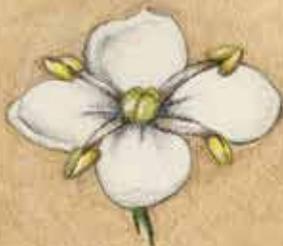
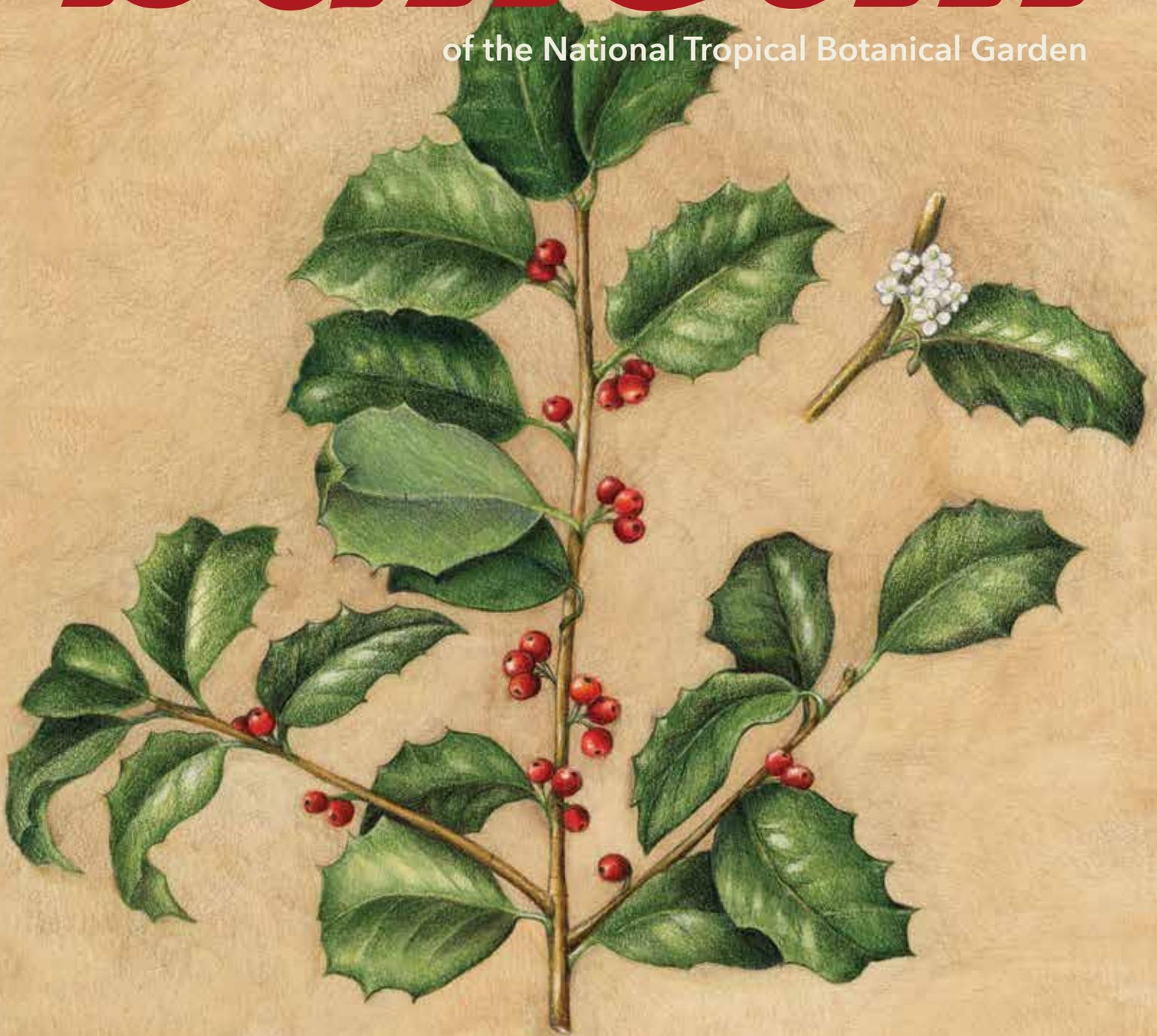


the bulletin

of the National Tropical Botanical Garden



Wendy Hollender

*From all of us at NTBG,
here's wishing you and your family the very best
holiday season and a happy new year.*



BLACK PINE (*PINUS NIGRA*) HALF-CASCADING BONSAI
ILLUSTRATION BY ASUKA HISHIKI

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ON THE COVER

The green, red, and white in this American holly (*Ilex opaca*) illustration captures the spirit of the season. This issue of The Bulletin features works by members of NTBG's Florilegium Society including botanical artist and instructor Wendy Hollender (cover image).

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

Bombarded with news of climate catastrophe, increasing habitat loss, species extinction, and unmitigated waste and pollution, it would be easy to succumb to hopelessness. But despair is not a solution and it's important to remind ourselves of what we are doing and what we can continue to do to save our planet.

At the dawn of the 2020s, I believe there is a greater concern for the environmental challenges we face than at any other time. We are seeing a groundswell of activism with an urgency reminiscent of the 1960s. As someone who remembers that time, I am heartened to see today's global youth leading the charge and demanding action.

On September 20th the world witnessed a global climate strike with more than 4 million people, many of them young people, pouring into the streets. Infused with energy, this movement can channel its power into creating the political pressure needed to influence policy makers and politicians.

That climate strike preceded the United Nations Climate Action Summit 2019 which brought together global stakeholders to develop ambitious solutions in six areas: a global transition to renewable energy; sustainable and resilient infrastructures and cities; sustainable agriculture and management of forests and oceans; resilience and adaptation to climate impacts; and alignment of public and private finance with a net zero economy.

Communities are thinking globally and working locally to reduce the use of plastics, perpetuate renewable energy, conserve biodiversity, and save endangered species. Here, at National Tropical Botanical Garden, we have embarked on new organization-wide initiatives to also be a part of the solution.

In 2019, NTBG has removed all plastic water bottles from our inventory and installed drinking fountain/water bottle fill stations throughout our South Shore Gardens. We are currently working on a fundraising strategy to create renewable energy sources throughout our gardens with the goal of creating net-zero energy use, beginning with our headquarters campus.

Our scientists and conservation teams work tirelessly to conserve biodiversity in native habitats by removing invasive species and replacing them with native plants. Our seed bank is collecting, storing, and evaluating seeds from threatened and endangered species to determine how best to keep the seeds safe for future propagation. We are also effectively using the latest technology (mapping, drones) to locate remote populations of endangered species. Earlier this year, our staff rediscovered a Kaua'i endemic plant (*Hibiscadelphus woodii*) that was thought to be extinct in the wild. Other more experimental and innovative uses of technology to save plants are ongoing.

While looking to the future, NTBG embraces the past with the practice of biocultural conservation, which restores health and function to the social-ecological system that had been sustainably managed by Native Hawaiians for centuries.

NTBG continues to learn from and work to protect Hawai'i's traditional ahupua'a (ridge to reef) system which embodies the philosophy and practice of maintaining biodiversity, ensuring forest health, protecting stream integrity, creating fertile agricultural fields, and promoting an abundant near-shore fishery — all of which support human life.

So if you find yourself feeling deflated by dire news, I invited you to take a closer look at what positive steps are being taken, and to acknowledge the importance of your own role in supporting NTBG as we strive to be part of the solution.



Janet Mayfield
Chief Executive Officer and Director



MARIAN CHAU COLLECTING SEEDS FROM
METROSIDEROS POLYMORPHA ON O'AHU.
PHOTO BY TIM KROESSIG

keep cool, stay dry, and you may live long

Major seed
storage
findings
published

BY DUSTIN WOLKIS, SEED BANK AND LABORATORY MANAGER AND
MARIAN CHAU, KALEHUA SEED CONSERVATION CONSULTING

In the summer of 1989 NTBG's future Breadfruit Institute Director Dr. Diane Ragone collected seeds from the critically endangered papala (*Charpentiera densiflora*), at Kahanu Garden on Maui, marking this as the oldest known collection in Hawai'i.

At that time, the Kew Millennium Seed Bank was still seven years from establishment, and the Svalbard Global Seed Vault wouldn't be constructed until 2008, the same year NTBG's Juliet Rice Wichman Botanical Research Center and future site of the NTBG Seed Bank and Laboratory was completed. NTBG has banked seeds every year since, and conserving these early collections for future use showed incredible forethought by NTBG staff.

Seed banking, especially at botanical institutions, would not hit the mainstream for at least another decade. But what would the shelf life of these collections be, and at what intervals should they be re-collected? The term "seed storage behavior" describes the physiological response to storage methods. If seeds tolerate desiccation and freezing, they are considered to have "orthodox behavior."

Until the early 2000s, it was assumed that because of Hawai'i's tropical location, the conventional storage methods of desiccating and freezing seeds would prove lethal to the majority of the Hawaiian flora, and therefore seeds from most species were not orthodox and could not be banked.



FREEZE SENSITIVE SEEDS OF ENDANGERED, ENDEMIC HAWAIIAN SPECIES IN THE LOBELIA FAMILY; CLOCKWISE FROM TOP LEFT: BRIGHAMIA ROCKII, CLERMONTIA LINDSEYANA, DELISSEA KAUIENSIS, AND LOBELIA OAHUENSIS. PHOTOS BY MARIAN CHAU

Fortunately, in 1995 Alvin Yoshinaga, then Seed Conservation Laboratory Manager at the Harold L. Lyon Arboretum at the University of Hawai‘i at Mānoa, had the tremendous foresight to initiate real time seed longevity experiments that would eventually transform the way we view seed storage behavior in Hawai‘i.

The experimental design was simple, but would take great fortitude to carry out. Yoshinaga’s experiment determined initial viability, then preserved the same seed collection in different ways (varying temperature and relative humidity), and continuously tested seeds stored at those different environmental conditions over the life the collection. These methods were eventually adopted by seed labs at the U.S. Army Natural Resources Program on O‘ahu and at NTBG.

It is easy to see how these experiments would transcend the duration of staff employment and even lifetimes. Even so, some patterns began to emerge, including how some species seemed to exhibit the curious seed storage behavior of tolerating desiccation (like that of an orthodox species) yet with viability declining faster at subfreezing temperatures (i.e. -18°C) compared to refrigeration temperatures (i.e. $+5^{\circ}\text{C}$).

These differences often take several years to detect, and are described by the seed storage behavior category “freeze sensitive.” It became clear that the time had come to make sense of these data and help inform seed conservation in Hawai‘i and globally.

With efforts led by Yoshinaga’s successor Dr. Marian Chau (currently owner of Kalehua Seed Conservation

Consulting and Hawai‘i Seed Bank Partnership Coordinator for Laukahi Plant Conservation Network) and collaborators from around the state of Hawai‘i including NTBG and others, results from these experiments were published open access in September in the American Journal of Botany².

The study utilizes over 20 years of real-time germination data pooled from the partner seed labs, including tests for freeze sensitivity and re-collection intervals for 197 and 295 native Hawaiian plant species, respectively. We found that species in Campanulaceae (lobelia, bellflower), Cyperaceae (sedge), Rubiaceae (coffee), and Urticaceae (nettle) families, and other genera exhibit freeze sensitive storage behavior.

We also presented a new metric and a simple protocol to determine freeze sensitivity, which can often take two to five years to detect. Interestingly, Hawai‘i has a greater proportion of its flora exhibiting freeze sensitive seed storage behavior than any regional flora assessed. Longevity varied from less than one to twenty plus years.

To give managers an idea of how long each species’ seeds might last in storage, we established a threshold of 70 percent of the maximum germination for each collection. After seeds drop below 70 percent, their viability often continues to decline quickly. The number

of years it takes seeds to reach that threshold is called the re-collection interval, which is the recommended period when managers should consider withdrawing seeds, before they lose significant viability.

At the time of the most recent test, 195 species had not yet reached their re-collection interval. Only 45 species had a re-collection interval of less than 5 years. It is of note that by their nature these experiments are ongoing, and thus new results are continuously being generated.

These results provide seed bank, land, and natural resource managers with critical information on ex situ (off site) plant conservation in Hawai‘i, and also offer an excellent starting point for future research. With this study being the largest to test real time seed longevity of native species, one of the only studies to test storage behavior in a large proportion of a tropical flora, and the first to find a large proportion of species to have freeze sensitive seeds, the Hawaiian flora can serve as a model for other tropical, subtropical, and/or island ecosystems looking to use seed banking as a means of plant conservation.

Read the full article open access at <https://doi.org/10.1002/ajb2.1351> or search for “Seed freeze sensitivity and ex situ longevity of 295 species in the native Hawaiian flora.” 🌿

¹ Timothy Chambers and Roy Kam (US Army Natural Resources Program on O‘ahu); Lauren Weisenberger (US Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office); Matthew Keir (State of Hawai‘i Department of Land and Natural Resources – Division of Forestry and Wildlife); Timothy I. Kroessig and Alvin Y. Yoshinaga (Lyon Arboretum, University of Hawai‘i at Mānoa); and Dustin Wolkis (NTBG Seed Bank and Laboratory Manager)

² Chau MM, Chambers T, Weisenberger L, Keir M, Kroessig TI, Wolkis D, Kam R, Yoshinaga AY (2019) Seed freeze sensitivity and ex situ longevity of 295 species in the native Hawaiian flora. American Journal of Botany 106(9):1–23. doi:10.1002/ajb2.1351.



DUSTIN WOLKIS IN THE FIELD. PHOTO BY RUTH BONE

IDENTIFYING A NEW SPECIES OF PERROTTETIA

Splitting Hairs

(even when there are none)

BY DR. DAVID H. LORENCE, SENIOR RESEARCH BOTANIST

As a botanist specializing in taxonomy, the classification of and distinction between closely related species is something I think about every day. The garden-variety plant lovers, however, may ask themselves how scientists identify new species or know when something is new to science?

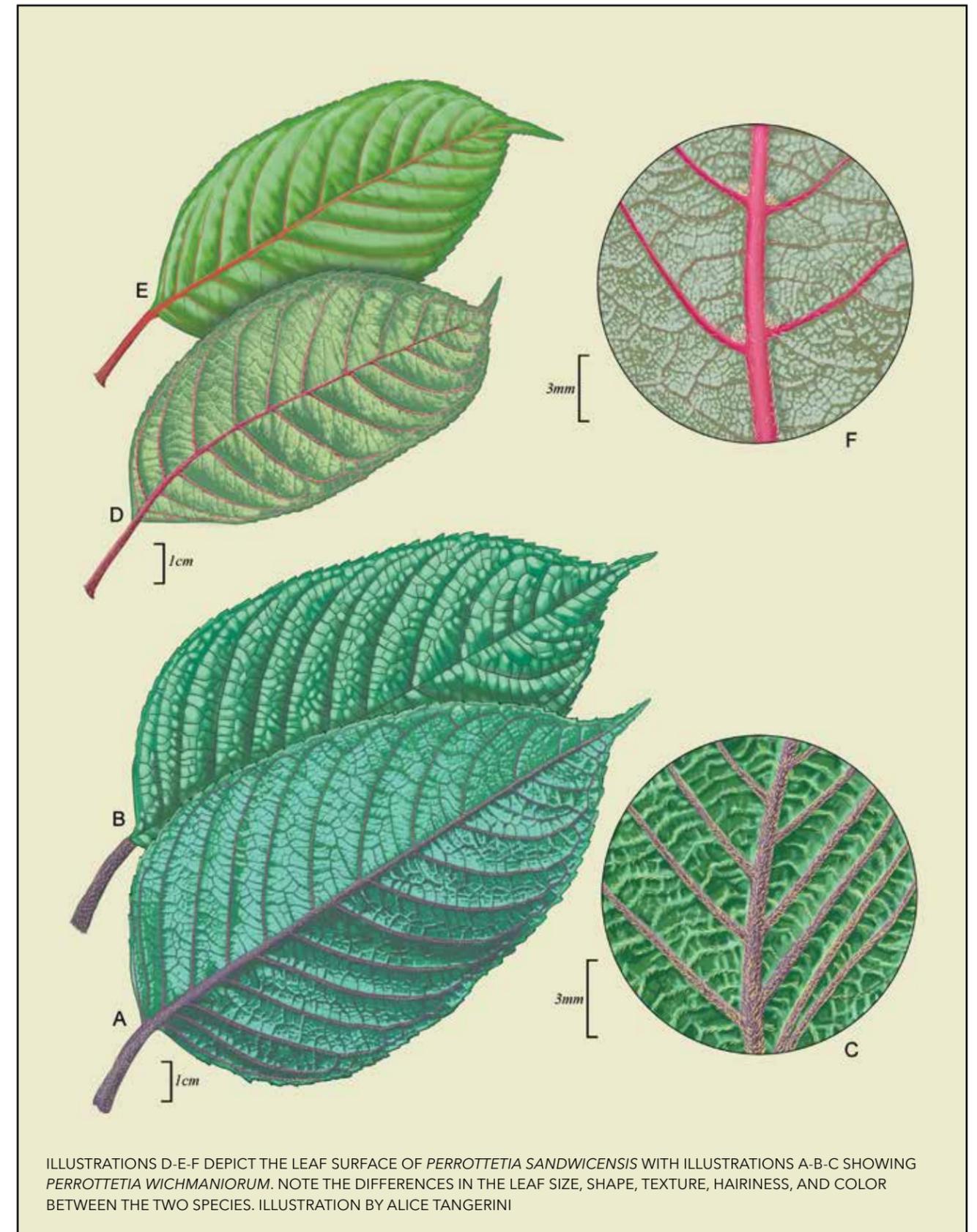
The differences separating biological species are, at times, quite subtle – even cryptic. For example, a plant that proves to be a new species may not stand out to scientists at first, and it may be necessary to look more closely for distinguishing characteristics, differences in morphology, or even genetic makeup.

Such was the case for a new species recently described and named by NTBG McBryde Chair Warren Wagner and me. This particular plant is in the genus *Perrottetia* which is a member of the small tropical family Diplodontaceae.

Perrottetia is a genus of 16–17 species of shrubs or small trees distributed from China, Malesia (Malaysia–Indonesia–Philippines), Australia, and Hawai‘i in the Pacific to Central and South America, with a center of diversity in Colombia.

Previously only a single Hawaiian species, *Perrottetia sandwicensis*, was recognized by botanists. Also known by its Hawaiian name olomea, *P. sandwicensis* occurs in mesic and wet forests on all the high Hawaiian Islands except Ni‘ihau and Kaho‘olawe. Although it’s not a rare plant, it has no known uses and field botanists (myself included) generally do not pay much attention to it.

I might not have ever given olomea more than a passing thought but that changed when, during the course of conducting field work on Kaua‘i, NTBG Herbarium Curator Tim Flynn pointed out a rather unusual form of olomea he found growing in the wet windward slopes and stream gulches along the upper rim of the Kalalau Valley.



ILLUSTRATIONS D-E-F DEPICT THE LEAF SURFACE OF *PERROTTETIA SANDWICENSIS* WITH ILLUSTRATIONS A-B-C SHOWING *PERROTTETIA WICHMANIORUM*. NOTE THE DIFFERENCES IN THE LEAF SIZE, SHAPE, TEXTURE, HAIRINESS, AND COLOR BETWEEN THE TWO SPECIES. ILLUSTRATION BY ALICE TANGERINI

There, in what is recognized as the most biodiverse part of the Hawaiian archipelago, this dioecious (having separate male and female plants) species was hiding in plain view. Further field exploration by Tim, Warren, and me revealed additional small populations of these plants in the region. They sometimes grow alongside the common *olomea* and may even hybridize with it based on herbarium specimens that we collected for study.

petals. Because the flowers are so small, only about 1–2 mm (less than 1/8 inch) across, it is necessary to examine specimens under a good dissecting microscope, which is another reason why the new species escaped detection for so long. Most noticeably, the new species differs in the color of its leaves which are smooth and dark green except for the petioles and veins which are usually purple or maroon-tinged when fresh, whereas the leaves of *P. sandwicensis* are shiny, dark green except for the pink, red, or reddish orange veins and petioles.

When naming and describing a new species of plant, it is customary to publish a diagnostic illustration or photo for reference. Recognizing these plants represented a new, as yet unnamed species, I requested visiting botanical illustrator Ann Farrer of Royal Botanic Gardens, Kew prepare a diagnostic pen-and-ink drawing several years ago. In 2018, Alice Tangerini, Staff Illustrator at the Smithsonian Institution Department of Botany, drew a beautiful color illustration of the leaves of both species.

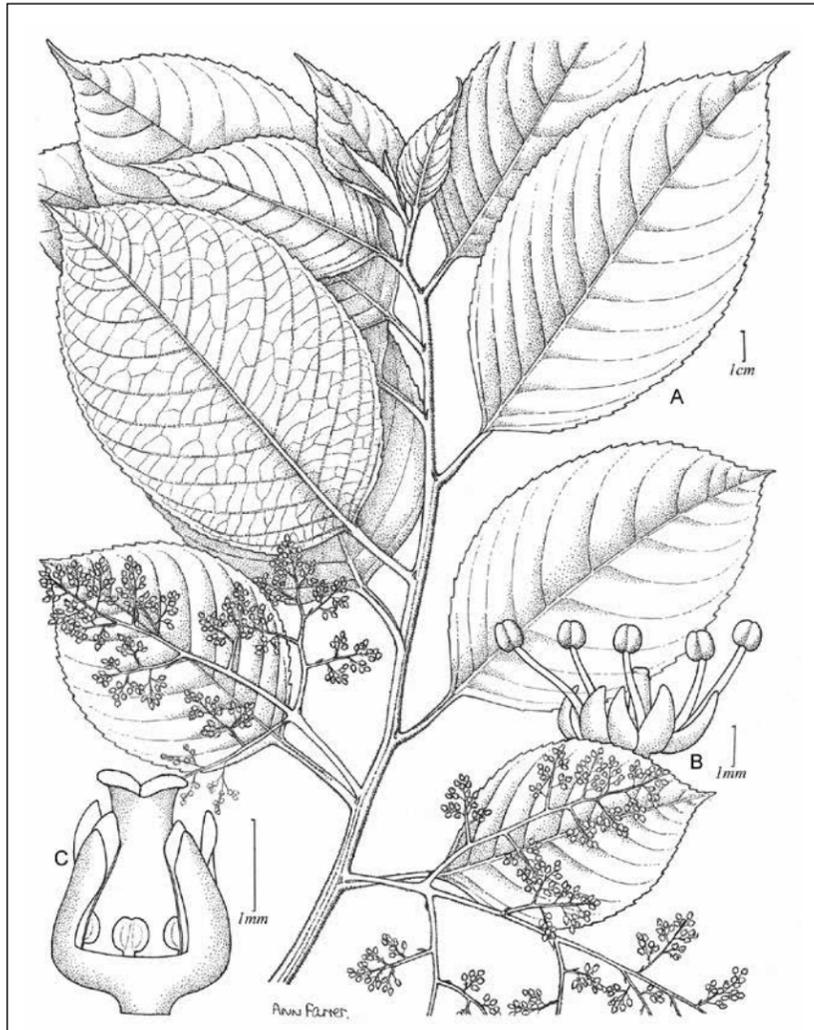
We also prepared a botanical description of the new species, a similar description of *P. sandwicensis* for comparison, a key (identification tool) to separate the two, distribution map (thanks to NTBG Research Biologist Ken Wood), list of specimens studied, and discussion of how the two species differ. Warren and I co-authored the paper and submitted it to the online journal *Phytokeys* where it was published in January 2019.

Finally, Warren and I named the new species *Perrottetia wichmaniorum*, meaning “of the Wichmans” in Latin, to honor Charles R. “Chipper” Wichman, Jr., NTBG’s Director and CEO (2005–2018) and current President, and his wife Hau’oli Wichman, who has served alongside Chipper throughout his directorship. The species recognizes the Wichmans for their service on behalf of the Garden and especially for their efforts to conserve the Hawaiian Flora.

The new species was evaluated using the International Union for Conservation of Nature (IUCN) Red List of Threatened Species criteria for endangerment under which *Perrottetia wichmaniorum* is categorized as Endangered (EN). That designation is recommended for taxa facing a very high risk of extinction in the wild due primarily to competition from invasive weeds, disturbance by goats and pigs, and a decline in the extent and quality of its habitat. In the case of *P. wichmaniorum*, it is known to occur only in a 10 sq.

km area of Kaua’i with an estimated population size of approximately 7,200 individuals.

By identifying species new to science, we can better monitor what survives where, how it is similar or different to closely related species, and how the conservation of our planet’s remarkable, irreplaceable biodiversity contributes to the well-being of other living creatures. 🌿



PEN AND INK DRAWING OF *PERROTTETIA WICHMANIORUM* BY ANN FARRER

Closer examination revealed the suspected new species differed from typical *P. sandwicensis* in a number of features such as thicker, hairier and rugose (rough textured) leaves with a smaller length to width ratio, larger inflorescences branching up to four times, moderately to densely short-hairy inflorescence branches, and flowers with glabrous (smooth, hairless)

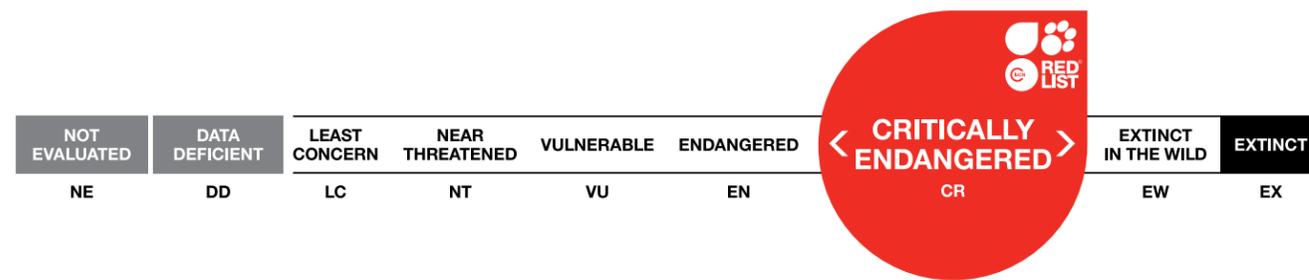


PERROTTETIA PHOTO BY DAVE LORENCE

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 1,200 native plant taxa in Hawai'i. To date, over 500 (approximately 40 percent) have been assessed, reviewed, and published on the Red List. Among these, 266 have been assessed as Critically Endangered, 98 as Endangered, 60 as Vulnerable, and 51 are listed as Extinct or Extinct in the Wild, adding to the more than 20,000 plant taxa published on the Red List worldwide.



Species name: *Delissea rhytidosperma* (Campanulaceae)

CONSERVATION STATUS: CRITICALLY ENDANGERED (CR) *POSSIBLY EXTINCT IN THE WILD

Delissea rhytidosperma is a Kaua'i endemic shrub that, although assessed as Critically Endangered (Possibly Extinct in the Wild) in 2015, is now believed to be extinct. It was once found in mesic forests dominated by *Metrosideros polymorpha*. Threats that contributed to the decline of *D. rhytidosperma* include direct competition by non-native plants, predation by pigs, goats, deer, rats, and slugs, and the decline of native pollinators and seed dispersers.

In recent decades botanists have monitored populations in the Hanakāpī'ai, Hā'upu, and Limahuli Valleys. The National Tropical Botanical Garden has successfully brought this species into cultivation and hundreds of outplanted individuals are managed in the Limahuli Garden and Lower Limahuli Preserve. In addition, among 42 accessions, over 100,000 seeds are stored in our Seed Bank and Laboratory and over 300 plants are growing in our nursery. — *Seana Walsh*

PHOTO BY UMA MAGENDRA



PHOTO BY HOLLY WHALAN



the green thumb

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Having grown orchids for more than 40 years, I've learned that one of the most important aspects to good orchid culture is matching your plants to your growing conditions. For those growing orchids indoors, lower light and dry air are formidable foes. In the subtropics, intense sunlight and occasional cold snaps, especially in winter, are both common and unwelcome.

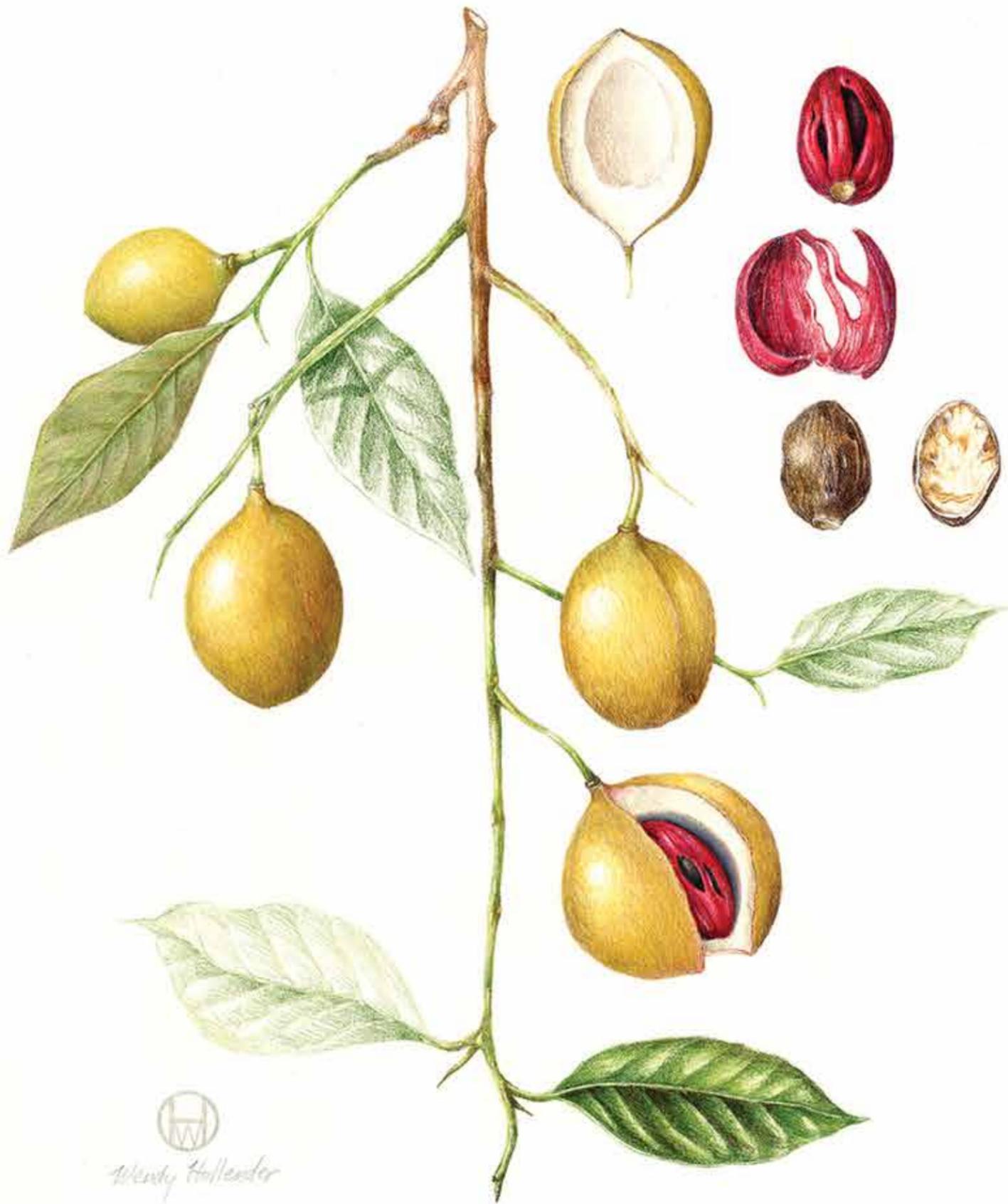
There are myriad 'hacks' to successfully growing orchids, but I've found that using hanging baskets is one of the most productive. The stalwart genera of retail orchids — Cattleya, Phalaenopsis, and Dendrobium — can grow quite well in hanging baskets where their roots receive the aeration they need.

Knowing the light level your orchids require is essential. The usual rule is to provide as much light as the plants can tolerate without yellowing. Even Phalaenopsis and Paphiopedilum orchids can grow well with early morning sunlight or bright light all day. Combined with a well-drained orchid medium suited for the orchid group, you'll be on your way to happy orchids.

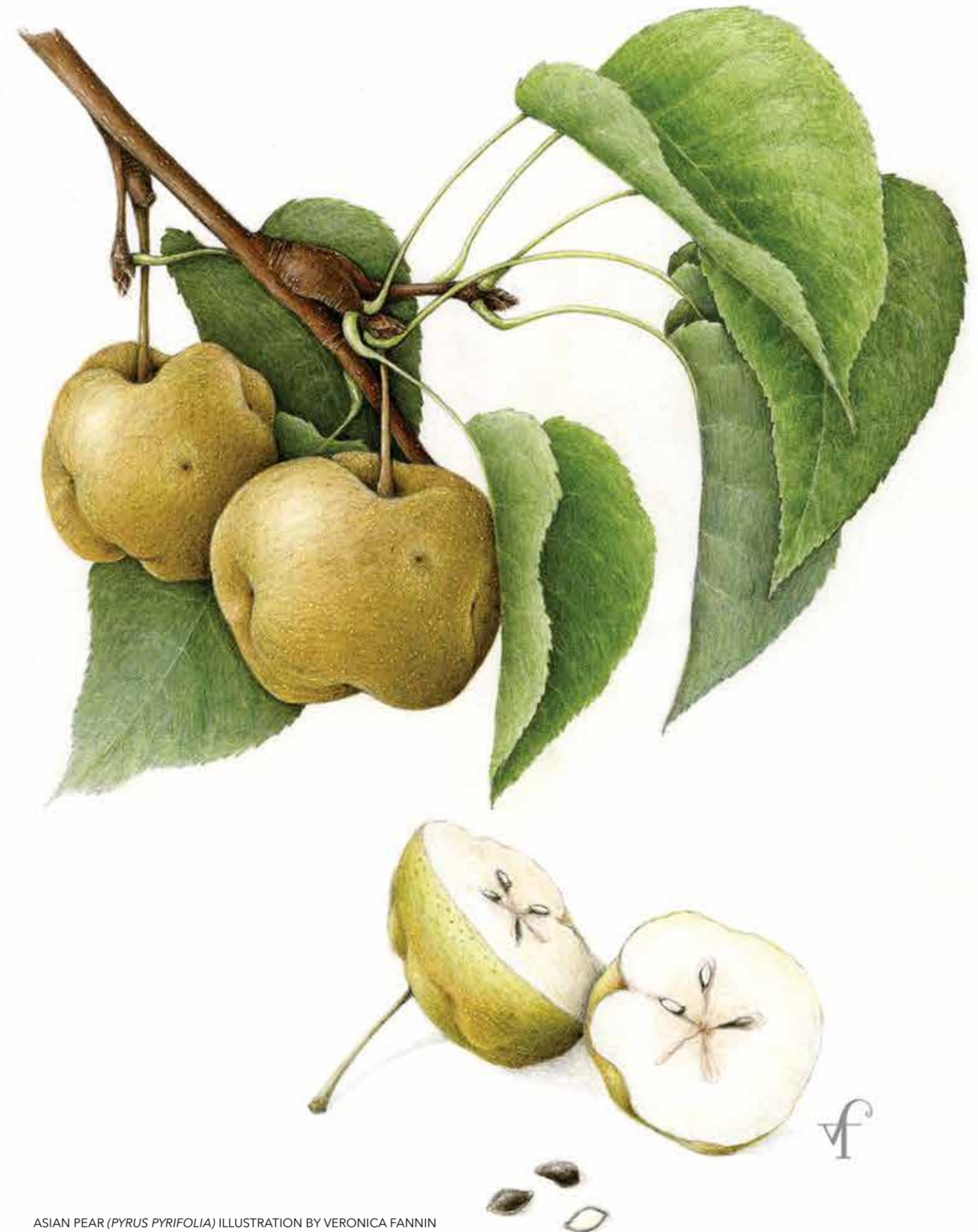
Routine thorough watering (ten minutes or more per session) is important to wet the media and roots, with a drying period between each watering. This will vary a lot with your specific conditions but is important to most orchid genera.

Finally, use a fertilizer specific to orchids, often available in a liquid form, that is gentle enough for orchids. Choosing a balanced formula, such as 20-20-20 will grow the widest array of plants. Fertilizing twice a month works for most orchids. By taking these simple steps, you will enhance your orchid experience. Widely available commercial orchids are wonderful, durable, and productive plants and by choosing wisely, even with minimal attention and care, orchids can bring long lasting color into your garden or indoors even during the darkest winter days.

— *Craig Morell, Director of The Kampong*



NUTMEG (*MYRISTICA FRAGRANS*) ILLUSTRATION BY WENDY HOLLENDER



ASIAN PEAR (*PYRUS PYRIFOLIA*) ILLUSTRATION BY VERONICA FANNIN



PHOTO BY KEN WOOD

FLORA OF THE MARQUESAS PUBLISHED

A published flora is an essential tool used by scientists to better understand the entirety of plant life in a geographic region or country. By early 2020, the first of two volumes of the Flora of the Marquesas will be published. The flora, a collaboration between NTBG, the Smithsonian Institution, and the Délégation à la Recherche de la Polynésie Française, documents the rich biodiversity and high endemism (48 percent), of the Marquesas, representing approximately 320 vascular species, 100 ferns and lycophytes (“fern allies”), and 229 angiosperms.

The Marquesas Islands are an isolated volcanic archipelago of 12 islands and numerous islets in the Polynesia-Micronesia biodiversity hotspot at the epicenter of the global extinction crisis, underscoring the importance of the publication of this flora.

The genesis of the project goes back to 1988 discussions between NTBG’s Senior Research Botanist Dr. David Lorence, Dr. Warren L. Wagner, Research Botanist and Curator at the Smithsonian Institution’s National Museum of Natural History, and Dr. Peter Raven, President Emeritus of the Missouri Botanical Garden.

The long-anticipated publication of the Flora of the Marquesas represents both a major contribution to the scientific knowledge of Pacific tropical plants, as well as a significant milestone for the individual scientists who researched the flora and the institutions they represent.



PHOTO BY JON LETMAN

BEE FRIENDLY AT THE BEACH

In a partnership with the University of Hawai‘i-Hilo’s Pacific Internship Programs for Exploring Science (PIPES), NTBG offered Kaua‘i Community College student Scott Tamayo a nine-week internship at the Garden. Working with Nursery Manager Ashly Trask, Scott focused on creating habitat to attract *Hylaeus kauaiensis*, an endemic Hawaiian yellow-faced bee. Within the Lāwa‘i Kai Special Sub-zone at Lāwa‘i Kai (Bay), Scott and Garden staff reintroduced some 100 endangered coastal native plants like lau‘ehu (*Panicum niuhauense*), ‘ilima (*Sida fallax*), naio (*Myoporum sandwicense*), and pua kala (*Argemone glauca*) in the hopes that they will encourage *Hylaeus* visitation. Under Ashly’s supervision, Scott developed a plant list, propagated the plants, and measured quadrants of potential habit where he spread pieces of coral, lava, wood, and rock, knowing that the bees are inclined to lay larvae in the holes of hard-surfaced material. Probable bee sightings have occurred but the bees are intentionally not trapped owing to their rarity.



PHOTO BY SPENCER KASHIWA

PEAK PERFORMANCE

Launched last August, NTBG is spearheading the Mt. Hā‘upu Native Habitat Management Project on the culturally important, haystack-shaped Kaua‘i peak. Parts of Hā‘upu support up to 85 percent native vegetation including over 110 native taxa near the summit, over two dozen of which are endemic to Kaua‘i, seven threatened and endangered. Collaborating with the U.S. Fish and Wildlife Service and Koke‘e Resource Conservation Program, NTBG staff are working to improve habitat for rare native species like *Schiedea perlmanii*, *Kadua fluviatilis*, and *Polyscias bisattenuata*. After conducting surveys on the 2,297 ft. high peak, invasive plants are being removed, creating better conditions for the plants, birds, and insects (including one of the world’s largest tree crickets) endemic to the mountain. The project continues through December 31, 2020.



PHOTO BY STEPHEN TANUJI

TWILIGHT HIGHLIGHT

Experience the beauty and mystery of the Lawa‘i Valley after dark at Allerton Garden and McBryde Garden (on Kaua‘i’s south shore) on NTBG’s Twilight Tours. Scheduled 2020 Twilight Tours dates follow: January 7, February 6, March 6, April 7, May 4, June 2, July 2 and 31, August 30, September 28, October 29, November 29, and December 27. Twilight Tours offer afford the opportunity to see, smell, and hear the Garden as the sun goes down. Call (808) 742-2623 to reserve your spot.



PHOTO BY PHYLLIS SOMERS

FALL INTERNS MEASURE ROBA BENCHMARKS

This autumn, NTBG’s five fall interns were tasked with measuring the degree to which the Regenerative Organic Breadfruit Agroforestry (ROBA) demonstration in McBryde Garden is achieving agroforestry standards. Those standards, developed by Breadfruit Institute Director Dr. Diane Ragone, Dr. Craig Elevitch, and Niki Mazaroli, target criteria that includes improving soil health, increasing water retention, enhancing biodiversity, sequestering carbon, and other outcomes.

The standards were designed to help small-scale rural farmers validate their own agroforestry practices based on species diversity, crop integration, and the density and number of layers of canopy. Standards assessment involved measuring 10 x 10 foot plots in three sections of the agroforest, identifying and inventorying crops, as well as basic planting, weeding, and harvesting. The eight-week project was designed to be low-tech in order to determine if small farmers could conduct the same assessment with limited means.



PHOTO: KAMPONG ARCHIVES

KAMPONG SHOOT SHEDS LIGHT ON QUINOA

In August, CNN’s Great Big Story film crew visited The Kampong to shoot a micro-documentary on how The Kampong’s first owner, legendary plant explorer David Fairchild, played a key role in introducing the South American edible plant *Chenopodium quinoa* into the United States in the 1920s. While collecting quinoa on an expedition, Fairchild reportedly almost fell off his mule into a canyon in the Andes while searching for the high-protein grain. Quinoa, native to the Lake Titicaca region, is among the many thousands of edible, ornamental, and useful crops Fairchild introduced to the United States. Others include varieties of avocados, mangos, olives, citrus, dates, Egyptian cotton, kale, cashews, hops, Japanese cherry blossoms, and many more. The Great Big Story quinoa micro-documentary can be found at: <https://www.greatbig.com>

INTERVIEW:

Dr. Nina Rønsted

NTBG's new Director of Science and Conservation

In August NTBG welcomed Dr. Nina Rønsted as its new Director of Science and Conservation. Dr. Rønsted came to the Garden from the Natural History Museum of Denmark in Copenhagen where she served as Director of Research as well as being responsible for managing a centuries-old two million specimen herbarium.

As the Director of Research at one of Europe's leading scientific institutions and a part of one of Scandinavia's oldest universities, Dr. Rønsted led efforts to preserve and care for collections and maximize their scientific and educational value. One of her greatest challenges, she says, was to balance the museum's ambition to be a leader in frontier research while maintaining core museum operations and overseeing educational programs for Masters and Ph.D. students. She brings these experiences to NTBG.

Shortly after Dr. Rønsted assumed her new position at NTBG, she sat for an interview with the editor of the Bulletin. That interview, edited for length, follows below.

Jon Letman: For most NTBG members and Bulletin readers, this interview will be their first introduction to you. In a few words, who are you?

I'm Nina Rønsted. I come from a position as a professor and curator of botanical collections at the Natural History Museum of Denmark, which is part of the University of Copenhagen. I come all this way because I think NTBG has a really important mission to do and is situated in the absolutely best place to do it.

How did you first hear of NTBG?

I first learned about NTBG in the botanical garden that is part of the Natural History Museum of Denmark. We have a conservation greenhouse where we showcase some of the world's rare and endangered plants. One of the pretty conspicuous ones is the small collection of *Brighamia insignis* (a member of Campanulaceae endemic to Kaua'i). Our gardener was hand-pollinating and telling about how this was a species that scientists in Hawai'i had been nurturing for many years. Reading about this, I learned about NTBG's efforts to save some of the world's most endangered plants.



PHOTO BY JON LETMAN



PHOTO BY JON LETMAN

After interviewing for this position and speaking with NTBG staff, what impressions did you take home?

The impression I got was, “Wow, there’s a lot more going on and it’s much bigger than I thought. Why is this not much more widely known?” There’s so much potential here and the staff is really knowledgeable and dedicated.

I could also see that I could bring something to the table, trying to think even bigger, align the many great projects to achieve a bigger picture, and integrate the different capacities across the organization, as well as attract more scientists here.

How are you learning about the Flora of Hawai’i — through reading? Field work?

The first thing is talk to people to figure out what and why they are working on specific things. What’s important? What’s the thinking behind each project?

I also plan to spend time with people that work in the garden, in the field, seeing how things are happening and trying to learn from the experts here.

But it’s not my primary job to become the next expert on the flora of Hawai’i. It’s my job to bring together groups of experts to work together to achieve our mission. I am here to build something bigger and I can only do that with the help of the people who already have all of this knowledge. And it’s very important that we can continue educating a new generation with that knowledge as well.

In terms of science and conservation, where do your primary interests lie?

My interests lie in how we can use science to make the right decisions. We all want to take care of the nature around us. We want to find out how we can best sustainably use our resources, but the problem is how? And I think science is very important here. This is where it becomes very exciting to be based in Hawai’i, because we are in an island system that has been very isolated... resulting in almost 90 percent of the native plants here being endemic, growing nowhere else.

We’re talking about a very specialized flora... This is why we strive to conserve our flora with more than 200 plant species that are already considered critically endangered and down to less than 50 individuals left in the wild. But there are endangered plants elsewhere as well. A lot of what we learn here for example, what’s the limit of how small a population you can have and still keep it genetically healthy, some of those results from the frontier of this area of extinction can be really useful for other places across the world.

I see NTBG has the possibility to show that Hawai’i is really a model for the rest of the world, for learning about how we can best do conservation, how we can save species, and maintain biodiversity. It’s not just about the flora here, it’s also the way we are thinking about the flora and how people and nature interact.

It sounds like you’ve been in Hawai’i for more than just one month.

I am struck by how much exciting work, opportunity, and knowledge there is here, but also how much more we can communicate. We really have an important task and we need the world to see that we have something to contribute. One of the things I am hoping to do beyond our research program is to help communicate even more of what we’re doing here.

“The adventures are not over. We don’t know everything — the books are not full. There’s so much more out there to discover.”

As a scientist, are you more comfortable in the lab, in an academic setting, or out in the field working with plants directly?

The possibility of getting the right people together to do great things is what I enjoy most. This is very much about identifying opportunities and seeing them through. One of the challenges in this position is that NTBG is an organization with five gardens and five preserves spread over several islands and all the way to Florida.

This gives us a great opportunity to work on the similarities and bigger pictures of tropical flora, and to do this NTBG has established the International Center for Tropical Botany together with the Florida International University based at The Kampong in Florida.

Are tropical island systems something you have been researching for many years or is this new for you?

I’ve been working on tropical botany for many years and am very interested in understanding how diversity works. This extends to why some lineages are successful and others not. I’ve also been working on medicinal plants and trying to understand where they are, how do we find them, and what determines what becomes a good medicinal plant. For example, why is one medicinal plant collected in Bolivia very high in content of the active compounds, whereas the same species in Peru has a much lower content and thus lesser value.

More than a quarter of the known over-the-counter drugs we have today actually come from plants and even more have been modified or inspired from natural products. So there are big resources but again, how do we find which plants are potentially useful for new medicines and why is it so important where we collect them?

For example, we have been looking at the history of the Cinchona bark [a South American tree in the Rubiaceae (coffee family)]. That was the origin of quinine that was basically the only treatment of malaria for about 400 years. We found that there’s a lot of variation between species and within species growing in different valleys or on different mountains along the Andes mountain range.

So you can say that sort of research looking for patterns and explanations to enable predictions and decisions is what I am bringing into an island setting. There are similar sorts of biological situations between mountains and islands. There is a term ‘sky island’ which refers to how plants living on different mountains can be isolated in the same way as plants on islands. They are adapted to living in the highlands so they cannot easily get down into the lower valleys and cross to reach other mountains. Consequently, there’s a lot of unique diversity in the upper parts of mountains that can’t cross the valleys — sky islands.

Research is very much about increasing our knowledge, but also developing our methods of approaching questions and trying to understand some general patterns and mechanisms, as well as communicating what we have learned and why it is exciting.

As a child, did you spend a lot of time outdoors hiking or in nature?

No, I am mostly one of those suburban kids who developed my interest along the way. I remember in high school being told about Darwin’s story of the Galapagos finches and thinking “Whoa!” Those were amazing adventures that scientists were doing but it didn’t occur to me then that it was something you could also do. I think that’s an important message to convey

to young people today — that the adventures are not over. We don't know everything — the books are not full. There's so much more out there to discover.

Approaching the same problems with new eyes or new tools allows us to create synergy. For example one of the new research projects I am interested in setting up relates to Hawaiian mosses. Mosses are an under-examined group of plants but they are being used as bio-indicators for airborne pollutants because they get all their resources from the air. They accumulate pollutants and they've been used to understand something about global patterns of airborne pollutants and can even tell what type of source the pollutant is coming from.

Doing a survey of pollutants in the mosses here will allow us to train taxonomists and build a new generation of knowledge while looking at a problem that's very relevant globally in a pristine environment that's very far from where most of the pollution is actually happening.

You've described yourself as an "enthusiastic science communicator." Can you expand on that?

I think it is very important that all the knowledge we have — the things that we discover — get out because they're not of much use if they're not communicated. This of course includes traditional scientific publications but it's also communicating to authorities, politicians, the public — to everybody who needs that knowledge to help our biodiversity better.

There's this term 'plant blindness.' It's very easy for everybody to imagine a panda or a dolphin, but it's not so easy for people to imagine or have the same feelings about a plant. We need to be able to tell the stories about how fantastic plants are so they're not just seen as a green background for animals on a safari or in a nature park. People are starting to understand that all is not good just because we have a green forest. It actually is the composition of the flora that's so very important. We need to be able to see the unique plants and understand their roles. We need to get those stories out to have people appreciate the importance of biodiversity.

Would you like to add any final thoughts?

If there's a good idea, I think we should make it happen. But I am also very people and communication-oriented. It's very important that we work together with communication, education, and the collections and

the way we think is integrated from field work to the scientific collections and back into restoration projects as well. It's very important for me to collaborate across the entire organization and beyond.

The only other thing I would like to say is that we need to work on several fronts here. There's been a lot of focus on our work safeguarding rare plants that are close to extinction and trying to re-establish them and NTBG has been excelling in this work. But it's just as important that we are looking at the whole ecosystem. One example is the hala (*Pandanus*) forest at Kahanu Garden that we are working towards restoring and protecting because that will not just conserve one species but everything that lives inside that forest and the near coastal waters.

We need to think at that scale and to think about the connection between people and plants because we cannot work with nature in isolation from the communities and the people who are living off it and in it. 🐟



supporting roots

Q & A with Dave Hubbard



Born and raised on the island of Kaua'i, Dave Hubbard is a professional bodyboarder. Along with his brother Jeff, both multiple world champion title holders, the Hubbard brothers started their own company specializing in bodyboards and accessories called Hubbards.

For Dave, bodyboarding is serious business and he's often called away to compete in places like Tahiti, Portugal, Brazil, and Japan. But whenever he's home on Kaua'i, Dave is a committed volunteer and supporter of NTBG's Breadfruit Institute. When he's not weighing buckets overflowing with freshly-harvested crop, Dave can be found, picker in hand, scanning the branches of the breadfruit trees in the Regenerative Organic Breadfruit Agroforestry demonstration, searching for ripe fruit. In 2017, NTBG recognized Dave as 'Volunteer of the Year.'

Growing up on Kaua'i, did you always have an interest in plants?

I remember watering plants in the yard as a chore when I was young, but I don't recall being fond of it. But there were definitely certain plants like heliconia that caught my eye and piqued my interest.

How long have you been volunteering with the Breadfruit Institute? How were you introduced to the Garden?

I responded to an open-call for volunteers for testing out some equipment used for making breadfruit flour around 2013. It was very fulfilling and I felt that it opened up a new chapter in my life.

Did you eat breadfruit when you were growing up or did someone in your family grow it?

No. I'd heard of it, but it remained very obscure. It wasn't until my first trip to Tahiti that I was properly introduced to breadfruit as an abundant food source. Almost instantly I became enthralled with everything about it.

As a volunteer at NTBG's Breadfruit Institute, what kind of activities do you do?

I monitor the trees and collect data, assist with tree care, harvest fruit, and take crops donated by NTBG to our local food bank. I also occasionally do educational outreach and work events. Typically, I respond affirmatively to most requests for help.

As you travel around the world, do you ever have the chance to talk with people about NTBG or breadfruit? If so, what do you tell them?

Yes, I do. It's hard not to talk about it, as it's one of my passions. Mostly I share how amazing breadfruit is in so many different ways and also talk about the work of the Breadfruit Institute.

How have you and your brother been able to incorporate the success of your bodyboard business into supporting NTBG?

Recently we established a product collaboration with our company Hubbards and the Breadfruit Institute. We developed a new swim-fin using an eco-friendly packaging concept and pledged to donate two percent of the profits to the Breadfruit Institute's world hunger initiative. It has been really exciting for me to bring all these things I love together for something so positive.

There are so many philanthropic environmental organizations that would welcome the energy, enthusiasm, and support of someone like you. What is it about NTBG that has kept you engaged as a supporter over the years?

NTBG's mission, specifically the mission of the Breadfruit Institute, is just so close to my passion for sharing breadfruit. I've also been welcomed in by the Garden and really feel at home when I come to volunteer. It's kind of become a little piece of who I am.

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**

NEW & REJOINING FELLOWS MAY-AUG 2019

Nilesh Bubna
Lucille B. & Michael Ceurvorst
Juliet Evans
Walt McCoy and Janet Mayfield
Reid Parker
Scott Valor and Heather George

NEW & REJOINING MEMBERS MAY-AUG 2019

Miss Farah Ansari
Deanna Arnold-Frady and Charles Frady
Kathryn and Ted Bachman
Bobbi Robinson and Brian Basset
Christine and Randall Battat
Erin and Mike Benaitis
Laura M. Benz
Yuet Berry and Caitlyn Berry
Michele and Roy Bolton
Sofia Borges and Paulino Diaz
Marian and Michael Bowman
Laura Campbell and Harris Mack
Erin Carrington and Warren Sparks
Juliana and James Cherry
Samantha Chow and Adam Wazzan
Monica Cooper and Olivia Cooper
Rita Cordova and Patrick Courtney
Katrina Amato and Chancellor Cota
Melinda and Brian Davis
Susan Dibble and Jeanne DeJoseph
Deborah and John Divine
Karen Funk and John Dilts
Jackie Dooley
Lisa and Justin English
Kaaren L. and Alan Finnieston
Erin Fischer
Amy Fletcher
Judy Franzen and Edward Franzen
Stephanie Frazier

Christine A. and Robert C. French
Gen Fujioka
Sue Nevler and Stephen Gattis
Gwen and Greg Gibbons
Linda and Val Gibson
Cindy and Tom Goff
Sandra and Lawrence Gonsales
Kim and Don Gray
Erikka and Daymon Gray
Amy and Derek Green
Linda and Robert Hacker
Mary A. Hannah and David H. Moore
Laura and Kenneth Hanson
Dawn McCluskey and Darin Harris
Jordana Hart and Kitty Hart
Nevenka and Joseph M. Harverson
Kelly Henslee and Jody O'Fallon
Joyce and Herb Herndon
Cynthia and Ronald Holmberg
Cecilia and Kip Irvine
Teresa and Stephen Jackson
Linda Ramsey and Stanley Jarosz
Gloria Jenness and Steven Harlan-Gran
Karin Jinbo
Steven Harlan-Gran
Madeline and Paul Kay
Johnfar Kerlee
Anat Laytner
Erin Leary
Mark LeDoux and William Albinger
Laura and Michael Locher
John Macy
Leila Magaro
Maryli Marcos
Alix Marduel and Tom Lockard
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Valarie Ross and Paula Siebenmorden
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Michael Sanderson
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*This season, give the greenest gift of all
— AN NTBG MEMBERSHIP!*

Show someone you care, and also help him/her care about saving plants with a one-year membership, starting at \$75. Members receive free and discounted garden tours, special event invitations, a subscription to The Bulletin magazine, and more. For each holiday gift membership purchased by December 31, 2019, NTBG will send the new member a special welcome gift. Go to: <https://ntbg.org/> membership or call (808) 332-7324 x 241.

National Tropical Botanical Garden is a not-for-profit, non-governmental institution. Each membership supports NTBG's mission to enrich life through plant discovery, scientific research, conservation, and education.



wish list

Small investments make a big difference for our programs and projects. If you would like to fund a wish list item, please contact development@ntbg.org or call us at (808) 332-7324 Ext. 212. Mahalo for your support!

FOR GARDENS ON KAUA'I

Bus cleaning tools - \$800
Break room furniture - \$600
Husqvarna leaf blower (3) - \$250 each
AquaFast turbidity meter - \$1,100
Gloves for nursery and garden volunteers - \$100
Windshield for UTV - \$1,000
Reusable cutlery and tableware for volunteer events - \$100

FOR SCIENCE & CONSERVATION AND LIVING COLLECTIONS PROGRAMS

Helicopter trip for conservation work - \$1,200 per trip
Flight for Dir. Of Science and Conservation to ICTB in Florida - \$750
Herbarium mounting paper - \$500
The Hawaiian Palm, Hardcover - \$50

FOR THE KAMPONG IN MIAMI

Cordless leaf blower - \$280
21-foot pole saw for pruning - \$300
24-foot fiberglass extension ladder - \$300
Printer - \$450

FOR KAHANU GARDEN ON MAUI

Garden cookware - \$600
Hand pruners (12) \$45 each

FOR THE BREADFRUIT INSTITUTE

Chef knives (2) - \$150

FOR NTBG'S IT (INFORMATION TECHNOLOGY) DEPT.

Computer monitors - \$200



JIM WISEMAN

Breadfruit Recipe

Breadfruit macadmia nut cake (Courtesy of Marie Friend) 2003 Kahanu Garden Breadfruit Cookoff 1st Place Winner

- 1 cup lehua honey
- 1/2 cup butter
- 3/4 cup breadfruit, cooked and mashed
- 1/2 cup sugar
- 1 tsp vanilla
- 2 cups flour
- 1 tsp baking powder
- 1 tsp baking soda
- 1/2 cup sour cream
- 1/2 cup macadamia nuts, chopped
- 1/2 cup raisins
- 3/4 tbsp cinnamon

Cream butter and honey. Mix in breadfruit, sugar and vanilla. Sift together dry ingredients, including cinnamon. Add dry ingredients to creamy mixture; add sour cream until well blended. Add nuts and raisins.

Pour into buttered or sprayed 8 in. x 8 in. cake pan. Bake at 350F for 1 hour.

Serve cake with coconut sauce.

COCONUT SAUCE

- 1 can coconut milk
- 1/4 cup confectioners' sugar

Whisk ingredients together. In a small saucepot heat mixture, but do not boil.

Find more breadfruit recipes online at: <https://ntbg.org/breadfruit/food/recipes>

MOONLIGHT & MUSIC

SAVE THE DATE

August 29, 2020

Reserve your tickets early by calling (808) 332-7324 Ext. 212

A fundraiser for National Tropical Botanical Garden

Botanical Illustration returns to Kauai!

Join instructors Wendy Hollender and Vern Fannin for up to 3 weeks of drawing plants and flowers sourced from McBryde Garden and Allerton Garden

February 24 to March 12, 2020

Week one: Feb. 24-27
strongly recommended for beginners

Week two: March 2-5

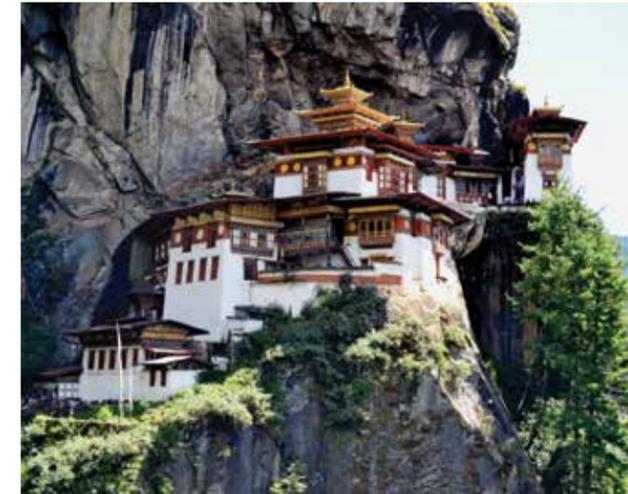
Week three: March 9-12

NTBG members will receive a 10% discount by request. Email info@drawbotanical.com to get your discount code.

visit ntbg.org/education/adult for more information.

fellows travel program

Join us and explore the world! Did you know the National Tropical Botanical Garden offers exclusive opportunities to see some of the world's most amazing plants, places, and botanical hotspots around the globe? Through our Fellows Travel Program, we offer specialized small group travel arranged just for us, hosted by NTBG staff. Please call Heather George, Director of Philanthropy, at (808) 631-3232 or hgeorge@ntbg.org to join our Fellows membership program, for further information, or to reserve your space today!



SPRINGTIME IN BHUTAN: A BOTANICAL AND CULTURAL JOURNEY

Dates of Travel: April 30 - May 13, 2020 in Bhutan. (Anticipate departing the US April 28 or 29 to overnight in Bangkok pre-trip. Return is May 12 or 13 with overnight in Bangkok post-trip)

Group size: 8-14 guests

An exciting mix of botany, birding, hiking, and cultural experiences. Trip highlights will include: Bhutan's native orchids and medicinal plants; towering rhododendron trees; visits to the Black-necked Crane Conservation Center; Taktsan (Tiger's Nest) Monastery; and more! NTBG's Heather George and KarmaQuest Ecotourism staff will accompany group.



A GRAND TOUR OF SCOTLAND

Dates of Travel: June 19-26, 2020 in Scotland
Group size: 16-20 guests

Join NTBG Trustee, Dr. David Rae, for a visit to magical Scotland. Trip highlights will include: The Isle of Skye; flowering pastures of Berneray island, Outer Hebrides; Standing stones of Callanish; Dundonnell House Garden; Scottish Plant Hunters' Garden; Inverewe Garden; visits to castles, churches, distilleries; and more!



GARDENS, AGRICULTURE, AND CULTURE OF CUBA

Dates of Travel: November 14-19, 2020 in Cuba
Group size: 12-16 guests

Join hosts NTBG President Chipper Wichman and Hau'oli Wichman for an intimate visit to Cuba. Trip highlights will include: a walking tour of Old Havana; cultural performances; local restoration projects; an urban organoponic cooperative garden; tours of the butterfly house and snail nursery at Quinta de los Molinos Garden; Cuba's National Botanical Garden; and more!

an eye on plants

SELECT SPECIES IN FOCUS

Cook and Norfolk Island pine (*Araucaria* sp.)

Although not usually associated with the tropics, two classes of gymnosperms — Cycadopsida (cycads, zamias) and Pinopsida — are commonly found in Hawai'i. Pinopsidas include the conifer family Araucariaceae which itself includes two species so widespread that they often go unnoticed.

Araucariaceae claim three genera and 41 species found in Asian-Australian rainforests from New Guinea to northeast Australia, New Zealand, Chile, and the southern Brazil.

Araucaria columnaris (syn. *A. cookii*) or Cook pine and *Araucaria heterophylla* (Norfolk Island pine) are both symmetrical, stately conifers that can reach 200 feet. Reminiscent of northern temperate forest pines, both have a special place in Hawai'i's landscape where they have long been used for windbreaks, landscaping, reforestation, and as a source of timber. During year-end holidays they grace parlors, lodges, and living rooms decorated brightly as Christmas trees.

Cook pines are native to the southern coasts of New Caledonia and the adjacent Isle of Pines. They were once as common as coconut palms, making them a symbol of the island. Norfolk Island pines have a native range limited to the tree's namesake island in the Tasman Sea between Australia, New Caledonia, and New Zealand

where the tree's image is emblazoned on the Norfolk Island flag.

Botanist Joseph Rock wrote that the genus *Araucaria* was named for the Arauco region of central Chile in 1789 by French botanist Antoine Laurent de Jussieu. Norfolk Island pines were brought to England in 1793 and to Hawai'i in the 1850s. The tree has also been introduced to South Africa, the Azores, and around the Mediterranean. For years, Rock noted, young Norfolk Island pines were imported to the U.S. from Ghent, Belgium which specialized in propagation.

According to the botanical literature, "Something called *Araucaria excelsa* was introduced to Hawai'i in 1851; because the name is a synonym of *A. columnaris* but has also been misapplied to *A. heterophylla*, it is unclear which of the two species was actually introduced at that time."

Early 20th century botanical literature describes "endless confusion" in trying to distinguish between Cook pines and Norfolk Island pines, something that is backed up by early reports.

Indeed, even many botanists find identification challenging, especially among young plants. Older trees may be distinguished by comparing the leaves with Norfolk pines which also bear a wider crown.

If you're unable to make that distinction, perhaps this description will help: "*A. excelsa* [Norfolk] is most nearly allied to *A. columnaris* [Cook], from which it differs in its more plumose habit and coarser foliage."

Speculation that the two species have produced hybrids in Hawai'i has been discounted owing to the fact that there is a six month gap between when each discharges its pollen. What some suggest is a hybrid may, in fact, be a Cook pine.

Another hint may be the seed cones. Norfolk pine cones tend to be round like a globe, while Cook pines are elongated and oval.

Joseph Rock wrote: "[*Araucaria cookii*] is similar in habit to *Araucaria excelsa* [Norfolk], but the lower branches tend to fall off.... The old leaves are densely imbricated or overlap as the tiles of a roof, they are short, egg-shaped and not pointed."

If all this leaves you confused or confounded, fret not! No matter what you have — a Cook pine or Norfolk Island pine — both are beautiful, tropical conifers, highly suitable as a Christmas tree, potted plant, or landscape focal point that will bring brilliant color and joy to your home or garden at any time of year.



PHOTO BY JON LETMAN



National Tropical Botanical Garden

3530 Papalina Road
Kalāheo, Hawai'i 96741 USA



ILEX ANOMALA, CALLED 'AIEA ON KAUA'I AND KĀWA'U ON OTHER ISLANDS, IS THE INDIGENOUS HAWAIIAN FORM OF HOLLY (AQUIFOLIACEAE) FOUND IN MESIC AND WET FORESTS. PHOTO BY KEN WOOD