

Vol. XXXVII No. 2

FALL 2021

the bulletin

of the National Tropical Botanical Garden





The Need is Upon Us.

Today we are at risk of losing plants faster than we can discover them. However, with your support we can reverse course. By studying, conserving, and protecting tropical plants worldwide, we can unlock solutions to our environmental challenges. The need to save plants and people is upon us all. Please support NTBG today using the enclosed envelope, or online at ntbg.org/support/donate.

contents

3 MESSAGE FROM THE CEO AND DIRECTOR

features

6 NTBG COMPLETES THE FLORA OF SAMOA
by Dr. David H. Lorence, Senior Research Botanist

12 LITTLE WING: DISCOVERING NEW FORMS OF LIFE IN THE LIMAHULI PRESERVE
by Jon Letman, Editor

20 SAVING THE KĀMAKAHALA OF KAUA'I
by Kenneth R. Wood, Research Biologist

in every issue

4 NEW MEMBERS

11 SUPPORTING ROOTS
Q & A with Sabra Kauka

18 RED LISTED

25 WISH LIST

26 GARDEN SPROUTS
News from around the Garden

28 EYE ON PLANTS
Select species in focus

ON THE COVER

Abutilon whistleri (Malvaceae) is a large tree endemic to the Samoan island of Savai'i where it grows above 1100 m. in cloud forests, far from human settlements. It is one of five Samoan plant species named for botanist Art Whistler, the original driving force behind the Flora of Samoa. Read how NTBG helped complete the flora on page 6. Photo by Ken Wood.

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


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

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


©2021 National Tropical Botanical Garden
ISSN 1057-3968
All rights reserved. Photographs are the property of NTBG unless otherwise noted.

Editor: Jon Letman
Graphic Design: Merriam Fontanilla

 <http://www.facebook.com/saveplants>

 <http://twitter.com/ntbg>

 <http://instagram.com/ntbg>

 <http://www.youtube.com/ntbgsaveplants>

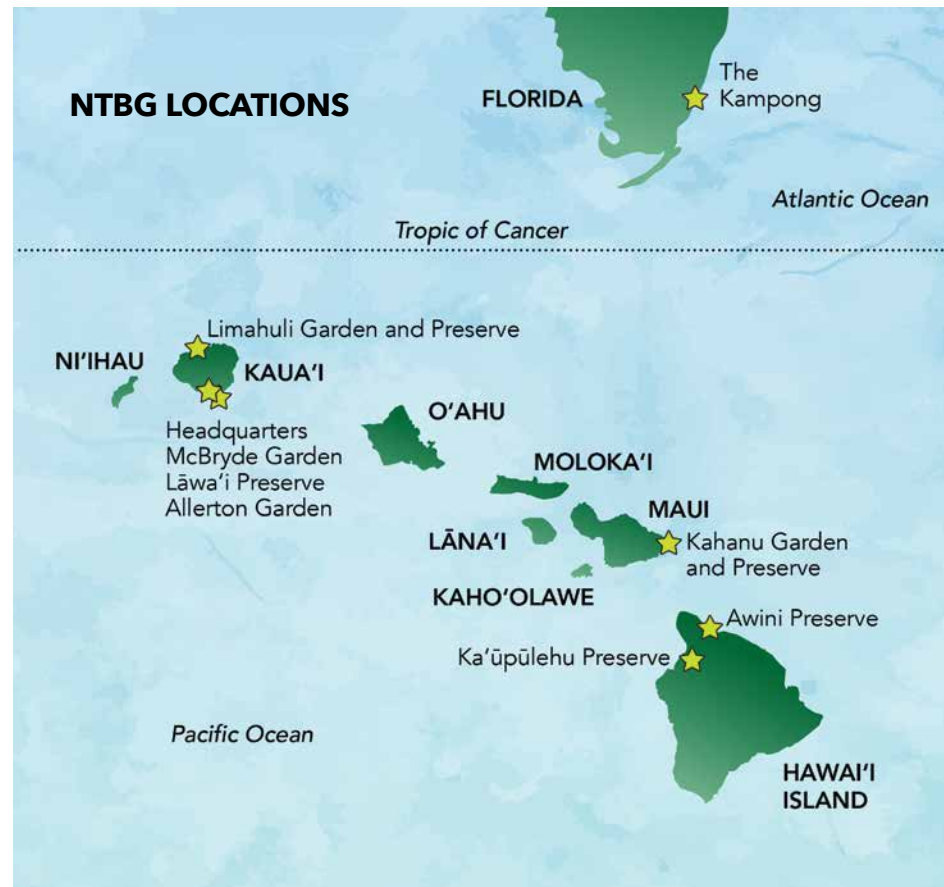


OUR MISSION

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.



BOARD OF TRUSTEES

CHAIR

Mr. Gordon L. Deane

SENIOR VICE CHAIR

Mrs. Wayne Richardson, III

VICE CHAIR

Ms. Anne G. Earhart

SECRETARY

Mr. David W. Pratt

SENIOR PRIOR CHAIR

Mr. Thomas D. Hewitt

PRIOR CHAIR

Mr. Merrill L. Magowan

Mrs. Devon Angelini
 Mrs. Mary M. Cudahy
 Mrs. Martin Dickinson
 Ms. Jan D. Elliott
 Mrs. Eric P. Fraunfelter
 Ms. Adaline H. Frelinghuysen
 Mr. Peter C. Gardner
 Sam 'Olu Gon, III, Ph.D.
 Mrs. Roger P. Hanahan
 Mr. Emerson T. Knowles
 Linford L. Lougheed, Ed.D.
 Ms. Elizabeth E. Matthews
 David Rae, Ph.D., OBE
 Professor John H. Rashford, Ph.D.
 Mr. Thomas L. Reveley
 Dr. Michael N. Rosenberg
 Mrs. Raymond L. Salley
 Ms. Anita Seipp
 Ms. Patricia W. Sheehan
 Mrs. Phyllis Evans Swindells
 Mrs. Catherine Topham
 Mrs. Judy C. Webb
 Mr. Robert D. Weist
 Mrs. Reed C. Wilson

CHAIR EMERITUS

Mr. Douglas McBryde Kinney

TRUSTEES EMERITI

Mrs. Martha W. Cox
 Mr. Glenn A. Goldsmith
 Donald W.Y. Goo, FAIA
 Mr. Patrick Henry
 Mrs. Sally O. Hewitt
 Mr. Thomas S. Kenan, III
 Mrs. Betsy K. Matthews
 Mr. David G. Meissner
 Professor Sir Ghilleen Prance, FRS
 Mr. Charles R. Wichman

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



Message from the CEO and Director

NTBG celebrated our 57th anniversary on August 19, providing a chance to take stock of where we are and how we got here. As I reflect, I am encouraged to see how over nearly six decades NTBG has maximized the strengths of partnerships we've forged and people we have invested in as we build capacity to fulfill our mission.

Viewing NTBG like a giant jigsaw puzzle, when I step back, I see how all the pieces fit together to form a coherent picture. As with a puzzle, upon closer inspection, the unified image is composed of many distinct parts, each one vital to completion of the whole.

From our staff (many who've been with the Garden for decades) to our partnerships and collaborations with like-minded institutions, individuals, and organizations at the local, national, and international level, NTBG's work is multi-faceted. We conduct important plant exploration and discovery expeditions, carry out research and restoration projects, and teach students, educators, and professionals about the importance of plant life.

Through global partnerships and diverse networks, NTBG plays an impactful role in discovering and saving Critically Endangered species, preserving biodiversity and wild habitat, while also bolstering food security and perpetuating cultural knowledge, all to enrich life on earth.

Once-in-a-lifetime events like the 2016 International Union for Conservation of Nature (IUCN)'s World Conservation Congress, which NTBG's President Dr. Chipper Wichman played a critical role in drawing to Hawai'i, and ongoing partnerships that include the Smithsonian Institution, universities, conservation and scientific bodies, and other botanical gardens, have helped NTBG expand our global impact.

These efforts continue as we establish new relationships through our director of Science and Conservation, Dr. Nina Rønsted and Dr. Chris Baraloto, director of the International Center for Tropical Botany (ICTB), under construction at The Kampong in Miami. Countless other relationships between our staff, Board, volunteers, interns, and visiting professionals propel the Garden forward at this critical time for the planet, even in the face of multiple, ongoing crises.

In this issue of the Bulletin, I invite you to read about NTBG's collaborative work, from publishing the *Flora of Samoa* (our second published flora in as many years) to protecting pristine native habitat for undiscovered plant, animal, and insects in the Limahuli Preserve to other partnerships in Hawai'i, Africa, and the Pacific.

All of this has been possible thanks to nearly six decades of committed members, staff, volunteers, and our steadfast Board of Trustees, Fellows, and Supporters who recognize that NTBG is making the world a better place, one species at a time.

As the end of 2021 draws near, I hope you too will take a moment to reflect on all we have achieved together, and what more we will do in the years ahead. Each of us plays a vital role in helping solve the puzzle to complete a picture that is beautiful and whole, as we pursue our core mission to save plants.

With gratitude and aloha,

Janet Mayfield
Chief Executive Officer and Director

A special thank you to our new Fellows and Members!

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

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

Become a Member of NTBG and support tropical plant conservation

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

NEW FELLOWS JAN-JULY 2021

Norma J. Craig
Claire Efird
The McCaslin Family
Joyce and Edward McDowell
Michael D. Moore
Timothy Moore
Mike Serpa
Katharine Sullivan

Danica and Jason Cauwels
Deborah Chaffin
Suzanne and Nicholas A. Charles
Byron Cleeland
Pam and Warren Clemmons
Jeanette M. Clough
Kristin Collum
Judy Compton
Patricia and David Cooper
Patty and Tom Cory
P. Emery Covington and William G. Tucker
Carol Hanson and Barry Cowan

Jeanie Cox
Isabella and Gerald Crabtree
Anne and Conrad Cyr
Phillip Daniele
Mary Danner
Lori Decker
Rae DeCoito and Ronald Nichols
Magalie and Carlos Del Angel
Natalie Delgado and Marc Lawrence
Karla and Phil Dellner
Dianne A. Delorenzo
Kathryn Demry and Vicki Mion
Jiashi Li and Jian Deng
D. Denis and Dayana Magalie Samson
Yvonne and Paul Dias
Dawn Diviniste
Winifred Donahue
Jennifer Doudna and Jamie Cate
Angela and Bill Dressel
Steven Dubey
Vanessa and Daniel Duffy
Penelope and Alan Dunckel
Fern Duvall and Mary Santa Maria
Lynn and Rod Ebright
Janie Ecker
Patricia and Larry Egger
Sandra Elefant and Estella Elefant
Elizabeth Ellis and Sarah Lawrence
Cory and Calvin Ellisor
Rafael Espinosa and Monte Scholz

Donna Esposito
Michelle Fanale and Adrian Rodriguez
Christina Farrow
Taisiya and Igor Faynzilbert
Sharon and Michael Finkelstein
June and Douglas Flagg
Diana and John Fleeman
Maureen Fodale
Tish Folsom and Justin Titus
Makiko Fonseca
Christine and Robert French
Mark A. Fulmer
Mary Gaughran
Charles Lucas Genello
Sharon George
Gabriel Venturelli and Soulei Goe
Patricia Goering
Carolyn and Matthew Gold
Sheryl Gold
Manuel Gonzalez
John Goodman and Peter Jenó
Stanley D. Goodyear and Susan Perry
Sharon Gottfried
Martin Grabias
Nancy Gray and Joseph Scudder
Beth Green
Adanzusu Greenberg and Tony Greenberg
Ursula and Jason Gregg
Sutjii and Bob Gunter
Mal Gurian
Maureen Hager
Shannon and Adam Hagmann
Laurel Hansch and Nina Marchiando
Amy and Todd Hansen
Noreen Hanson
Nick Hardens
Susan and Richard Harder
Valerie and David Harjo
Jennifer and Todd Harris
Susan Hart
Nevenka and Joseph M. Harverson
Julie and Richard Haviland

Kristin Hawes and Eric Chelsey
Elizabeth and Charles Hearey
Dawn Hegger Nordblom and Hal Nordblom
Yuliya Gorlovetsky and Aron Hegyi
Robert Heyn
Lea and Mike Hines
Hayden Hislop and Laura Moritz
Leilani Zimmerman and Arlo Hoffman
Dr. James Holbrook
Cynthia and Ronald Holmberg
Theresa Houk
Catherine Hurd
Amy Hutson
Kathryn Ibata-Arens and Cris Arens
Craig Ingram and Jason Dantico
Alicia and Scott Iverson
Paula Iversen
Terri and Lee Jacobson
Maggie and David Jansen
America and Kevin Johnson
Patricia and Matt Johnson
Marilyn Kane and Donna Twardowski
Kelly and Gregory Karczmar
Caroline Karr
James Keach
Sandra J. and Harry D. Kelley
Gloria Kennedy
Judy and Larry King
Jeffrey Kirby
Ann Hirsch and Stefan Kirchanski
Mina Kirkova and Kalin Kirilov
Jessica Kitchens and Jack Williams
Peter Kjaergaard
Donna and Denis Kokernak
Shirley Krohn
David L. Kundysek
Daina Landeza-Olivier
Sheree and Mike Latif
Robert Laven
Chandis and Charles Lawrence
Marla Miller and Lance Lawson
Suzanne Lawson
Dawn Butcher and Layne Leach
Ann Hankinson and Gary Leatherman
Cherrill Spencer and Richard Leder
Connie Lee
Terry Leppo and Brian Glenn
Jennifer Levine
Leslie and Will Littlejohn
Nora and James Loftis
Judi Bogdanoff-Lord and David Lord
Kathleen Macie
Sharan Magnuson and Jason Boyleston
Maureen Mahoney-Barraclough
and Bruce Barraclough
Hanaa Boumah and Simon Maisel
Laurine J. and Glen K. Makaneole
Julie Marcus
Linda Markowitz and Diane Chesler
Lei Ann Marshall and Michael Seidenberg
Lisa Marshall
Lori and Mike Martin
Prudence Emery and Milton Masur

Treasa and Richard Mathias
Anneliese Mauch and Robert Hainer
Fran and Mac McDonald
Allison and Bernard McGourty
Laurens McKenzie and Adelaide Faulkner
Lynn and Kevin McLaughlin
Thomas McOsker
Arlene Mehlmán and Leah Garber
Karen and James Merchant
Zachary Mermel
Xon Mikolajcik
Julius Miller and Jeanne Miller
Susan Milligan and Philip McGuire
Chelsea and Matthews Millunchick
Elaine Mirkin
Joshua Mitchell
Donna and Marco Mladineo
Mia Monroe and Stephan Meyer
Donna J. and Edward Morris
Kathryn Mumper and Joe Valenzuela
Connie Mundell
Alyssa and Jonathan Murata
Susan Murphy
Nathaniel Myers
Elizabeth and Thomas Niethammer
Jacqueline Nelson and Georgette Nelson
Melissa Nelson and Jaune Evans
Jay Noller
Bettina Oelke
Linda and Gregory Oppenorth
Sally Philips and Peter Ostrowsky
Christie Overmyer and Anne Overmyer
Lisa Paladino and Julie Gamage
Taleria and Antonio Palmer
Karen and Harry Parker
Sangeeta Parulekar and Walt McClelland
Sherri Patrick
Cisco Peru
Teresa and Lewis Pilot
Kathleen and Donald
Christina Planje
Ingrid and Robert Planje
Elizabeth R. Pogostin
Emma and Rich Pompetti
Brian Potter and Joey Pierre
Cynthia L. Price
Susie and Ken Purdy
Leah and Michael Pytel
Alex Quintana
Amy and Marvin Raidman
Vonnell Ramos
Kelly and Todd Raybuck
Peter Reid
Heather and John Rosenthal
Peter Ruvalcaba and Consuelo Cervantes
Yukiko Sassone
Lisa Scoggins
Linda and Judd Serotta
Kara and Jesse Shannon
Mary Shields
Elizabeth Short, M.D.
Marium Ann Short
Victoria and Bill Shrader

Stacey and Marc Siegel
Kathryn Simon
Meriamne Singer and Mark Sorensen
Gary Slack and Samuel Slack
Sabrina Middleton and Daniel Sommerville
Peggy and Mitch Sowl
Debra G. Speyer
Terry and Jerry Spodick
Fredrick and Marilyn Stark
Mary and John Stein
Joy and Marcus Stenzel
Vanessa Stevens
Mark Stevenson
Jody and Dave Stillwell
Alice Stipak and Anne Kohlstaedt
Khadija Striegel
Jenna Walter and Stuart Suna
Patricia and Kendon Stubbs
Era and Stefan Swanepoel
Joanne Cutting-Gray and James Swearingen
Kenneth R. Taylor
Maureen and Noel Testa
Kim and Ruth Thich
Celia Smith and William Thomas
Sylvia and Dennis Tobolski
Andrea Tosi and Benjamin Paly
Nevin Trampenau
Susan and Bruce Travis
Melissa Tremblay and Owen Prentice
Maria and Paul Turvey
Barbara and Michael Van Deusen
Kim and Jef Veilleux
C. James Vitus
Susan Wagner
Tammy Waleski
Fran and Ira Warren
Sascha Watkins and Ed Falero
Linda Weidner
Sally C. and Robert D. Weist
Linda Werner
Mark Westgate
Kathleen A. West-Hurd and Steven Hurd
Karen White-Trevino and Kenneth Olson
Lorraine and Anthony I. Wichman
Diane and Todd Wiley
Jane Fox and Jason S. Williams
Kristine Williams
Patricia and Peter Williamson
Ken Willner and Jim Stine
Angela and Dave Winters
Debra and Dhruv Wolf
Betsy Pfleger and Kent Wosepka
Whitney N. Wyatt
Zisha and Scott Yamano
Lingbo Zhang and Peter Shin
Chris Zuleeg
Marion Zweiter

NTBG COMPLETES

THE FLORA OF SAMOA

BY DR. DAVID H. LORENCE, SENIOR RESEARCH BOTANIST
PHOTOS BY KEN WOOD

PSYCHOTRIA PACIFICA, IS ONE OF TWELVE *PSYCHOTRIA* SPECIES NATIVE TO SAMOA AND A MEMBER OF SAMOA'S SECOND LARGEST FAMILY, RUBIACEAE (COFFEE FAMILY).

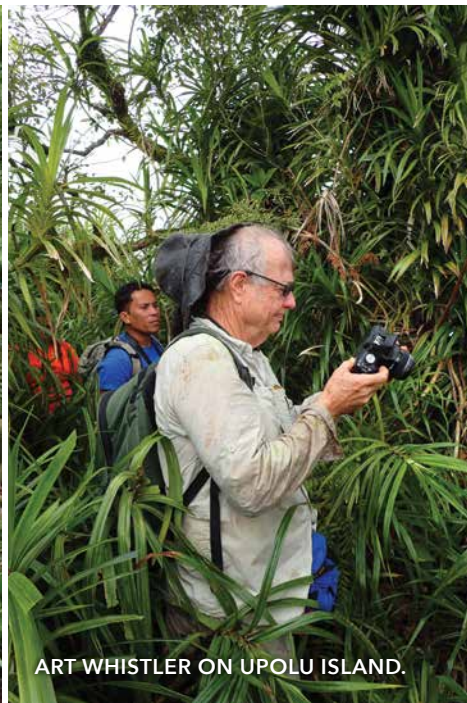
The saga of the *Flora of Samoa* began on January 16, 1968, when W. Arthur (Art) Whistler arrived in Samoa as a Peace Corps volunteer. Known locally as *Pisikoa*, Peace Corps volunteers were often assigned to teach in host country schools, and Art taught biology in Samoa for three years. With a master's degree in botany, Art soon developed a keen interest in Samoan plants. One year after his Peace Corps stint ended, Art returned to pursue botanical collecting in earnest, eventually botanizing on every island in the archipelago. For the next half century, Art visited Samoa every year but one. His 4,900 collections of herbarium specimens include over 90 percent of the known flowering plants and ferns of Samoa.

Art's first set of specimens are stored at the National Tropical Botanical Garden's (PTBG)¹ herbarium, with duplicates (especially early collections) sent to many other herbaria, including the Bishop Museum in Honolulu, Royal Botanic Gardens Kew, and the Smithsonian Institution.

After earning a PhD in botany in 1979, Art met Dr. William Theobald, NTBG's former director, who offered him the position of ethnobotanist which he held from 1983 to 1992. Art also lectured in botany at the University of Hawai'i and, for many years, worked as an independent botany consultant in Hawai'i and throughout the Pacific. Art published numerous articles and books on Pacific botany and ethnobotany and always dreamed of publishing a *Flora of Samoa* that would serve as a definitive compilation and identification guide.



NTBG FIELD TEAM AND PARTNERS ON SAVAI'I ISLAND. CONTRIBUTED PHOTO.



ART WHISTLER ON UPOLU ISLAND.

In 2015, NTBG commissioned Art as a McBryde Fellow to prepare a written Flora of Samoa for publication. In what was to be the culmination of a career dedicated to bringing knowledge of the flora and conservation by local communities to a scientific audience, Art had nearly completed the flora's manuscript, but passed away in April 2020 from Covid-19 complications before it could be finalized.

Following this tragic and unexpected loss, Dr. Warren Wagner, curator of botany with the Smithsonian Institution, and I agreed we would complete the final scientific editing and updating of the manuscript to ensure the flora was published.

RACING TO SAVE KNOWLEDGE

Publication of the Flora of Samoa is urgent as the plant life (particularly in upland ecosystems) is rapidly being lost to invasive plants and animals, land degradation, and threats from climate change. The Flora of Samoa has long been recognized as a priority by the International Union for Conservation of Nature (IUCN) and is consistent with Global Strategy for Plant Conservation goals, including Target 1 of developing an online flora of all known plants.

Samoa is located in the South Pacific, between 500 and 700 miles north and east of Fiji and Tonga. Samoa

(formerly called Western Samoa) is comprised of two main islands with the U.S. territory American Samoa to the east. Samoa occupies an important place in the Polynesia-Micronesia biodiversity hotspot, but until now, no published flora existed as a source of essential data for managing and conserving Samoa's biological diversity.

The Samoan archipelago plays a central role in the Pacific region and the argument for a published flora is strong. First, although the islands' plants have historically been under-explored, thanks to decades of research by Art, organizational and research infrastructure is in place, and a wealth of preliminary information has been previously published. Additionally, Samoa's plant diversity is threatened by development, land conversion, and other human activities with Pacific islands and atolls among the first places to be impacted by sea level rise.

Culturally and biologically, Samoa is a cohesive area that would benefit from a single, modern plant diversity resource for studying the effects of climate change. With comparable floras published for Fiji, Hawai'i, and the Marquesas Islands, it's time Samoa had its own printed flora. The completion of this work will greatly aid biologists, ornithologists, vegetation ecologists, and resource managers. A detailed synopsis of the plants is the first step needed for the study and preservation of rare or threatened endemic Samoan species and habitats.



PHLEGMARIURUS AUSTRALIS, AN INDIGENOUS EPIPHYTIC LYCOPHYTE (A TYPE OF FERN ALLY) ON SAVAI'I ISLAND.

¹NTBG's herbarium is known as "PTBG", based on the Garden's original name Pacific Tropical Botanical Garden



ABUTILON WHISTLERI

Plants named for Art Whistler: *Abutilon whistleri* (Hibiscus family), *Hoya whistleri* (Dogbane family), and three in the Orchid family: *Calanthe whistleri*, *Dendrobium whistleri*, and *Taeniophyllum whistleri*.

A RICH AND DIVERSE FLORA

With 541 native species (186 of which are endemic) and nearly 300 naturalized flowering plant species and 225 ferns and fern allies, Samoa has the second largest native vascular flora in Polynesia after the Hawaiian Islands. About 34 percent of Samoa's native plants are found nowhere else, compared with 90 and 47 percent endemism among the floras of Hawai'i and the Marquesas respectively.

Compared with the flora of Fiji, the Samoan flora is about one-third as large, but they share many floristic affinities due to their relative proximity. The largest family of flowering plants in Samoa is the orchid family (Orchidaceae), with 101 native species. No other Polynesian islands have such a rich orchid flora. Samoa's second largest family is Rubiaceae, the coffee family, with 47 native and five naturalized species.

NTBG'S ROLE

In 2002 and 2003, NTBG's Breadfruit Institute director Dr. Diane Ragone and I participated in botanical and ethnobotanical inventory field trips in the National Park of American Samoa for a project funded by the U. S. National Park Service. In 2016, Art accompanied NTBG scientists Tim Flynn, Ken Wood, myself, and two young botanical researchers on a six-week, grant-funded botanical expedition to Samoa's two largest islands, Savai'i and 'Upolu. Special emphasis was placed on searching for populations of 15 poorly known or "lost" flowering plant species, some not collected in over a century, as well as documenting populations and distribution of additional rare plants. Although the lost species were not rediscovered, two new fern species were. Collaboration with Samoa's Ministry of Natural Resources and the Environment staff was an essential component of the field work.

From the early 1980s until Art's untimely passing in 2020, he dedicated himself to studying, collecting, and conserving the plants of Samoa. Art's manuscript included a considerable number of taxonomic treatments with an emphasis on finalizing all remaining work in recent years. Over those four decades, parts of the original manuscript fell out of sync with other new Pacific botany publications. In the final phase of the peer-review process, Warren and I were in discussion with Art about updates and changes. In Art's absence, we completed these necessary changes to reflect the latest taxonomic classifications.

Ultimately, the style, format, and content of the manuscript remain in accordance with Art's wishes and intent. We are deeply honored to get this extraordinary body of research across the finish line, publishing what represents Art's *magnum opus*, a definitive publication on the plants of Samoa that will be used for generations to come.

An enthusiastic photographer, Art had selected nearly one thousand plant photos, mostly taken by him, for inclusion in the flora which will also feature over 150 beautiful color figures by Smithsonian illustrator Alice Tangerini, based on Art's photos. As of the summer of 2021, work on the manuscript is nearly complete and slated for publication by NTBG in 2022 (depending on funding). The published book will comprise nearly 800 pages and represents a milestone in the study of Pacific Island floras as well as the embodiment of Art Whistler's life-long love for the people and plants of the Samoan Islands. 🌿



VACCINIUM WHITMEEI

supporting roots

Q & A with Sabra Kauka



PHOTO BY JON LETTMAN

Seated on a woven hala (*Pandanus*) mat in her Island School classroom at the foot of Kaua'i's Kilohana volcano, Sabra Kauka teaches Hawaiian studies with a focus on the music, dance, arts, and culture that are an integral part of Hawaiian life. Central to the curriculum and her relationship with her students are culturally important plants like the palapalai (*Microlepia strigosa*) and laua'e (*Microsorium scolopendria*) ferns used in ceremonial and celebratory lei.

For decades, Sabra has partnered with NTBG – teaching, gardening, and caring for the wauke (*Broussonetia papyrifera*), 'ōlena (*Curcuma longa*), and other plants she uses for making kapa (traditional bark cloth) and natural dyes. After many months, Sabra was able to return this summer to teach in McBryde Garden in a series of kapa and dye workshops. A longtime supporter, partner, and friend of the Garden, Sabra's 'ike (knowledge) and a deep love for plants which, she says, "goes from the earth to the heavens and back," continue to enrich the Garden.

How were you first introduced to NTBG?

It was so long ago – over 30 years. With my connection to Hawaiian culture and hula, the more I got into it, the deeper my association with the Garden grew. I recognized the importance of NTBG's work – not just

to Kaua'i but all of Hawai'i and across the world. So my appreciation of plants just continued to grow, literally. The more I dove into Hawaiian culture, I realized that in order to practice the cultural arts, I needed the plants to do it.

You've taught hundreds, maybe thousands of students at NTBG. As an educator, what does the Garden mean to you?

NTBG is my favorite classroom in the world. I love when I am able to take students down into the garden. It's one thing we really couldn't do last year and I've missed being able to take them there.

Do you see any common reactions by your students when they are learning in the garden?

The students love being outdoors. They just love it. To see and feel and do things there really opens their eyes. They can use all their senses when they are in the Garden.

How does NTBG's work directly affect your teaching?

If I want to teach kids how to pound poi, I have to have the taro. If I want to teach kids how to make kapa, I have to have the plants and they have to be healthy and usable. If I want to teach about dyes, we have to have the plants as well, and they have to know which varieties are the best and when to pick them.

Taking a global view, what are your thoughts on NTBG's role in an age of converging environmental and health crises around the world?

We have so many changes that are impacting us and they're coming closer together. We already saw it with the floods that hit us here on Kaua'i (April 2018 and March 2021). I can't tell you how important I think it is that NTBG's mission is to protect, preserve, perpetuate, and educate the world about the importance and the beauty of these plants. NTBG makes a huge contribution to environmental stability.

Discovering new forms of life in the Limahuli Preserve

Little wings

BY JON LETMAN, EDITOR

PHILODORIA BASALIS. PHOTO BY CHRIS JOHNS



PHILODORIA HIBISCELLA
MINED HIBISCUS
ARNOTTIANUS LEAF

PHOTO BY CHRIS JOHNS

The Hawaiian Islands are often associated with big, dramatic natural events (volcanic eruptions, powerful ocean swells) and large, complex ecosystems (dense tropical forests, dynamic coastlines), but it's Hawai'i's earliest, smallest, least known creatures that offer one of the most important lessons about evolution, diversity, and interdependence.

Hawai'i is home to a genus of micromoth called *Philodoria* which is believed to have first reached the Hawaiian Islands 21 million years ago (some 8 million years before Hawai'i's largest plant clade, the Lobeliads). Like the larvae of some beetle and fly species, *Philodoria* are leaf miners. They're also extremely small – about as long and as thick as a human eyelash.

When the tiny moth lands on the leaf of its host plant, it lays eggs which produce microscopic caterpillars that burrow through the leaf, forming tiny tunnels and caverns as they eat their way through the tissue of their thin, green home. There they grow into larvae safely sheltered from predators like parasitoid wasps which are known to use *Philodoria* larvae as a host.

After several weeks, the caterpillar grows until it pupates, emerging from the leaf in a cocoon before metamorphosing into a moth. The whole process takes up to six weeks.

Survival of the *Philodoria*, which are endemic to Hawai'i, depends on the moth-host plant relationship. If the host plant goes extinct, it stands within reason that the moths that depend on them will disappear too.

“NTBG has something really, really, really special,” Johns says. “In terms of moth diversity and the potential for future discovery and protection...Limahuli is one of the best places. I think the work that’s being done there is top notch.”

BIOLOGIST DR. CHRIS JOHNS IN THE
LIMAHULI PRESERVE. PHOTO BY GEENA HILL





PHILODORIA SCIALLACTIS. PHOTO BY CHRIS JOHNS

BARELY KNOWN, RARELY SEEN

Earlier this year, researchers from Osaka Prefecture University and the Florida Museum of Natural History (University of Florida) published a monograph (in depth study) with names, descriptions, and the conservation status of 13 new *Philodoria* species and their host plants. In total, researchers confirmed 51 *Philodoria* species, many of which hadn't been seen in over a century, and 13 of which were new to science.

Among the newly described moths, *Philodoria limahuliensis*, is known from a single location in the Upper Limahuli Preserve. Biologist Dr. Chris Johns, a co-author of the paper, first saw the moth in 2016. Johns, a self-described micromoth enthusiast, says even this tiny creature plays an important role in the ecosystems they inhabit.

Studying *Philodoria* can help us understand many other forms of life, including our own, says Johns. “*Philodoria* moths can teach us a lot of things about life on this planet and evolution.”

When Johns teamed up with entomologist Dr. Akito Kawahara at the University of Florida in 2013, *Philodoria* hadn't been studied closely in over a century and their conservation status was poorly understood. Johns, who had previously done conservation work in Hawai'i, jumped at the chance to join Kawahara for what would be a five-year study searching for some of the world's smallest moths inside of the world's rarest plants.

Over the course of six trips to six Hawaiian islands, Johns partnered with local scientists to search for *Philodoria* living among host plants including 'ōhi'a (*Metrosideros* spp.), māmakī (*Pipturus* spp.), and *Hesperomannia*, an extremely rare native member of the sunflower family. *Philodoria* are diverse feeders and tend to develop a very specific host plant relationship. One species lives among *Wollastonia integrifolia*, a coastal plant, while another lives within the greenswords (*Argyroxiphium grayanum*) of west Maui's high elevation bogs where it was described as *Philodoria wilkesiela* by English entomologist Lord Thomas de Grey Walsingham in 1907. Johns found the same moth in that exact location in 2013. *Philodoria*'s historical range has been well-documented, Johns said, but it was difficult to find intact habitat that hadn't been developed or entirely replaced by invasive species.

In 2015, based on Kawahara's past collaboration with NTBG staff, Johns was introduced to then-NTBG field collector Natalia Tangalin, from whom he learned of known leaf miners suspected to be *Philodoria* in the Limahuli Valley. That year Johns and Tangalin helicoptered to a weatherport¹ in the Upper Limahuli Preserve. Based on a hunch from Tangalin, they hiked down to a place where a small stream flows into a waterfall. Just above that spot, a lone shrub – *Hibiscus waimeae* subsp. *hannerae* – grew out of a sidewall in the stream. There they collected ten moths which Johns believes were unique to the location and to date is the only known habitat of

what has been named *Philodoria limahuliensis*. Johns says *P. limahuliensis* is one of the rarer species but a second *Philodoria* species was found in Limahuli Valley living with its host 'ōhi'a (*Metrosideros* sp.).

WHY DOES IT MATTER?

Some might question the significance of finding a tiny moth on a Critically Endangered plant in the back of a remote valley. Johns explains how such a discovery sheds light on the origin and age of organisms in Hawai'i, a place that has informed much of our scientific understanding of evolution on islands. *Philodoria* may be the oldest extant lineage in the archipelago. “As far as things that remain alive in Hawai'i today, *Philodoria* seems to be one of the first to get here,” Johns says.

And because, like the Galapagos, Hawai'i is a storied natural laboratory for evolution, identifying a new micromoth found nowhere else on earth opens a new chapter of scientific inquiry and can address the same questions asked about other organisms, offering a new perspective and more comprehensive understanding of evolution and life on earth.

To study an insect as small as *Philodoria*, scientists must go to great lengths to identify and understand how species are related to one another. One method of identification is a morphological examination of the genitalia of each species which is challenging given the moth's size. Another technique is the molecular analysis of tissue to compare DNA among differing species.

Using phylogenetics and a technique called ancestral reconstruction², *Philodoria* researchers have gained new insights to what ancient moths might have been feeding on when they inhabited now sunken Hawaiian Islands that predated the islands we know today. Johns says it's likely those ancient host plants belonged to Ebenaceae, Malvaceae, and Primulaceae. “That paints a really interesting picture of something we didn't know before about this place,” Johns says.

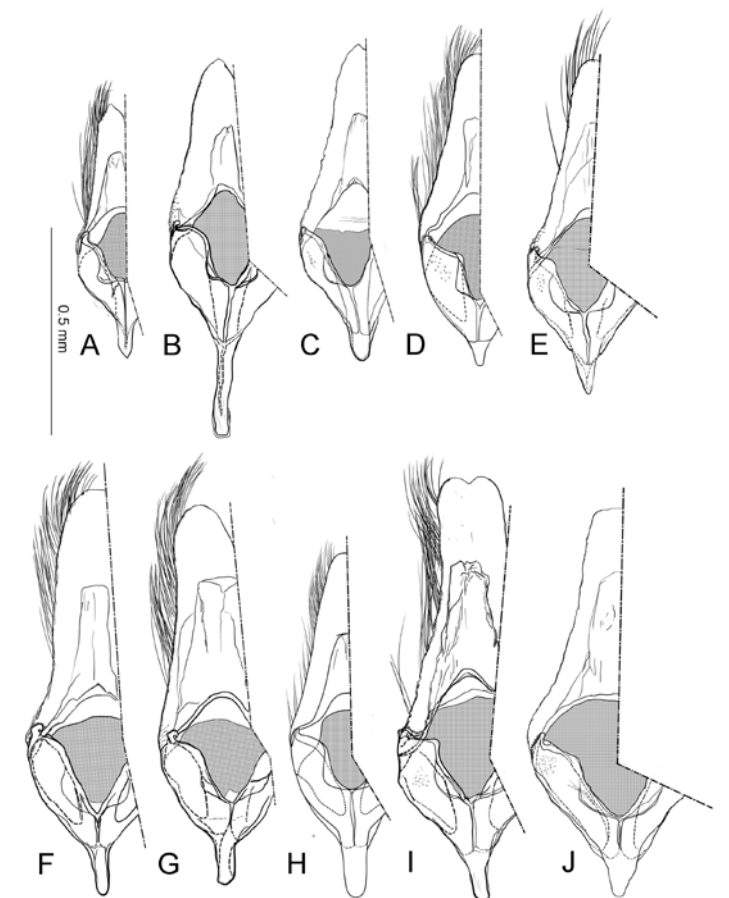
A TREASURE TROVE OF DISCOVERY

Even for the non-scientist, Johns says people are drawn to anything that creates a deeper, more complex picture of a place revered for its natural beauty. “What is it that comprises that natural history?” he asks. “It's biodiversity. Who doesn't love a new angle to a beloved story or character?”

The discovery of *Philodoria limahuliensis* near a small waterway that feeds into the Limahuli Stream underscores the importance of protecting and studying this pristine riparian habitat. The unique conditions found along the stream led to an NTBG-led project to restore the health and function of the stream. Selective tree trimming, outplanting, and extensive monitoring are expected to benefit native flora and fauna while helping preserve whole-ecosystem biodiversity in the Limahuli Valley.

Having found and identified *Philodoria limahuliensis* in the Limahuli Valley, Johns was elated to have had the chance to work in a native forest that remains largely intact and relatively weed-free. He calls Limahuli “among the very best of privately held land with robust environmental protection” in Hawai'i.

“NTBG has something really, really, *really* special,” Johns says. “In terms of moth diversity and the potential for future discovery and protection... Limahuli is one of the best places. I think the work that's being done there is top notch.” 🌿



PHILODORIA MOTH MALE GENITALIA USED FOR IDENTIFICATION. ILLUSTRATION BY SHIGEKI KOBAYASHI

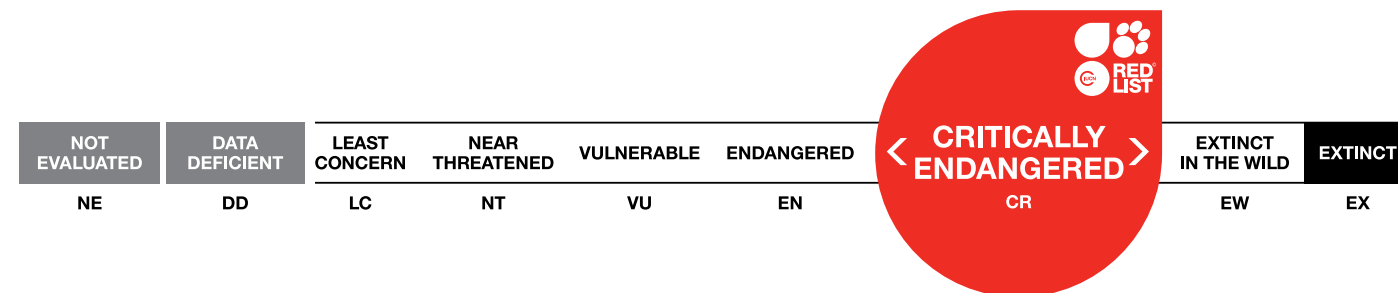
¹ NTBG built a weatherport in the Upper Limahuli Preserve that serves as a year-round shelter allowing for extended multi-day fieldwork.

² DNA analysis to understand how species are related to one another

red listed

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

In recent years, conservation agencies, institutions, and organizations including NTBG have increased efforts to assess the nearly 1,400 native plant taxa in Hawai‘i. To date, nearly half have been assessed, reviewed, and published on the Red List, adding to the more than 54,000 plant taxa published through the latest update of the Red List worldwide.



Species: *Pritchardia woodii* (Arecaceae)

IUCN RED LIST CATEGORY:
CRITICALLY ENDANGERED (CR)

Pritchardia woodii is a Maui single-island endemic palm that occurs in mesic to wet forests and is restricted to the southeastern slopes of Haleakalā. The palm was named after NTBG’s research biologist, Ken Wood, to honor Ken’s extensive work with this and all other *Pritchardia* species throughout the Hawaiian Islands. An estimated 437 individuals occur among two subpopulations. Like most of Hawai‘i’s native plant species, persistent threats to *P. woodii* include habitat degradation and direct

predation by non-native animals, particularly rats, and competition by non-native invasive plant species. There is a continuing decline in the number of mature individuals, subpopulations, and suitable habitat.

Pritchardia is the only native palm genus with 22 species in the Hawaiian Islands, whereas the coconut (*Cocos nucifera*) is considered a Polynesian introduction and did not arrive here on its own. Hawaiians use *Pritchardia* wood for spears and bowls, the leaves for thatching roofs, enjoy the inner soft white meat of young seeds as a delicacy, and parts can be used medicinally to treat infections.

Field botanists of NTBG and the State of Hawai‘i Plant Extinction Prevention Program have made seed collections for propagation of *Pritchardia woodii* over the years. Ex-situ representation is still in its infancy and out-plantings in the wild have not yet occurred. — *Seana Walsh*



Surveying Critically Endangered Palms on Maui

BY MIKE OPGENORTH, DIRECTOR OF KAHANU GARDEN AND PRESERVE

KAHANU GARDEN’S PULE KRAUSE (LEFT) AND MIKE OPGENORTH PREPARING FOR FLIGHT. PHOTO BY HANK OPPENHEIMER, PLANT EXTINCTION PREVENTION PROGRAM

Last April, Kahanu Garden and Preserve staff led the first-ever aerial survey of *Pritchardia woodii*, a native Hawaiian palm endemic to the forests of east and southeast Maui. *P. woodii* is one of Hawai‘i’s most elusive palms, and until our survey, had never been assessed for the International Union for Conservation of Nature (IUCN) Red List of Threatened Species.

Uncertain how many trees remained, we set off to explore the verdant slopes of Haleakalā, Maui’s central towering volcano. Our survey team included Hank Oppenheimer, the Maui Nui coordinator for the Hawai‘i Plant Extinction Prevention (PEP) Program, Pule Krause, Kahanu Garden’s lead Mālama ‘Āina Technician, and myself.

Upon entering the Waiho‘i Valley, we scanned the vast amphitheatre-like walls surrounding us in search of the palm. When we spotted two palms at low elevation, we descended into a clearing where Hank and Pule jumped out of the chopper to inspect the palms, take vouchers, and collect seeds for a conservation collection to be grown at Kahanu Garden.

Leaving Hank and Pule to explore, the pilot and I continued to scour the valley from above in an effort to count as many trees as we could find. Flying low, we zigged and zagged, looking for trees, always mindful of the cloud-enshrouded towering cliffs around us.

After we surveyed the whole valley, we picked up Pule and Hank and returned to the garden where we compiled our data. The trip proved to be valuable as we confirmed there are more trees than we had suspected.

Based on the survey, we estimate around 430 *Pritchardia woodii* remain in two of east Maui’s most remote valleys. This population is low enough for the species to be assessed as Critically Endangered under Red List criteria, but Hank noted, “I believe this whole valley used to be covered edge to edge with these palms.”

With rats, pigs, and invasive plant species preventing young trees from establishing themselves, we are confident that our conservation collection may be critical to the species’ survival. Botanizing by helicopter is not cheap, but the importance of finding and saving rare plants goes beyond monetary value. This project has allowed us to witness the current state of this valley’s greater ecosystem from above, allowing for a more holistic view of this unique topography. What’s more, this work is profoundly inspiring.

Reflecting on the trip, Pule told me, “As a Native Hawaiian who grew up on the lower slopes of the Waiho‘i Valley, it was special to go up there and actually collect seeds that can be cultivated and may help save this species.”

SAVING THE KĀMAKAHALA OF KAUA‘I

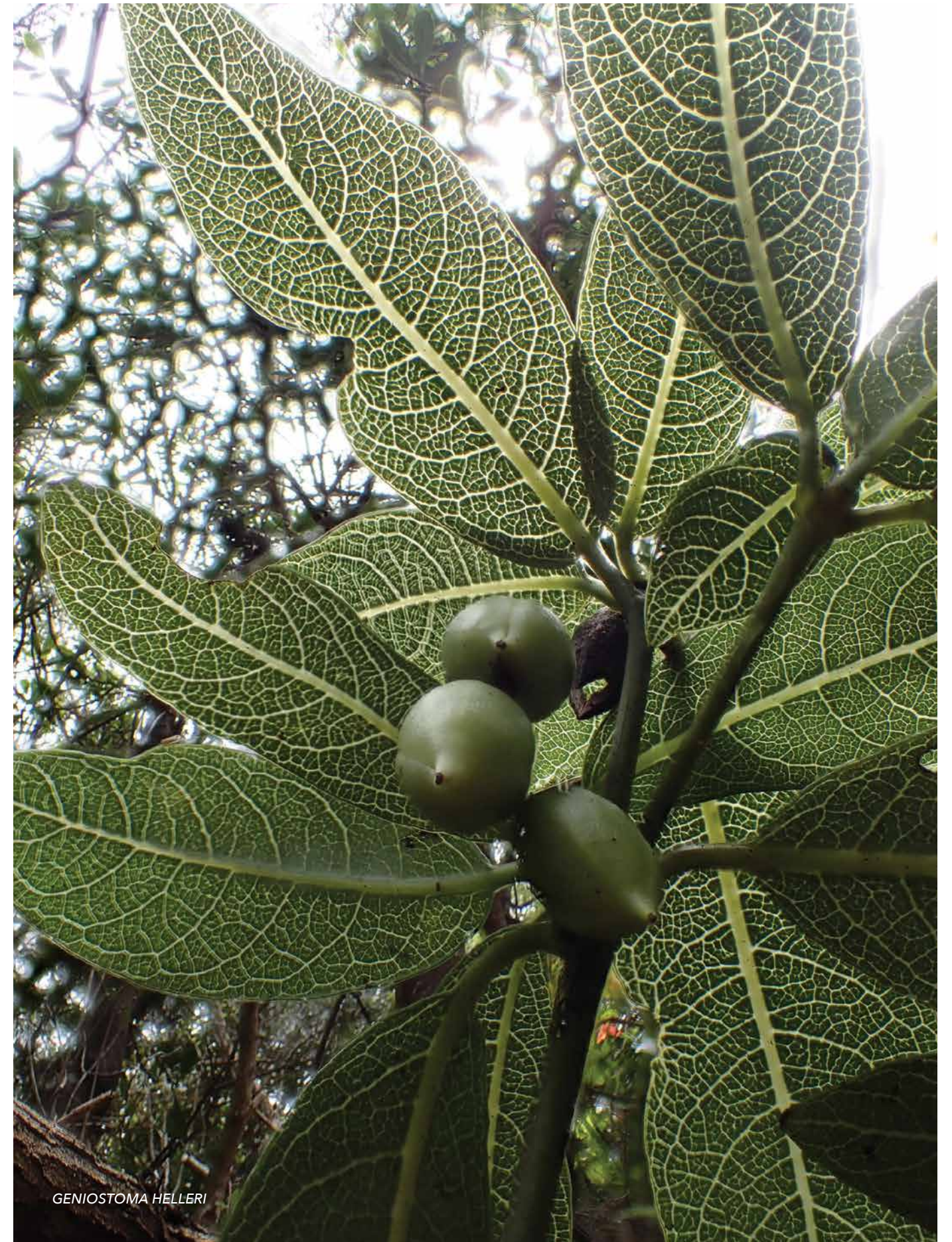
STORY AND PHOTOS BY KENNETH R. WOOD,
RESEARCH BIOLOGIST

Botanists and enthusiasts of the Hawaiian flora may recognize the genus *Geniostoma* by its older name, *Labordia*, or by its melodic Hawaiian name kāmakahala. The genus includes *Geniostoma helleri*, a divinely beautiful and Critically Endangered Kaua‘i endemic tree species in the Logania family. Long ago, the seed of the original founder was likely carried to the Hawaiian Islands by a bird. Over millennia, kāmakahala evolved in isolation into a lineage of 19 extraordinarily unique taxa, eight of which are federally listed as endangered, each a masterpiece of evolution.

The conservation of kāmakahala can be difficult since plants are either male or female and require the presence of both sexes in the colony. Insect visitation of flowers is also needed for pollen exchange. Where there are highly fragmented and separate individuals, biologists need to gather pollen from males and hand-pollinate the isolated female when she is with receptive flowers.

Over the last few decades, NTBG’s Science and Conservation team has mapped all seven species of kāmakahala on Kaua‘i, including over 100 *Geniostoma helleri* individuals throughout Kōke’e’s mesic forests and Kaua‘i’s western canyons. This phytogeographical knowledge of distribution and abundance has been fundamental in our conservation efforts, and we are thrilled to report that we have exceeded our expectations for the conservation of *G. helleri*.

5mm



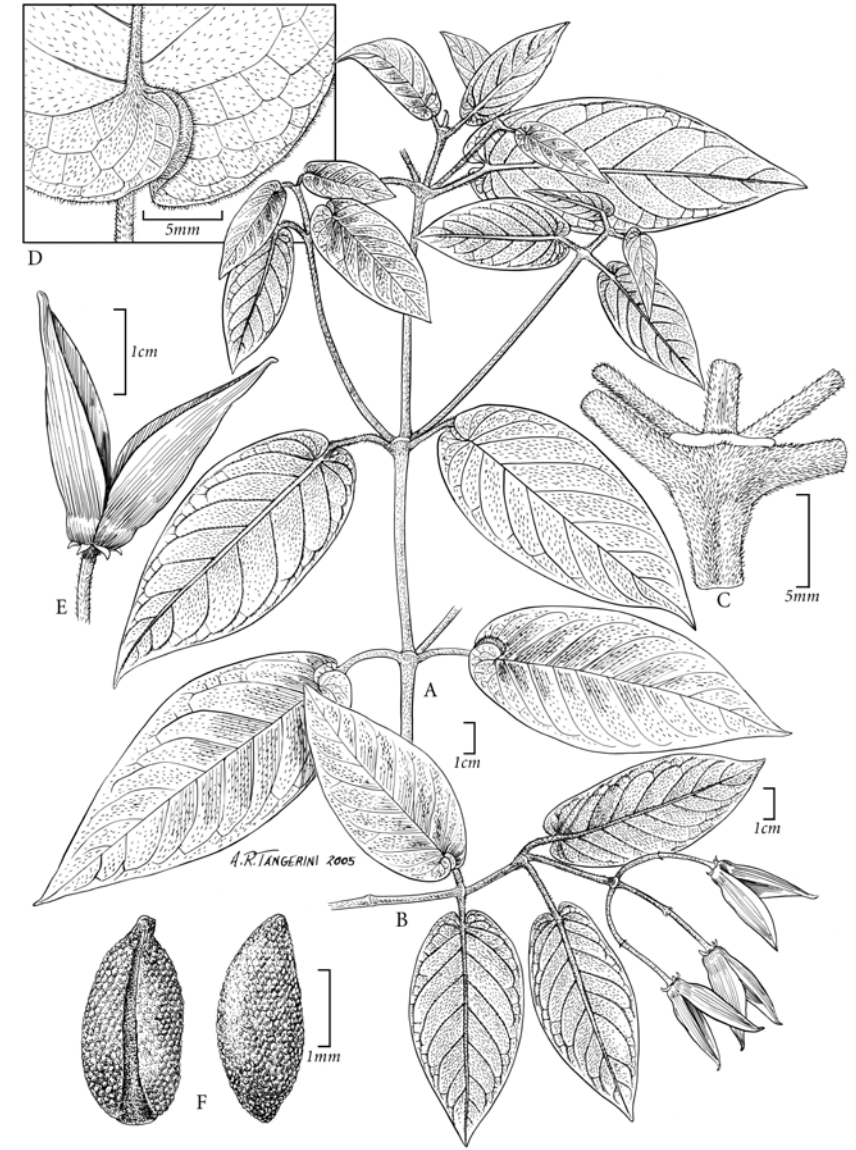
GENIOSTOMA HELLERI



OPEN SEED CAPSULES OF *GENIOSTOMA HELLERI* COLLECTED BY NTBG SCIENTISTS. THE BLACK SEEDS SURROUNDED BY ORANGE PULP ATTRACT HAWAIIAN FOREST BIRDS WHICH DISPERSE THE SEEDS.

In the spring of 2021, collections were made from five separate female trees, with one of those collections rendering over 1,000 seeds, the total number of seeds collected for this project increased to approximately 2,800. These are by far the best collections we've ever acquired from *Geniostoma helleri*. Portions of seed are being cultivated by NTBG's Horticulture team, and significant numbers are being preserved in our seed storage facility under the curation of seed bank and laboratory manager Dustin Wolkis.

Another single-island endemic kāmakahala on Kaua'i is *Geniostoma lorencianum*. In the early 1990s, while searching with entomologists in remote interior canyons for the rare endemic fabulous green sphinx moth (*Tinostoma smaragditiis*), NTBG staff discovered a new species of kāmakahala which was described and ultimately named in honor of Dr. David Lorence, NTBG's senior research botanist. Only a single colony of this kāmakahala species has ever been found, which included three males and one female tree. Lorence's kāmakahala is a wonderful example of inter-agency conservation. The collaborative efforts of NTBG, along with the Kaua'i Plant Extinction Prevention Program (PEPP), and the Hawai'i State Division of Forestry and Wildlife (DOFAW) have resulted in successful seed collections of *G. lorencianum*, followed by nursery propagation, and finally reintroduction back into the forests where the species was originally discovered. Many dozens now occur in their natural habitat and are protected within a fenced enclosure from goats and pigs. DOFAW has made great efforts to maintain that enclosure.



GENIOSTOMA LORENCIANUM IS NAMED FOR NTBG'S SENIOR RESEARCH BOTANIST DR. DAVID LORENCE. ILLUSTRATION BY ALICE TANGERINI, SMITHSONIAN INSTITUTION

In Kaua'i's rugged, wet windward and northern forests, another extremely rare and strikingly beautiful kāmakahala occurs. Named in honor of Reverend John Mortimer Lydgate (1854-1922), *Geniostoma lydgatei* has exquisitely delicate flowers and the smallest fruit capsules of any kāmakahala. *Geniostoma lydgatei* also occurs in the Upper Limahuli Preserve where NTBG biologists are methodically mapping and monitoring individuals and have been collecting seed for conservation.

During the spring and summer of 2021, PEPP and NTBG have made significant observations of *Geniostoma lydgatei* in lowland wet 'ōhi'a forest, but this extraordinary species is still only known from several hundred individuals. NTBG plans to maintain and enhance viable populations of this federally endangered species in the fenced Upper Limahuli Preserve.

Currently NTBG's director of science and conservation, Dr. Nina Rønsted, has partnered on a National Science

Foundation (NSF) grant to study the phylogenetic relationships and diversification of the entire Hawaiian lineage of kāmakahala. The grant will also include 11 other Hawaiian plant radiations in need of molecular and taxonomic work. This NSF research is in partnership with Washington University, University of California-Los Angeles, UC-Berkeley, Smithsonian Institution, and involves several NTBG staff who will be collecting and organizing leaf material for the proposed gene sequencing.

With approximately 1,300 native plant species, 90 percent of them endemic, the challenge to conserve the Hawaiian flora can be overwhelming. It's sobering to think that around 30 Hawaiian plant species have gone extinct since 2000, raising the number of extinctions to approximately 130 species of flowering plants and ferns. This fact should leave us with a deeper appreciation of the need



for greater focus and funding to secure and build populations of the Hawaiian flora. NTBG secured a grant to conserve *Geniostoma helleri* from The Mohamed bin Zayed Species Conservation Fund, but further expansion of horticultural facilities, staff, and

increased funding is recommended to successfully manage our endangered plants and forests. Like the concept for the Ark of Noah, we are gathering Hawai'i's rare plants together to be preserved, grown, and planted back into the wild.

Thank you very much!

We are so grateful to the following forward-looking individuals who have included the National Tropical Botanical Garden in their estate plans. These Legacy Donors are our future, and we are so thankful they have put their faith in us.

Patti Amstutz
Kathy Nelson and Steven Arns
Mr. and Mrs. Matthew Blair
Dr. Ben Bowen and Dr. Renee Kossiak
Motoko and Gordon Deane
Mr. Keith Evans and Ms. Sharon Pollock
Rob Evans and Terry Micheau
Andrea Henderson Fahnestock
Lock and Jann Gibbs
Heather and Patrick Henry
Mr. Merrill L. Magowan
Hau'oli and Chipper Wichman

"I am enamored of beautiful gardens in general and was struck by the sheer beauty of Allerton and McBryde Gardens. When I became an NTBG Trustee and got more and more involved, I became convinced NTBG is a great institution. So I put NTBG in my will 12 years ago. I have been donating through my IRA ever since, rather than taking Required Minimum Distributions. I learned to use my IRA for deferred gifts, thanks to significant tax savings."

– Merrill Magowan

We invite others to consider this philanthropic option. A gift in your will or trust is a meaningful way to support the National Tropical Botanical Garden. Known as a charitable bequest, a gift in your will is a simple way to ensure the programs you support will continue for years to come. For more information, contact NTBG Director of Philanthropy Heather George at (808) 762-1499 or hgeorge@ntbg.org.

MOONLIGHT & MUSIC

Mahalo to all of our supporters!

We are so grateful to everyone who made donations in honor of this event and who donated or purchased items at the online auction.

For a full list of all 2021 Sponsors and Donors, visit <https://ntbg.org/events/the-ntbg-virtual-auction/>

Stay tuned to the *Go Botanical* e-newsletter for information about 2022 plans.



National Tropical Botanical Garden has received accreditation from Botanic Gardens Conservation International (BGCI) as an Advanced Conservation Practitioner. The designation is the highest level obtainable and recognizes excellence and international leadership in plant conservation policy, practice, and education, a distinction limited to a select global group of botanical gardens. NTBG also holds the highest level IV of accreditation from The ArbNet Arboretum Accreditation Program, which recognizes international industry standards for arboreta.

Learn more here:



wish list

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

ADMINISTRATION/FINANCE

Two upholstered chairs - \$500
 Paper shredding - \$500
 10-key calculator - \$60

BREADFRUIT INSTITUTE

Standing desk for PhD Scientist - \$600
 Desktop computer and software - \$1,900

KAHANU GARDEN

All terrain tires for utility vehicle - \$400
 Gravel for road improvements - \$450

LIMAHULI GARDEN

Medify air purifier - \$350
 Hand radios (10) - \$290 each

LIVING COLLECTIONS AND HORTICULTURE

Evaporator cooler for rare plant propagation - \$600
 'Phytatray' fern propagation containers - \$450

MCBRYDE AND ALLERTON GARDEN

Automated External Defibrillator - \$1,250

SCIENCE AND CONSERVATION

Extra drone batteries - \$300

THE KAMPONG GARDEN

Computer for Senior Horticulturist - \$500
 Monitor for security system - \$250

VOLUNTEER PROGRAM

4mm polyester braided cording - \$30
 Batik or Hawaiian cotton fabric - \$50

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



PHOTO BY JANNE LARSEN

LET IT FLOW

In March, Hawai'i's Commission on Water Resources Management announced the end of a century of stream diversion and return to continuous flow for the Lawa'i Stream. The small but important waterway meanders from the mountains of central Kaua'i through NTBG's McBryde and Allerton Gardens to the bay at Lawa'i-Kai, a special subzone conservation area fronting Allerton Garden. The change comes after decades of encouragement by Kaua'i's conservation community. NTBG President Chipper Wichman calls the restoration a "balancing act," but also a "win-win" for stakeholders. Owners of nearby reservoirs can still collect high-flow storm water and supply small farmers with affordable ag water, helping them feed the community. As for NTBG, continuous flow will improve the health and beauty of the stream, enhance native species habitat, and reduce stream blockage by invasive plants while providing vital irrigation water to the Garden.



PHOTO BY JON LETTMAN

POUNDING, STAMPING, AND DYEING

After 15 months of distancing and mostly remote events, NTBG held three sessions of workshops on how to make traditional Hawaiian kapa (cloth bark) from wauke plants (*Broussonetia papyrifera*). Nearly 50 local residents joined instructors Sabra Kauka and Janne Larsen for the three-day sessions. Participants harvested, stripped, and pounded the outer bark of wauke harvested from McBryde's Hawaiian Life garden. Working in the open-air thatched hale (house), small squares of kapa were pounded soft. Next, natural dyes were prepared using Hawaiian 'canoe plants' like 'olena (turmeric), kukui root bark, hau, and introduced trees such as rainbow eucalyptus, African tulip, and others. Participants used 'ohe kapala (bamboo carved stamps) to make patterns on their kapa. Sabra and Janne welcomed the chance to share and perpetuate plant-based Hawaiian arts and culture in the garden and expressed their gratitude for all NTBG staff who care for the garden.



PHOTO BY MIKE DEMOTTA

RAREST OF THE RARE

First discovered in the Upper Limahuli Preserve by NTBG research biologist Ken Wood in 1991, *Cyanea kuhihewa* (Campanulaceae) was thought to have been driven closer to extinction by Hurricane 'Iniki (1992) with the last known individual dying in 2003. In 2017, NTBG staff, partnering with The Nature Conservancy of Hawai'i, discovered a new population of three *C. kuhihewa* in a valley near Limahuli. Since 2018, NTBG has collaborated with the University of Hawai'i's Lyon Arboretum to propagate wild collections of immature seeds and clonal seeds of excised embryos from the mother plant. NTBG initially outplanted four individuals in the Upper Limahuli Preserve and will be planting more after receiving 60 seedlings grown in Lyon's laboratory on O'ahu. Although it is one of the rarest plants in the world, decades of staff commitment and ongoing collaboration, along with support from Kamehameha Schools, Fondation Franklinia, and the National Geographic Society, are giving *Cyanea kuhihewa* a new chance to thrive.



PHOTO BY STEVE FERLMAN

ICTB RESEARCHERS VISIT KAUAI

Construction of the International Center for Tropical Botany (ICTB) won't be complete until at least the spring of 2022, but researchers are already collaborating with NTBG staff. Last June, Dr. Elliot Gardner, a postdoctoral researcher working on taxonomic and DNA analysis projects, visited NTBG headquarters on Kaua'i. His work has led to the publication of a new species from Brazil, *Plantago campestris*, authored by Dr. Gustavo Hassemer with co-authors he and Conservation and Science director Dr. Nina Rønsted. In May, seed bank and laboratory manager Dustin Wolakis hosted Florida International University (FIU) graduate student Christopher Sorich to conduct fieldwork with he and botanist Steve Ferlman to study how chemical defenses and other traits help Hawaiian Lobeliads adapt to their habitat. A second FIU graduate, Ashwaq Younis, visited in July to join conservation biologist Seana Walsh in building a database to compare traits between rare and more common Kaua'i endemic plants. The project relies on data compiled during NTBG's 2020 IUCN Red List assessment campaign to complete all 255 Kaua'i single-island endemic plant species.



PHOTO BY THE GRACE PROJECT

'ULU FOR AFRICA

NTBG's Breadfruit Institute (BFI) continues to collaborate with organizations around the world to distribute select varieties of breadfruit (called 'ulu in Hawaiian) for the greatest impact. Working with the Trees That Feed Foundation, in 2019 the Breadfruit Institute contributed to the shipment of 1,000 trees to Kenya, Tanzania, and Uganda. Varied distribution provides the opportunity to document optimal growing conditions for future shipments. In East Africa, a group called the Grace Project partners with a local collective, Women Against Poverty, to produce breadfruit flour used to feed hungry communities. Meanwhile, in West Africa, BFI is partnering with Germany-based Cultivaris GmbH who has worked with Rotary International to ship 500 tissue culture-produced Ma'afala trees provided by the Breadfruit Institute to Gambia for community projects and trials by the Ministry of Agriculture. Rotary hopes to ship one million trees in the next decade.

an eye on plants

SELECT SPECIES IN FOCUS

Avocado (*Persea americana*)

A favorite fruit-bearing tree since pre-Columbian times, the Aztecs called it *ahuacatl* – a not-so-subtle anthropomorphism inspired by the drooping egg-shaped fruit thought to enhance fertility. When the first avocados were introduced to the United States from Mesoamerica in the 19th century, they were a curiosity.

Today the ubiquitous big green fruits – technically a single-seeded berry – has achieved celebrity status and is more beloved than ever. Mexico is the world’s largest exporter, but California and Florida are major producers, growing colorfully named cultivars: ‘Zutano’, ‘Pinkerton’, ‘Lula’, ‘Mexicola’, and the world famous ‘Hass’, self-named by California postman Rudolph Hass.

In Florida, the avocado epicenter is Miami-Dade and Collier counties where West Indian and Guatemalan varieties are most common. At NTBG’s Miami garden The Kampong, avocados harken back to the days of botanist and plant explorer Dr. David Fairchild who developed the site as his home and garden (1916-1954).

While on an expedition in Chile in 1899, Fairchild had a life-altering encounter with an avocado. Enraptured by its smooth, buttery consistency, Fairchild recognized the avocado’s potential as a crop suitable for the southern United States. He proceeded to pack nearly one thousand “alligator pears” into

crates which he shipped to the USDA’s Division of Seed and Plant Introduction.

By the time the shipment had reached Washington, most of the fruit had spoiled, but the seeds remained viable and were transferred to a greenhouse for propagation. Some of the resulting trees made it to California where they helped spawn a multi-million dollar industry.

In those days, the avocado was a luxury item for the few, but Fairchild believed it would appeal to the masses. In 1913, he dispatched a young agriculturist named Wilson Popenoe to collect the budwood of 23 avocado cultivars in Guatemala which were later grafted onto trees in Miami.

According to Fairchild’s handwritten planting notes, he introduced over 50 avocado trees representing nearly 30 cultivars including ‘Kampong’, ‘Bluenose’, ‘Way Late #12’, ‘Cannonball’, ‘Itzamna’, and ‘Fuerte’, which has been growing for nearly a century, making The Kampong a “living encyclopedia” of early fruit tree introductions.

Today 23 avocado varieties grow at The Kampong including many grafted onto Fairchild’s original rootstock by Kampong director emeritus Larry Schokman during his tenure. The trees are most productive between September and October, with some bearing heavily every year and others on alternate

years, according to Kampong director Craig Morell.

As tall and stately as avocado trees can be, this thirsty crop faces no shortage of threats in south Florida from competition for land to hurricanes, drought, and disease. Since 2002, the redbay ambrosia beetle has spread south from Georgia into Florida, carrying a pathogenic fungus which causes laurel wilt, a disease that kills avocado trees and other woody members of the Lauraceae.

In a 2010 Bulletin article (Vol. XXVII, No. 3), then-Kampong curator of living collections David Jones recounted how The Kampong sent 17 cultivars to an agricultural research facility in Ft. Detrick, Maryland for quarantine before they were transferred to a USDA Agriculture Research Facility in Hilo, Hawai’i for safe keeping. Celebrated for their legend and lore, avocados continue to play an integral role in the beauty and heritage of The Kampong, a reminder of why we love trees and work tirelessly to save plants.

The UN General Assembly has designated 2021 as the International Year of Fruits and Vegetables. The campaign provides an opportunity to increase awareness of the importance of fruits and vegetables to health, nutrition, food security, and UN Sustainable Development Goals.



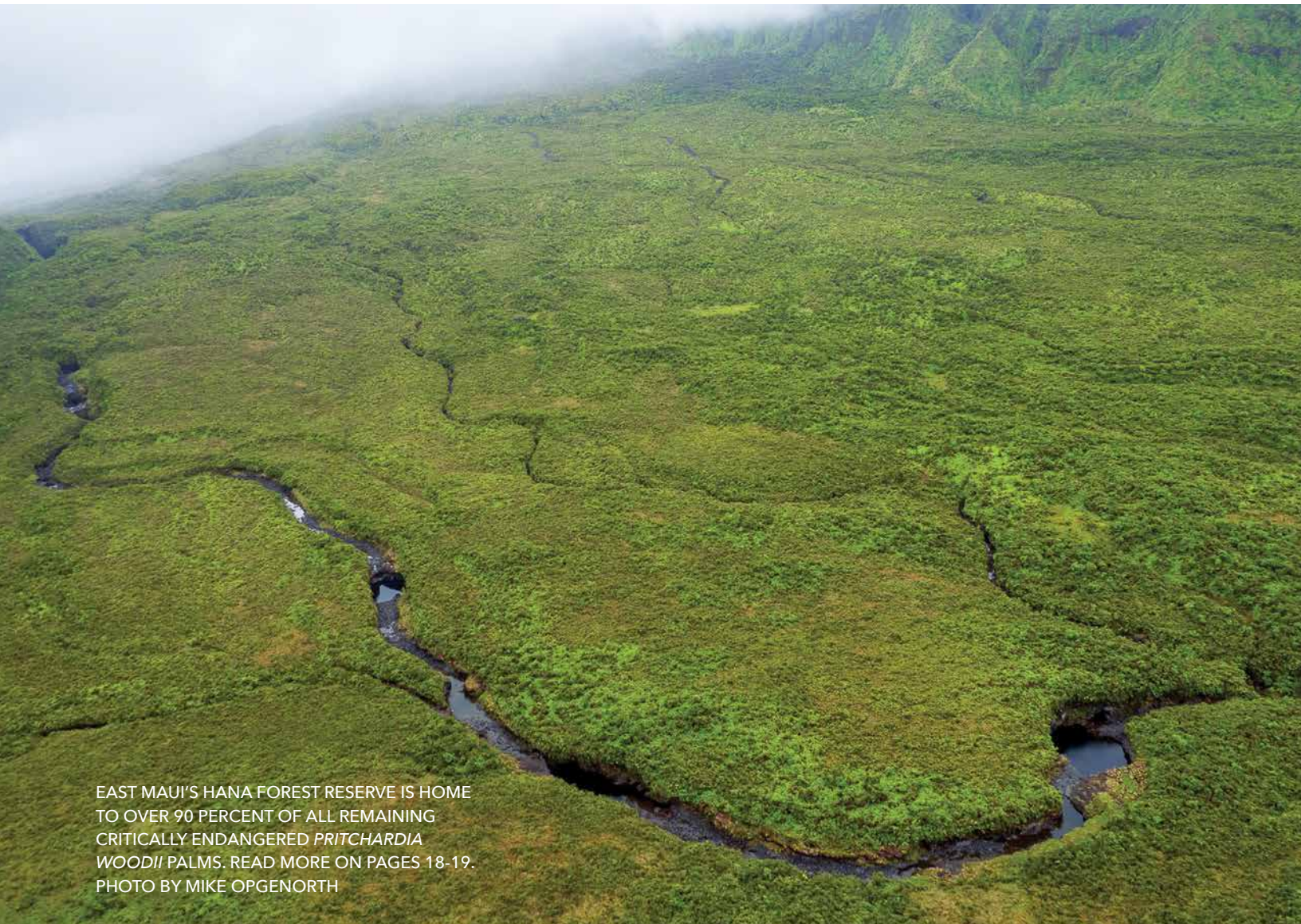
PHOTO BY CRAIG MORELL



National Tropical Botanical Garden

3530 Papalina Road
Kalāheo, Hawai'i 96741 USA

Saving Plants, Saving People



EAST MAUI'S HANA FOREST RESERVE IS HOME TO OVER 90 PERCENT OF ALL REMAINING CRITICALLY ENDANGERED *PRITCHARDIA WOODII* PALMS. READ MORE ON PAGES 18-19. PHOTO BY MIKE OPGENORTH