian species such as *Delissea rhytidosperra*, *Kadua haupuensis*, *Kanaloa kahoolawensis*, *Stenogyne campanulata*, and others might have gone completely extinct had it not been for our efforts.

In recognition of NTBG's ongoing work, Fondation Franklinia, a Swiss private foundation that supports the conservation of globally threatened trees, funded a new project to conserve the endangered endemic trees of Kaua'i. The project, called Securing the Survival of the Endangered Endemic Trees of Kaua'i, Hawai'i, runs from 2020 through 2022. Because Fondation Franklinia specifically targets the conservation of species in their natural habitat, this gave us a unique opportunity to focus on native trees in need of critical conservation. For this project, eleven species were selected which either previously grew in the Limahuli Valley or which still have a remnant population of less than ten individuals.



UPPER LIMAHULI PRESERVE BY NTBG STAFF



CYANEA KULIHEWA BY NTBG STAFF

Knowledge of the historical occurrence of particular species in the Limahuli Valley comes from more than 40 years of monitoring and collecting by NTBG's science and conservation team. Through these efforts, we have amassed a wealth of information stored in our herbarium and accompanying databases and in technical reports and scientific publications. Pollen profiles of sediment cores have also provided information about past species occurrences, and GIS mapping and potential habitat range analysis helps guide our understanding of conservation needs and opportunities.

The eleven taxa we are targeting for this project are: two species of Hawai'i's only native palm genus, *Pritchardia limahuliensis* and *Pritchardia perlmannii*; two sweet scented white Hibiscus, *H. kokio* subsp. *saintjohnianus* and *H. waimeae* subsp. *hannerae*; three lobeliads associated with pollination by nectar-feeding native honeycreepers, *Cyanea hardyi*, *Cyanea kuhlheua*, and *Trematolobelia kauaiensis*; as well as the lesser known *Charpentiera densiflora*, one of the few tree species in the Amaranth family (Amaranthaceae); also *Ochrosia kauaiensis* which is a yellowwood in the dogbane family; the curious *Polyscias racemosa* which produces a long racemose inflorescence with up to 250 tightly packed flowers; and the charismatic *Gardenia remyi*, a member of the coffee family (Rubiaceae).

Over the course of the three-year project, NTBG will be collecting and propagating seeds as well as using previous collections from our seed bank to balance the need for substantial seed collection of the few remaining plants. When the new treelets are strong enough, most will be outplanted in the Limahuli Preserve in relatively pristine areas or where weed control is ongoing.

To help protect them from seed predation, additional rat traps are being installed in the area. All of this work draws on many skilled science, conservation, and nursery staff from across NTBG, including the help of a full-time project dedicated KUPU member, Matthew Kahokulua Jr., as part of the KUPU Conservation Leadership Development Program.

The re-introduction of these endangered, endemic trees to Limahuli Valley, where they once proliferated, will reinvigorate wild populations in the Limahuli Preserve where NTBG staff will be able to monitor them long into the future. Conservation collections will also be



OUTPLANTING IN LIMAHULI PRESERVE BY NTBG STAFF

retained in NTBG's seed bank, nursery and McBryde Garden. Mature trees representing several of the species are already thriving in the gardens, for example near the South Shore Visitors Center, where visitors may enjoy them up close.

Simultaneously targeting eleven endangered and endemic tree species is a confident step towards restoration of the diversity of native Hawaiian ecosystems. In the race to conserve Hawai'i's native forests, every step is critical. While trees are the major part of the biomass, healthy habitat also includes shrubs and herbs, as well native ferns and mosses, many of which also need a prioritized conservation effort.

Alongside the Fondation Franklinia project, and with the support of our members, collaborators and additional grants, NTBG remains dedicated to helping save as many endangered plant species — trees or otherwise — as possible as we work to protect and restore native ecosystems on Kaua'i and beyond. 🌿

STANDING UP FOR TREES

Trees are the foundation of forest ecosystems. To date, over 60,000 trees have been named and described globally. Since 2015, a Global Tree Assessment campaign, led by Botanical Gardens Conservation International (BGCI) and the International Union for Conservation of Nature's IUCN Red List of Threatened Species, has been assessing the conservation status of the world's trees. This enormous effort has resulted in the assessment of 45 percent of the world's trees, roughly 38 percent of which are threatened with extinction. This means more than one in five of the world's tree species faces extinction.

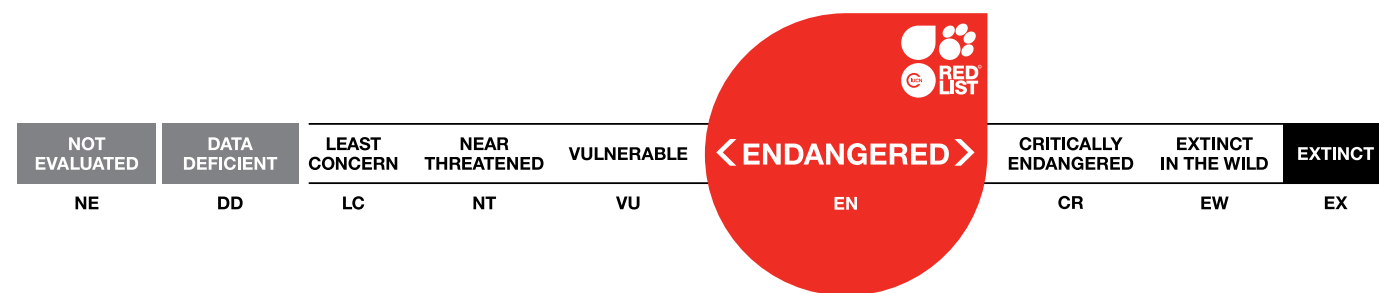
Because of isolation and wide range of climatic zones, Hawai'i is a global hotspot of botanical diversity. Of the more than 1,360 known native Hawaiian plant species, nearly 90 percent are unique to the islands. Many species are found only on one island or even a single ridge or valley. Approximately 13 percent of Hawai'i's native flora (more than 175 species) are trees. These include Hawai'i's most common and foundational forest trees 'ōhi'a (*Metrosideros polymorpha*) which is culturally very important, and koa (*Acacia koa*).

Hawai'i also has a high extinction rate with an estimated 10 percent of the flora reported to have gone extinct since the 1840s. Over 50 percent of the species are considered threatened, primarily from the introduction of non-native plants which compete for habitat and destructive animals that eat seeds or foliage. These threats illustrate the importance of the Fondation Franklinia's Securing the Survival of the Endangered Endemic Trees of Kaua'i, Hawai'i project.

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 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 43,000 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 (flowering plants and ferns) in 2020. As of late September, NTBG has completed 75 new assessments in 2020.



Species: *Sadleria unisora* (Blechnaceae)

IUCN RED LIST CATEGORY: ENDANGERED (EN)

Sadleria unisora is a small, Kaua'i single-island endemic fern species that can completely cover vertical walls of narrow montane streams, surviving even when submerged by flood waters. An estimated 70,000 individuals occur among 6 subpopulations. However, populations are severely fragmented and there is a continuing decline in the number of mature individuals, subpopulations, and habitat. Persistent threats to *S. unisora* include habitat degradation by non-native animals and competition by non-native invasive plant species.

Ferns are an important but often overlooked part of the plant diversity in islands and the 167 known taxa of native ferns and allies in Hawai'i constitute roughly 15 percent of the native flora. Ferns naturally make up a significant component of healthy native forest understories.

NTBG has developed significant knowledge on proper fern spore storage and with the establishment of NTBG's Fern Lab for fern propagation, collection efforts of fern spores, including *S. unisora*, has increased in order to create ex situ conservation collections. This will allow us to reintroduce a diversity of native fern species into restoration projects on the island, including NTBG's Limahuli Preserve. — Seana Walsh

supporting roots

Q & A with Prof. John and Grace Rashford



*John Rashford, Professor Emeritus of Anthropology at the College of Charleston, is a life-long student of people, plants, and human landscapes. He's also passionate about world travel and has a deep interest in the genus *Adansonia* (baobab). After several meetings and participation in an ethnobotany summit hosted by NTBG, he joined NTBG's Board of Trustees in 2007.*

In addition to serving on the Science and Conservation, Education, and McBryde Garden Planning committees, John is the current Chair of the Breadfruit Institute Committee and an enthusiastic supporter of the Breadfruit Institute's Regenerative Organic Breadfruit Agroforestry demonstration which harkens back to the Caribbean food forests he knew growing up in Jamaica.

From his home in Charleston, South Carolina, John spoke with the Bulletin and was later joined by his wife Grace to talk about why they support NTBG.

What most appeals to you about being a Board member and NTBG supporter?

John: It's just been an exceptionally enjoyable learning experience — interacting with the Board, administration, and the Garden staff as a whole. From my own professional point of view, working with the scientific members of the staff and of the Board has been an absolute delight. It's also been wonderful to be a student of NTBG's individual garden directors. They're all so knowledgeable and committed to the Garden.

This year has been a shock to the world. What positive changes do you hope come from the pandemic and how might it shift the role of botanical gardens?

John: I hope there will be a greater appreciation for the role of science in meeting the challenges of current global issues such as climate change, the loss of biodiversity, and public health. I would include in that, a great appreciation for the importance of botanical gardens and the knowledge of plants that we rely upon, not only when diseases arise, but in their prevention.

What kind of impact is the pandemic having on gardens?

John: It is going to have an impact and it should have an impact. I hope that the most fundamental impact it will have is a sobering reminder to all of us of how essential scientific research is in meeting the requirements for global life.

If you met somebody who wasn't interested in plants or gardens, what would you say to them?

John: I don't know anybody like that, but the best place to start is to invite people to visit the garden for an informed introduction. You need to give people an opportunity to appreciate not only the plants and the history of the garden, but also the history of botany that tells the story of the relationship between people and plants. Interest is rooted in knowledge. If people don't have a venue by which they can become informed about the fundamental role of plants in their lives, I don't see why they should care.

Grace, what strikes you most about NTBG?

Grace: It's quite impressive, just the idea that the garden is so far-reaching. It gives a good appreciation for the trees and plants around us and so it's a means of making us that much more aware of what trees offer for our very survival.

For those who have never visited NTBG, how would you encourage them to have a look?

Grace: The people I talk to about the gardens of course are interested in the plants — beautiful flowers and rich, lush vegetation. It makes you so much more aware of the appreciation of plants and flowers and insects.

John: I want to communicate what a wonderful opportunity people have to visit a very special botanical garden that has great research and conservation programs. It is a treat to explore an extraordinarily put-together scientific garden.



A Breadfruit By Many Other Names

BY DR. DIANE RAGONE, DIRECTOR, BREADFRUIT INSTITUTE

The world can be a confusing place and so we impose order and make sense by classifying and naming things. Taxonomy, the science of systematic naming, has been practiced by scientists for several hundred years. Latin binomials (two-part names) — such as *Artocarpus altilis* (breadfruit) — are the accepted nomenclature for flora, fauna, and fungi.

In the Pacific, pre-literate people have had their own naming systems for centuries. Indigenous agriculturists and others have used their own astute observations to recognize and assign names to domesticated or cultivated plants, often to the varietal level.

Breadfruit naming is a prime example of the depth, complexity, and sheer beauty of how plant names tell the story of people and places. For millennia, breadfruit has been an important staple crop in Oceania. The tree is a key element of multi-layered agroforests well adapted to diverse island environments.

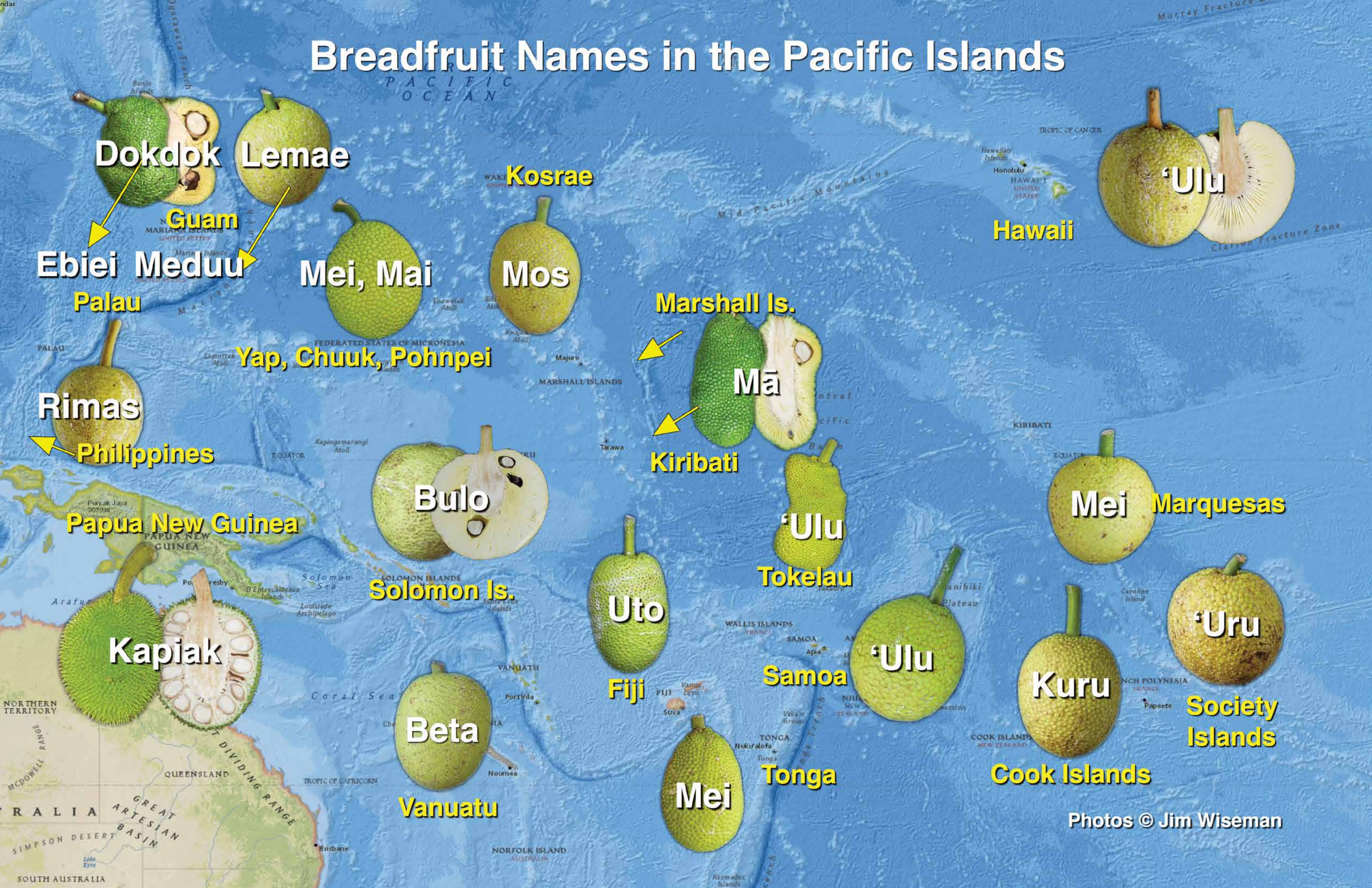
All Pacific Islanders have a generic term for breadfruit, such as ‘ulu in Hawai‘i or mei in the Marquesas Islands. These terms reveal the linguistic connections between migration, settlement, and the spread of this nutritious tree crop to islands separated by vast expanses of ocean. In certain archipelagoes, breadfruit has only one generic name such as lemae in the Mariana Islands. Does this mean there was only one type of breadfruit? Does it suggest that it was not an important food? Or could it be that the expertise required to recognize different varieties was lost over time?

Oceanians are masterful horticulturists who carefully selected, cultivated, and named hundreds of breadfruit varieties. Some are unique to an island or island group; others are more widely distributed. A practical system of “folk taxonomy” is used to distinguish between and name varieties. Distinctions are based on appearance (fruit shape, texture, color, presence of seeds, leaf shape, etc.), culinary properties, geographic origin, or comparative — being similar to something else.



BREADFRUIT AT KAHANU GARDEN (THIS PAGE);
MEI KOENG IS A HYBRID BREADFRUIT VARIETY
UNIQUE TO MICRONESIA (PREVIOUS PAGE).
PHOTOS BY © JIM WISEMAN

Breadfruit Names in the Pacific Islands



Dokdok

Lemae

Guam

Ebiei Meduu

Palau

Rimas

Philippines

Papua New Guinea

Kapiak

Mei, Mai

Yap, Chuuk, Pohnpei

Kosrae

Mos

Marshall Is.

Mā

Kiribati

Bulu

Solomon Is.

Uto

Fiji

Samoa

Tonga

Beta

Vanuatu

Mei

Hawaii

'Ulu

Mei

Marquesas

'Uru

Society Islands

Kuru

Cook Islands

Photos © Jim Wiseman



DIANE RAGONE TAKING FIELD NOTES IN AMERICAN SAMOA. PHOTO BY © JIM WISEMAN

When I began studying breadfruit in the early 1980s, I first did so through library and archival research studying documents in which visitors to Pacific Islands recorded rituals, agricultural practices, food preparation, and other aspects of daily life. Careful examination of these accounts has yielded details about the importance and use of breadfruit on various islands. In some cases, especially in dictionaries, names were recorded and sometimes included brief descriptions.

Prior to beginning my initial Pacific fieldwork in 1985 and 1987, I compiled this information into a master reference list for each island or island group. The lists proved to be an invaluable starting point in my quest to locate, document, and collect breadfruit varieties across the region.

Working with local agricultural extension agents, I reviewed lists with villagers and farmers to verify variety names and locate specific trees. I asked what each name meant and was given their definitions. As they perused the list, people often asked, “Where did you get this name?” Frequently the names (and my pronunciation) elicited laughter. One amused villager told me that one name essentially meant “Joe’s breadfruit” as it grew on Joe’s land. Person by person, village by village, and island by island, I revised the lists: correcting, deleting, and adding names.

As I located each tree representing a variety, I documented it with photographs and/or herbarium vouchers while collecting propagation material whenever possible. I recorded provenance, distribution, conservation status, and other ethnobotanical information.

WHAT IS IN A NAME?

A good example of how sophisticated breadfruit names are in reflecting subtle differences can be seen in a group of 26 trees from the atolls of Tokelau growing at Kahanu Garden. All of Tokelau’s breadfruit trees are seeded, but varietal names reflect an understanding of origin, reproductive biology, and seedling variation. Examples include ‘Ulu hamoa which has fewer seeds than ‘Ulu elise which represent different species — *Artocarpus altilis* and *A. mariannensis* respectively. Their progeny are known as ‘Ulu afa (meaning half or mixed) and are further distinguished as ‘Ulu afa hamoa or ‘Ulu afa elise depending on which parent they most resemble.

Other names succinctly describe an attribute or situation. The “crying child breadfruit” is called Chepnei on Chuuk and Meiserihseng on Pohnpei where the quickly cooking variety calms a crying, hungry child. Variety names like Palau’s Ebechab (“sprinkled with ash”) indicate how it is prepared (roasted in a fire) or the fruit’s texture such as Samoa’s ‘Ulu ma’a (stone).

In Samoa, Momolega’s deep yellow flesh evokes the color of an egg yolk, in contrast to the white flesh of ‘Ulu sina. When cut, the Cook Islands variety Toto bleeds a thin watery sap that discolours red. Mei koeng/keang on Chuuk has deeply dissected and narrow lobed leaves resembling the branching of coral. Some varieties such as Ma’afala and Aveloa (Samoa) are examples of names that cannot be translated or the meaning has been forgotten.

ACROSS THE PACIFIC

In more recent field expeditions (1999–2011) throughout the Pacific, I incorporated a more systematic approach to gathering information. In addition to collecting propagation material of varieties not represented in NTBG’s breadfruit conservation collection, I conducted interviews using a standardized form. I asked each interviewee to name as many different varieties as they could, as well as relevant information, availability, and location of trees.

Working with participants of an NTBG-hosted tropical ethnobotany field course in the year 2000, we interviewed over 350 Samoans on five islands in just two weeks. This methodology has been shared with indigenous researchers in the Solomon Islands and Yap who used these interview forms to document varieties on their islands.

A wealth of additional material about varieties and breadfruit ethnobotany amassed during structured and unstructured interviews with numerous Pacific islanders is recorded in field books and on paper forms. The interviews were concurrently documented using visual media (photos, video, etc.) by Jim Wiseman, a professional photographer and videographer. These valuable resources have not yet been transcribed, nor has the data, including digital metadata, been entered into spreadsheets so it can be analyzed, synthesized, and published in print and online.

The decades of field work I have conducted, along with the breadfruit collection we have assembled at Kahanu Garden and McBryde Garden are helping preserve trees

representing 150 varieties of three species of *Artocarpus* (breadfruit, breadnut) from 34 Pacific islands.

A walk through the Breadfruit Institute’s conservation collection at Kahanu Garden takes one on a botanical and linguistic journey through far-flung, but interconnected islands. There, beneath the canopy of the many-named trees, one gains an appreciation of the value of documenting the names of hundreds of breadfruit varieties throughout Oceania, and the importance of perpetuating the cultural knowledge that connects people and islands across time and space. 🌿



JIM WISEMAN WITH LOCAL AGRICULTURIST KADALINO LORENS DOCUMENTING TRADITIONAL PRACTICES ON POHNPEI, MICRONESIA. PHOTO BY © DIANE RAGONE

garden sprouts

News from around the Garden



PHOTO BY ASHLY TRASK



PHOTO BY SEANA WALSH

SUPPORTING FERN DIVERSITY

NTBG has been growing native ferns since at least 2007. Currently NTBG is growing 19 genera of ferns representing 36 unique native species, most of which are rare and endemic. These are being grown in a laboratory in the Conservation and Horticulture Center on Kauaʻi. For more than 12 years, NTBG staff, volunteers, and interns, in collaboration with Research Associate Dr. Ruth Aguraiuja of Tallinn Botanic Garden, have been producing thousands of native ferns for outplanting in the Limahuli Preserve and elsewhere.

Curator of Living Collections Mike DeMotta says that by maximizing resources and developing capacity, NTBG has the potential to become a premier source for fern propagation and research in Hawaiʻi. Presently NTBG has one KUPU intern working part-time in the fern lab, but having a long-term regular staff dedicated to working with ferns would benefit operations.

One aim of growing ferns is to provide material to re-establish spore banks in the forest floor. Mike says that because ferns play a critical role in healthy forests, NTBG's commitment to supporting fern diversity benefits everything else in the forest, creating favorable conditions for restoration at the ecosystem scale. Regardless of how rare or common they are, ferns capture moisture, prevent erosion, and suppress invasive weeds with their dense root masses. Ferns can also support pollinators such as moths when they lay their eggs.

Reflecting on the rarely visited pristine habitat, Mike is inspired. "When I see such a diversity of ferns – terrestrial ferns growing on rotting logs, absorbing moisture, and replenishing the watershed, I realize we can recreate this in the Lower Limahuli Preserve," he says. "It gives me a greater appreciation for the importance of fern diversity."



PHOTO BY MIKE ORGENORTH

KAHANU'S GREENHOUSE

Kahanu Garden's modest greenhouse has served the garden since 2010. The space allows staff and volunteers the chance to care for a wider range of indigenous crop and native plants that are used for research and restoration projects in the garden and coastal pandanus preserve. The greenhouse's sprinkler system, comprised of misters, overhead sprayers, and drip lines, is simple but reliable and easy to repair. Among the plants being grown are breadfruit, rare banana cultivars, and native plants like the Critically Endangered hō'awa (*Pittosporum halophilum*). Having a reliable greenhouse makes it possible for Kahanu Garden to offer occasional plant sales, helping introduce indigenous crop varieties and native plants back into the community.

garden sprouts



PHOTO BY JON LETMAN

BREADFRUIT AGROFOREST DEMO MARKS THREE YEARS

The Regenerative Organic Breadfruit Agroforest (ROBA) in McBryde Garden celebrated its third anniversary in early August. The research orchard of 24 breadfruit and breadnut trees has been transformed into a dynamic, biodiverse system. The ROBA is a place of beauty and abundance with elegant breadfruit trees, fragrant plumeria and papaya blossoms, colorful splashes of zinnias, and butterflies wafting on the breeze.

Covering just two acres (the average size of a small-holder farm in the tropics), 120 species and varieties of plants are currently being cultivated. More than 8,600 pounds of breadfruit, 6,900 pounds of other crops, and 1,300 cut flowers and ornamental plants have been harvested. While many of the plants are grown for food, others provide an array of environmental services such as habitat for pollinators and beneficial insects; food for soil microbes; roots that penetrate deep into the soil, improving drainage and porosity; living mulch and more.

The ROBA is a positive model that demonstrates how farmers and their families can produce highly nutritious food, improve the quality and health of their land, and have the opportunity to sell or trade produce from their farms by adopting and adapting organic regenerative practices exemplified here.

WHY WE'RE ALL IN...



"We were first taken in by the obvious splendor of the gardens and the stories behind them, only to find that there was so much more. NTBG's passion to nurture and preserve Hawaiʻi's cultural heritage and unique flora is contagious. The Breadfruit Institute's noble mission to study and promote breadfruit as a means to address global issues in food security and deforestation is truly inspiring. We are truly honored to support the mission."

— Matthew and Michaline Todd,
NTBG Fellows since 2015

To learn about the impact and benefit of Fellowship, please contact Momi Kelekoma at (808) 332-7324 Ext 212 or mkelekoma@ntbg.org.

ntbg.org/support/fellows

NTBG SUPPORTS JOURNALISTS

Reporting on Plants Around the World

Central to NTBG's mission is the advancement of academic and public understanding of tropical plants and ecosystems. By contributing to the public's knowledge of and concern for plant life, NTBG fulfills its mission and helps create a more plant-savvy population that better appreciates the importance of saving plants.

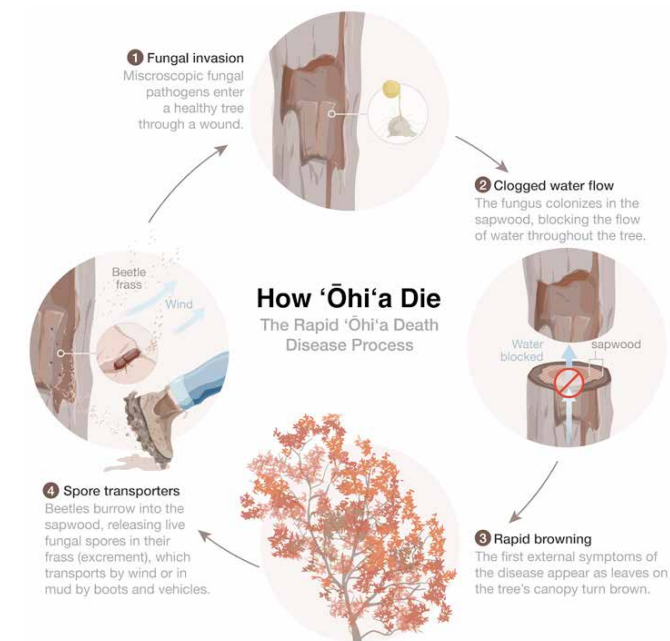
For two decades NTBG has drawn on its own staff and resources, and from the local scientific, conservation, and cultural communities, to offer an Environmental Journalism Program. The primary goal of the program is to teach journalists about critical concepts, practices, and trends related to ecology, botany, plant conservation, and other issues related to the tropical natural systems and environments.

Since 1999, over the course of 17 programs, NTBG has provided professional training for scores of journalists and media professionals from around the world, giving them valuable on-the-ground experience. The knowledge they gain at NTBG becomes part of their reporter's tool kit as they continue to report on the vital role of healthy plants and ecosystems everywhere.

In the below passages, four program participants share examples of their recent work and explain how they reported these plant stories.



PHOTO BY VINCENT WANG
ILLUSTRATION BY DAISY CHUNG



VISUALIZING HEALTHY HAWAIIAN FORESTS

I created this data-driven visual story in collaboration with writer Kim Rogers to illustrate how scientists are working with the public to save Hawai'i's most important tree, the 'ōhi'a, by collecting seeds. The effort is in response to the Rapid 'Ōhi'a Death (ROD) crisis, a fungal disease destroying thousands of acres of Hawai'i's most abundant native forests.

The story idea was sparked when I participated in NTBG's 2019 Environmental Journalism Program where I met Kim Rogers, a writer and ROD Outreach Specialist. Kim passionately presented the severity of ecological consequences if the 'ōhi'a forests collapse. I felt the crisis needed to be shared beyond Hawai'i and knew strong visual storytelling would be effective. Working with Kim, we caught the interest of editors at Nightingale, a data visual publishing platform, as part of their Earth Week series.

Kim and I decided to focus our reporting on the Seed Banking Initiative. Our aim was to visualize data to showcase the success when scientists and the public work together. The result was a series of data visualization graphics and maps highlighting the progress of seed collecting and the importance of seed zones.

For me, the most rewarding aspect of this project was learning about new research developments and conservation efforts of NTBG staff and others. I believe these visuals are critical tools that can serve a larger and urgent undertaking. They have since been used for various outreach initiatives, publications, and a recently published paper on ROD. —Daisy Chung

Collecting Seed to Save Hawai'i's Native Forest published by *Medium*, April 24, 2020

Daisy Chung is a science visual communicator, illustrator, and creative director at wikiHow where she transforms complex information into engaging visuals. (Environmental Journalism Program 2019)

Web: <https://daisychung.com/> | Twitter @daisychungart



PHOTO BY DENISSE MATEO CHERO

CLOUD CURTAINS OF PERU

In July 2019, I traveled to Wayqecha Cloud Forest Biological Research Station near the border of Peru's Manu National Park to accompany scientists studying the elusive spectacled bear which makes its home in the country's cloud forests. Hiking through the dense foliage, our group suddenly came across a huge mesh curtain which hung nearly 100 feet in the air and covering a large forest plot.

Scientists at the station explained to me it was part of a novel research experiment to determine how climate change will affect cloud forest plant communities. The mesh netting intercepted cloud moisture and prevented it from reaching the trees, epiphytes, bromeliads, and orchids growing in the curtain's shadow. As temperatures warm, it's expected that the point where clouds and forests intersect will move farther upslope, leaving plants thirsty. The curtain mirrored that effect.

I instantly knew I had to write about this bizarre tropical experiment. I set about interviewing one of the scientists, Roxy Cruz, who was in the middle of her fieldwork when I visited and jotted down the names of other scientists to interview once I left Peru. Cloud forests are exceedingly rare, making up just 2.5 percent of Earth's tropical forests. In Peru, they're also home to one-third of the country's 270 endemic birds, mammals and frogs. Ultimately, understanding how climate change would affect the cloud forests also greatly aided my reporting on the spectacled bear, which feasts on the bromeliads of the cloud forest. —*Gloria Dickie*

These scientists created a 'cloud curtain' in Peru's tropical forests to mimic the future published by *Public Radio International*, January 27, 2020.

Gloria Dickie is a freelance journalist covering climate change and biodiversity conservation. (Environmental Journalism Program 2017)

Web: www.gloriadickie.com | Twitter: @GloriaDickie

RESTORING PEAT BOGS IN SCOTLAND

In September 2019, I traveled from Portland, Oregon, to "Flow Country"—the world's largest expanse of blanket bogs—located in northern Scotland, courtesy of a European Geosciences Union journalism award. My aim was to report on innovative efforts to restore bog health. Decades ago, Scotland drained and replaced peat bogs with forestry plantations. Not only did the trees fail to grow, but the dried, carbon-rich wetlands became one of the country's biggest sources of carbon dioxide emissions. Researchers have been experimenting with ways to remove trees, block drainage ditches, and stimulate native *Sphagnum* moss regrowth to stop carbon emissions.

When I arrived, the scars of an early 2019 peat fire that broke out in one of the Flow Country restoration sites were still striking—a rare and ominous event in typically soggy Scotland. After attending a conference in Inverness on the successes thus far of the five-year restoration project, I spent three days tromping through bogs in various stages of repair. What was most interesting was how the Scottish government saw the restoration as a way to meet their Paris Climate agreement goals, but also as a way to protect this vital piece of Scottish identity. In fact, greater awareness of Flow Country secured a UK nomination for UNESCO World Heritage Site status, the first peatland to receive the honor.

In addition, many of the techniques being pioneered in Scotland, such as using satellite measurements of bog movement with the water table, may be applicable in peatland restoration efforts elsewhere in the world, including Indonesia. If restoration is successful, it could mitigate the 2 billion tons of carbon dioxide annually—roughly 5 percent of anthropogenic greenhouse-gas emissions that occur globally as a result of peat fires and oxidation of the buried carbon. —*Virginia Gewin*

How peat could protect the planet published by *Nature*, February 12, 2020

Virginia Gewin is a Portland, Oregon-based freelance science journalist covering climate change, land use, and food security.

(Environmental Journalism Program 2011)

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PHOTO BY NEIL MCINNES



PHOTO BY TOM NANCE

CLIMATE CHANGE ON ALASKA'S COAST

I first learned about *Alexandrium catenella*, an ultra-poisonous type of algae that lurks along ocean coasts, at a journalism fellowship in Cape Cod. The algae, which contains a potent biotoxin that's impossible to detect through taste, touch, or smell, accumulates in natural water filters like clams and mussels. The toxin can't be fried, baked, or frozen out of shellfish. Once consumed, it causes an illness called paralytic shellfish poisoning (PSP) which can trigger total paralysis and lead to sudden death.

At the outset of what became a year-long investigative project, I learned every coastal state except for Alaska has programs to protect residents from paralytic shellfish poisoning. Yet Alaska, which has more coastline than all other U.S. states combined, is the only place in the U.S. where people still die of PSP. Research shows warming ocean waters are helping *Alexandrium* intensify and spread.

In September 2019, I flew to Kodiak to find out how proliferation of this algae is affecting tribes and other communities in southeast Alaska. I met with members of the Alutiiq and Sun'aq tribes, researchers, fishermen, public health experts, and local artists. Everyone told me different versions of the same story: Alaska is changing. The shellfish is more toxic, blight is blackening salmon berry thickets in the mountains, and fires rage through the summer.

Fortunately, there is a silver lining. Initiatives to monitor and document *Alexandrium* in Kodiak and other tight-knit Alaskan communities are providing a much-needed layer of protection for subsistence harvesters. There have been no PSP-related deaths in southeast Alaska since researchers developed a shellfish monitoring network in 2011.

My favorite part of reporting this story was witnessing the myriad and creative ways people band together to protect each other. As the effects of climate change continue to impact communities across the world, it's important to remember that some of the best climate solutions are grown at the local level. —Zoya Teirstein

Alaskan Roulette: As warming waters make shellfish toxic, a way of life becomes deadly for Native Alaskans published by *Grist*, February 25, 2020 **This article won third place for an Outstanding Feature Story (Small Newsroom or Circulation), Society of Environmental Journalists*

Zoya Teirstein is an environmental reporter at *Grist*. She covers clams, ticks, politicians, and other creatures affected by climate change.

(Environmental Journalism Program 2018)

Web: <https://grist.org/author/zoya-teirstein/> | Twitter: @zteirstein

wish list

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BREADFRUIT INSTITUTE

Employee work boots - \$225
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KAHANU GARDEN

Shindaiwa 262x brush cutter - \$430
Pots and sprinkler heads for the greenhouse - \$350
Storage cabinets at the shop and office - \$500

LIVING COLLECTIONS & HORTICULTURE

Protective case for Samsung tablet used in mapping - \$50
Air conditioner unit for Nursery Manager office - \$300
Greenhouse circulation fans - \$400
Helicopter flight to survey and collect Olonā - \$900

MCBRYDE AND ALLERTON GARDEN

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Climate data loggers for collection preservation in the BRC (3) - \$375
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THE KAMPONG

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Oriental-design ceiling light - \$350
1-year Verizon cell phone service for Senior Horticulturist - \$600
Epson digital projector for lecture and event - \$800

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PHOTO BY CRAIG MORELL

the green thumb

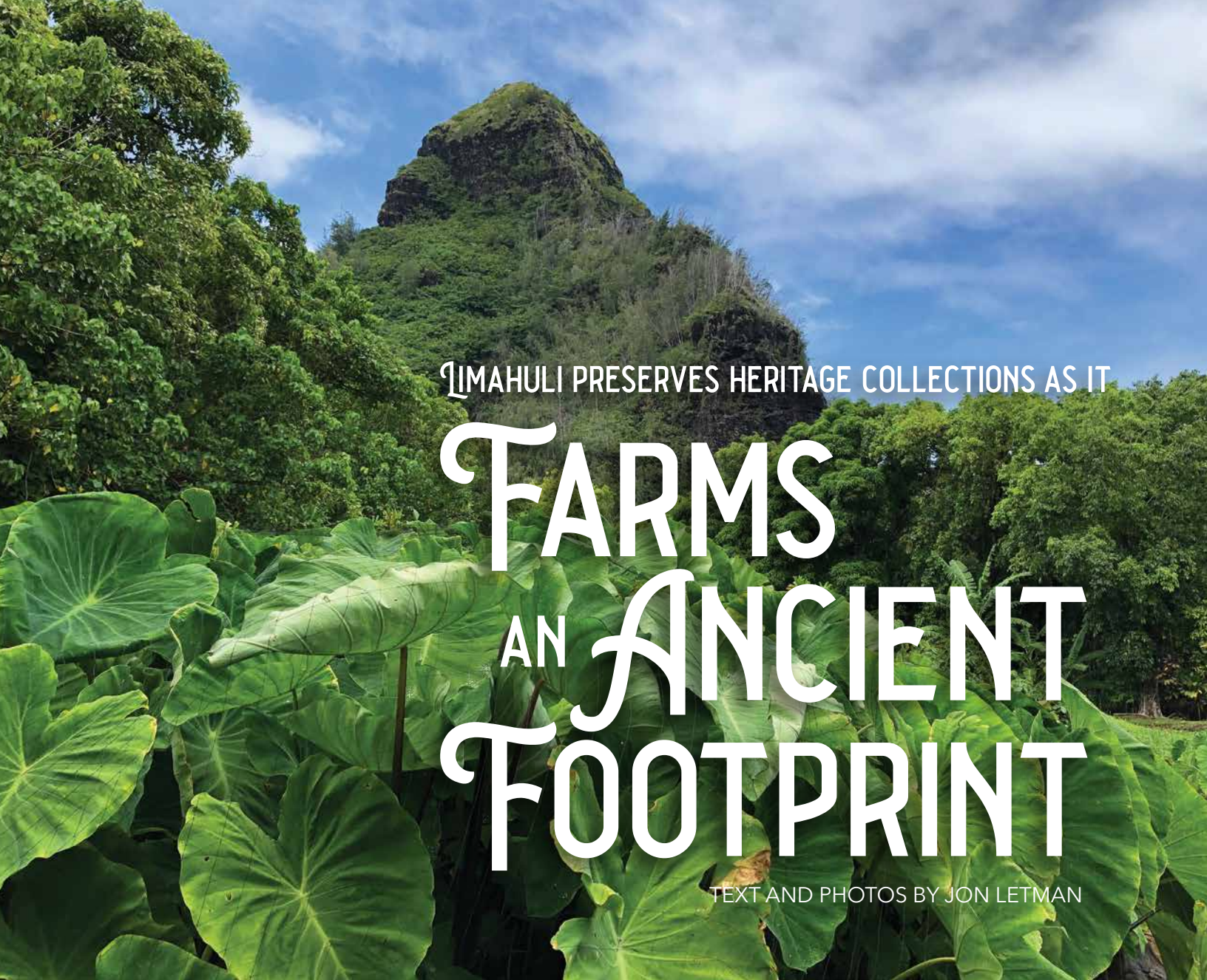
With late autumn and winter ahead, now is a good time to think about pruning trees and hedges for next year. Depending on what you grow and where you live, grooming your plants now by removing or trimming interior vertical branches can improve the health of the plant. Many trees flower and set fruit on new growth, improved by proper and timely pruning. Let's review some basic botany before you trim.

Many plants have a terminal bud. Trees and shrubs have a lateral bud at the base of the leaves or branches that help them grow and expand their branches. Palms, on the other hand, have only a terminal bud which, if removed, will kill the tree. The only parts of a palm that need trimming are the dead leaves. Shrubs and hedges can be formally trimmed with a hedger or informally with clipper and hand saw. Trees and shrubs can be reduced in height by removing leaders and vertical branches, leaving smaller branches below which can be cut back where a bud indicates a branch may grow.

Many trees have tissue formed in a ring at the base of a branch, called a branch collar. It's very important not to damage the collar when trimming. To make a safe, non-damaging cut, try this three-step method. First, make a small cut on the underside of the branch about ten inches from the trunk. The second cut is made an inch further away from the trunk. The branch should snap off cleanly without damaging the trunk. The third cut should be made just slightly outside the branch collar without damaging it.

Here in Miami, we trim our fruit trees after harvesting, so new flowers appear the following year on new growth. I recommend you ask local arborists or agricultural specialists in your area before you trim your plants. Keeping your plants groomed will make them healthier, more attractive, and longer-lived.

—Senior Horticulturist, *The Kampong*, Benoit Jonckheere



LIMAHULI PRESERVES HERITAGE COLLECTIONS AS IT

FARMS AN ANCIENT FOOTPRINT

TEXT AND PHOTOS BY JON LETMAN

Limahuli Garden on Kaua'i's north shore is home to centuries-old restored lava rock kalo lo'i (irrigated patches for growing taro). Located in one of Hawai'i's most storied valleys, Limahuli Garden has long been recognized as a pu'uhonua (a place of refuge) for both rare and endangered native plants as well as people and culture.

For nearly 45 years, Limahuli Garden has also built up its collection for traditional Hawaiian crop varieties such as 'awa (kava), 'uala (sweet potato), and kalo (taro or *Colocasia esculenta*). In the 1980s, under then Limahuli Garden Director Chipper Wichman, there were at least 45 kalo varieties. In 2005, a new Garden Director, Kawika Winter, introduced more rare

varieties of kalo. In 2012, he authored a paper which documented upwards of 400 historical kalo cultivars.

Today, of the estimated 80 known remaining kalo varieties, around 50 are being grown at Limahuli Garden. This includes both wetland and dryland kalo varieties Mana'ulu, Kapa'aloa, Pi'iali'i, Wehiwa, and Pi'ikea.

In recent months, especially since the onset of the coronavirus pandemic, Limahuli staff have devoted more time to developing the kalo collection in a roughly two-acre plot adjacent to the garden informally known as "the farm." There, staff are restoring an ancient system of more than a dozen kalo lo'i which archaeologists say is over 800 years old.

MAHALO KĀKOU I KA MEA LOA'A

(Let us be thankful for what we have)



LIMAHULI STAFF BESIDE KALO. FROM LEFT: KEVIN "BEAR" KALEIOHI, ALOYIUS "UNCLE MOKU" CHANDLER, AND RANDY UMETSU.



MANAPIKE VARIETY OF TARO DETAIL.

Helping spearhead these efforts is Noah Ka'umoana, Limahuli's Mālama 'Āina¹ Specialist who has been collecting kalo for more than a decade, including rare varieties from renowned Hawai'i Island taro farmer, the late Jerry Konanui. By growing as many varieties as possible, Limahuli preserves important plant stock, contributes to greater kalo consumption, and helps preserve culture.

Limahuli's Randy Umetsu, a Horticulture Technician, says there's great importance in growing and sharing kalo cultivars that are unknown to most people. "If one day we can get those onto people's plates and in people's yards, that will help perpetuate Hawaiian kalo varieties."

Limahuli Garden and Preserve Director Lei Wann says, "We have the historical footprint left for us in Limahuli and the lo'i agricultural system. That motivates our staff to restore the system to what it used to be." Lei, who has a background in education, says Limahuli is a special place that can inspire curriculum. "The agricultural footprint drives what we do."

Limahuli staff use the farm plot to also grow vegetables like okra, beans, leafy greens, herbs, root crops, tomatoes, watermelon, cucumber, and other common crops. The harvest is shared with staff and their families with a portion set out at the garden entrance for anyone to take freely.

Meanwhile, the sharp decline of island visitors due to the pandemic has given Limahuli staff a chance to help their neighbors by partnering with a local non-profit called 'Āina Ho'okupu O Kilauea in delivering Community Supported Agriculture bins of fresh produce grown by local farmers to some 200 households.

Since the start of the pandemic, Limahuli staff have helped distribute over 24,000 pounds of food to the community and in doing so the garden receives a stipend to offset the cost of delivery, helping support the garden while visitor numbers are down.

Lei says Limahuli Garden not only fulfills its role as a refuge for rare and endangered plants, but as a place to grow delicious, healthful food. That alone is an act of empowerment and great morale booster during a time when people across the island face uncertainty and isolation.

In a year filled with so much adversity, there's something very meaningful about knowing that your work stays true to its mission, while providing the ability to sustain and nourish family, friends, and neighbors by growing healthy plants. 🌿

¹Malāma 'Āina means to 'care for the land'

an eye on plants

SELECT SPECIES IN FOCUS

Pelagodoxa palm

Trekking through the dense forests of Nuku Hiva in the Marquesas Islands, NTBG botanists Steve Perlman and Ken Wood swatted their way through clouds of tiny, biting nono flies until they reached the back of Taipivai Valley. There, below the plunging Teuakueenui waterfall, stood ten tall, slender *Pelagodoxa henryana* palms at the site of an ancient human settlement.

Beginning in the 1980s and continuing through the 90s, they made several more treks, relying on local knowledge of the forest and occasionally accompanied by French botanists, to the only known site of the rarely seen *Pelagodoxa* palms.

On one visit, Ken used his climbing prowess to scamper to the tops of nine of ten trees to collect the unusually large, curiously-shaped single-seeded fruits. After taking measurements and making voucher collections for NTBG's herbarium, he gathered the softball-size fruits which are covered in rows of protruding spiked nodes, giving the fruit the appearance of a medieval torture device, to be cleaned of pulp and the seeds sent to Hawai'i.

Back at NTBG headquarters on Kaua'i, the seeds were germinated and planted in McBryde Garden where today nine palms (seven *P. henryana* and two hybrids) grow on a shady hillside above the Lāwa'i Stream, protected from the wind, allowing the leaves to unfurl

like bright green sails. Two older *Pelagodoxa* palms grown from a seed exchange with botanical gardens in Fiji and Tahiti in 1977 and 1980 stand along the garden pathway along the stream.

Known in the Marquesas as the enu palm, the genus name *Pelagodoxa* comes from the Greek words *pelago* meaning sea or flowing water and *doxo* meaning glory. The species honors Charles Henry, director of the French Society of the Marquesas, who collected the palm in 1916. Based on pollen evidence, *Pelagodoxa* may have formerly occurred in the Austral Islands which, like the Marquesas, are part of French Polynesia.

Initially, the genus *Pelagodoxa* was thought to be monotypic (having only one species). Today, however, the genus is recognized as having two species — *P. henryana* and *P. mesocarpa*, the second species being named for its moderately-sized seed.

Pelagodoxa henryana and *P. mesocarpa* have been accepted as both different species and alternately lumped together as synonymous, but morphological and molecular evidence supports recognizing both species. For years, botanists have wrestled with the true relationship of *Pelagodoxa* with other palms.

Currently *P. henryana* is assessed as Critically Endangered but it may be extinct in the wild and

is known only from Nuku Hiva island and wherever it is cultivated. The second species, *P. mesocarpa* is known only from Melanesia (Solomon Islands and Vanuatu), also as a cultivated tree. The palm's endosperm (inner nut) can be scraped out with a spoon and eaten like a young coconut which suggests it may have been grown as a ceremonial or famine food.

Dr. David Lorence, NTBG's Senior Research Biologist, and co-author of the recently published *Flora of the Marquesas*, suggests that actual wild *Pelagodoxa* populations may have once been more abundant in the lowlands but were lost as humans transformed habitat into cultivated land.

Steve Perlman, who collected the first *Pelagodoxa* seeds growing at NTBG, says that the Garden's collection is significant because there are only around a dozen trees left in the Marquesas. Having a conservation collection helps ensure the species doesn't go extinct and by having seeds from as many different individuals as possible, more genetic diversity is preserved, increasing the likelihood of survival.

Read more about *Pelagodoxa* palms in the recently published **Flora of the Marquesas Islands, Volumes 1 and 2** by David H. Lorence and Warren L. Wagner, available at Amazon.com.



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INTERNATIONAL YEAR OF
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DR. DIANE RAGONE AND DR. GAUGAU TAVANA INTERVIEWING SAIPIPI, A
SAMOAN CHIEF ON THE ISLAND OF SAVAI'I. PHOTO BY © JIM WISEMAN