Ēwe Hānau o ka Āina

(*Natives of the Land*)

A seed bank, a laboratory and a greenhouse: In just a few modest spaces, Honolulu's Hawaiian Rare Plant Program is doing vast and valuable work. Its aim? To preserve the last living examples of species that play an important role in the ecosystem—and the culture—of the islands.

By Christine Thomas Photography by Dave Lauridsen

180

previous spread: (left) Nellie Sugii at Lyon Arboretum; (right) the endangered Ha'iwale

right: inside the micropropagation laboratory at Lyon Arboretum

A SMALL BURST OF leafy green rises in a clear glass tube—moist and healthy, contained and secure. It is a native Hawaiian plant in miniature—a *Cyrtandra gracilis*, or ha'iwale (ha-ee-vah-lay), federally listed as endangered and found nowhere else in the world. This unassuming shrub is just one of the Hawaiian archipelago's thousands of unique species and 1,400 native plants, 365 of which are listed as endangered or threatened. Since 2001, this rare specimen has been perched with other displaced and threatened Hawaiian flora rescued by the humble yet invaluable Hawaiian Rare Plant Program at Honolulu's Harold L. Lyon Arboretum.

"There is a ton of stuff in here that is really rare," says programme manager Nellie Sugii, identifying native unscented mints, ferns, orchids and even tree species—each with its own story and reason for decline, whether habitat loss, competition from invasive species, pathogens or climate change. More than 37 percent of species on the United States endangered species list are in the Hawaiian Islands.

Since 1997, Sugii has worked tirelessly to help the programme evolve from its roots as an orchid propagation centre into a robust native plant rescue and recovery operation focused on Hawaii's most critically endangered plants. The only programme of its scale in the state, with the largest Hawaiian native plant collection, it operates a greenhouse, a 6 million–strong seed bank, and a specialized micropropagation (*in vitro* plant multiplication) laboratory maintaining more than 20,000 plants in tissue culture for research and replanting.

"It's the Noah's ark of native plants," says Chris Dacus, a landscape architect and president of the Landscape Industry Council of Hawai'i, who also works with Lyon on a personal mission to conserve rare native palms. "Think of Nellie's lab as the tropical version of Svalbard," he says, referring to Norway's doomsday-defying seed bank (see page 183).

"Since 1997, Nellie Sugii has worked tirelessly to help the programme evolve from its roots as an orchid propagation centre into a robust native plant rescue and recovery operation focused on Hawaii's most critically endangered plants."

INTO THE VALLEY

The 194-acre (80-hectare) Lyon Arboretum sprawls in the cradle of verdant Mānoa Valley, minutes from urban Honolulu. Hidden in plain sight, the Hawaiian Rare Plant Program is tucked inside a plantation-style house that once accommodated workers of the Hawaiian Sugar Planters Association, which established the arboretum in 1918. It's small and simple, a place where one might think to leave one's shoes outside the door, in keeping with local custom, before entering the compact front office. The building itself underscores the

> *Some plants go to the greenhouse and back to a wild restoration site in less than two years, but half of the programme's plants are displaced—a much larger number than desired.*

tenuousness of native plants and of this entirely grant-supported effort—subject to both tropical winds and politicians' appetite for funding conservation.

That doesn't stop Lyon from blazing paths, propagating a treasure trove of native plants and pioneering seed storage protocols, developed with the University of Hawaii Seed Lab. "We have the majority of the state's collection, but we also have the best-equipped facility for research and testing," Sugii explains. "So if people have trouble figuring out how to store seeds, we either assist or do the trials and the research."

Lyon partners with other seed banks in Hawaii, including the National Tropical Botanical Garden (NTBG), with the goal of developing and implementing uniform storage protocols and procedures. "We look to Lyon with a great deal of respect," says Michael De Motta, NTBG's director of Living Collections and Horticulture. "They've always been the leaders in micropropagation, and are very successful in reproducing rare Hawaiian plants in their lab and maintaining them for the long term."

INSIDE THE LAB

Rows of plant-filled glass tubes rest patiently on wire racks inside the tissue culture lab, awash in fluorescent light. It's a sight so beautiful and so removed from nature that each diminutive specimen somehow seems larger than life. "Think of it like an emergency room," says Sugii. "Plants that can't be stored or grown in the seed bank or the greenhouse come into the lab." But as plants decline in this contained environment, necessary routine maintenance makes it seem more an intensive care unit. If it's possible to refresh them, plants can remain in vials for as long as a decade and then need to be grown anew from seed or cuttings, reviving the cycle.

Some plants go to the greenhouse and back to a wild restoration site in less than two years,

clockwise from top left: Lyon Arboretum greenhouse; the North Shore from Pahole Ridge; Uluhe ready for potting; furled fern; offices at Lyon Arboretum; protected flora on Hawai'i Loa Ridge

EUROPE

● **Svalbard Global Seed Vault** | Norway

SEED SAVERS | Norway's Svalbard

A thousand kilometres from the North Pole, secure in the permafrost of Norway's Svalbard archipelago, sits a crucial safe house ensuring genetic diversity in our global food supply. The **Svalbard Global Seed Vault** preserves duplicate seed collections conserved by approximately 1,400 gene banks around the world to protect future food security and agricultural sustainability in the face of expanding global population, new diseases and a changing climate.

REALLY BIG

- Capacity for 4.5 million seed samples = 2.25 billion seeds
- In full use, the world's largest seed collection

REALLY COLD

- Stored at minus 18°C (0°F)

REALLY SECURE

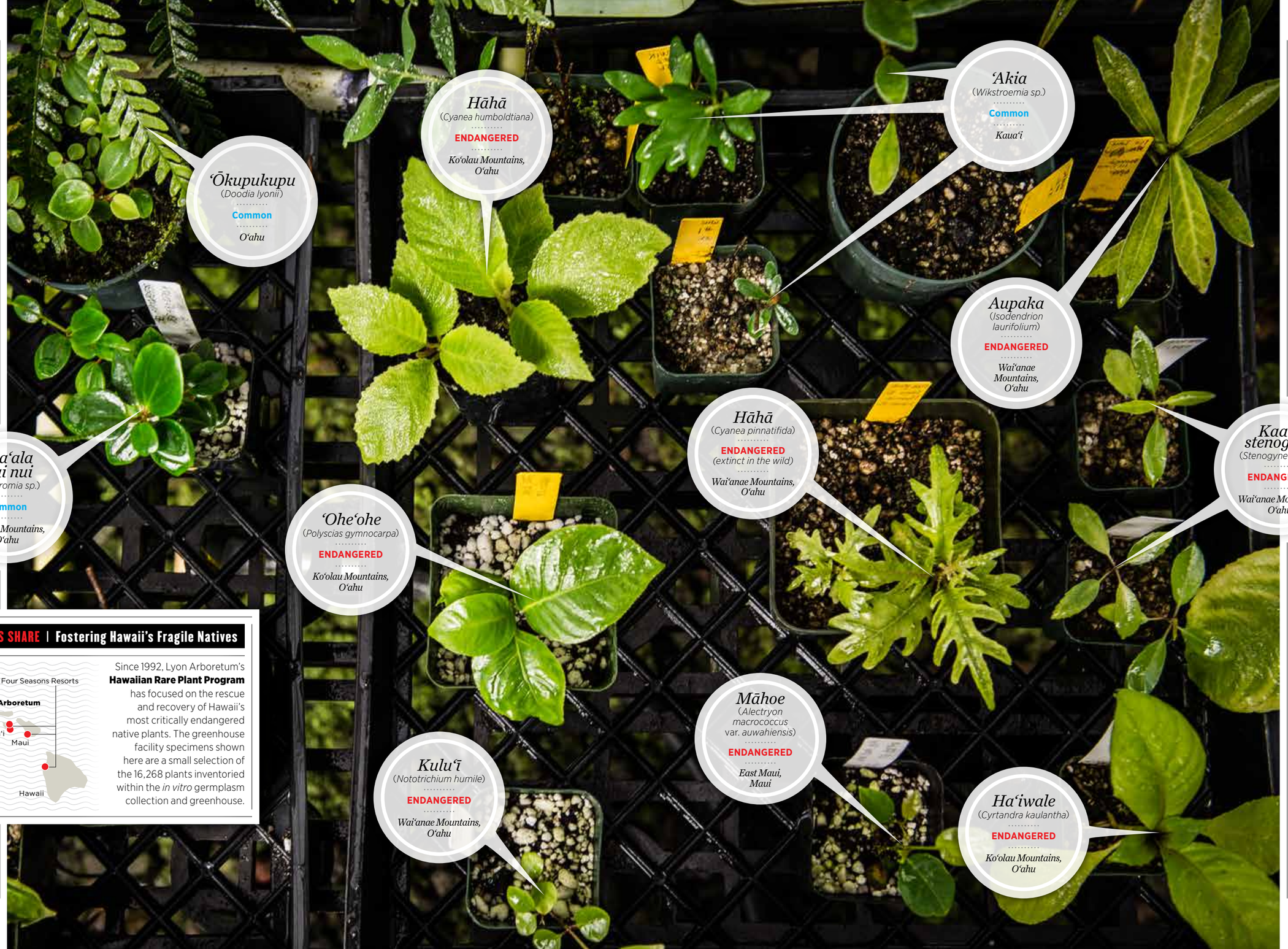
- Permafrost ensures viability if electricity fails.
- Three 1,200-cubic-metre (42,400-cubic-foot) underground chambers, 120 metres (400 feet) inside a mountain
- 130 metres above sea level to protect against sea level rises

NEARLY PERMANENT

- Seeds survive frozen for tens to hundreds of years.
- Before seeds die, a few are planted and new seeds harvested and stored.

For more . . .

www.regjeringen.no/en/dep/lmd/campain/svalbard-global-seed-vault.html



ʻŌkupukupu
(*Doodia lyonii*)
Common
Oʻahu

Hāhā
(*Cyanea humboldtiana*)
ENDANGERED
Koʻolau Mountains, Oʻahu

ʻAkia
(*Wikstroemia sp.*)
Common
Kauaʻi

Aupaka
(*Isodendrion laurifolium*)
ENDANGERED
Waiʻanae Mountains, Oʻahu

Hāhā
(*Cyanea pinnatifida*)
ENDANGERED
(extinct in the wild)
Waiʻanae Mountains, Oʻahu

Kaala stenogyne
(*Stenogyne kaalae*)
ENDANGERED
Waiʻanae Mountains, Oʻahu

ʻAlaʻala wai nui
(*Peperomia sp.*)
Common
Koʻolau Mountains, Oʻahu

ʻOheʻohe
(*Polyscias gymnocarpa*)
ENDANGERED
Koʻolau Mountains, Oʻahu

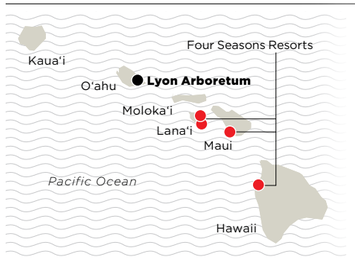
Māhoe
(*Alectryon macrococcus* var. *auwahiensis*)
ENDANGERED
East Maui, Maui

Kuluʻī
(*Nototrichium humile*)
ENDANGERED
Waiʻanae Mountains, Oʻahu

Haʻiwale
(*Cyrtandra kaulantha*)
ENDANGERED
Koʻolau Mountains, Oʻahu

NORTH AMERICA

LYON'S SHARE | Fostering Hawaii's Fragile Natives



Since 1992, Lyon Arboretum's **Hawaiian Rare Plant Program** has focused on the rescue and recovery of Hawaii's most critically endangered native plants. The greenhouse facility specimens shown here are a small selection of the 16,268 plants inventoried within the *in vitro* germplasm collection and greenhouse.

“The team maintains plants until an exit strategy and secure habitat are in place, but even then challenges abound, from lifelong management to continued protection from threats.”

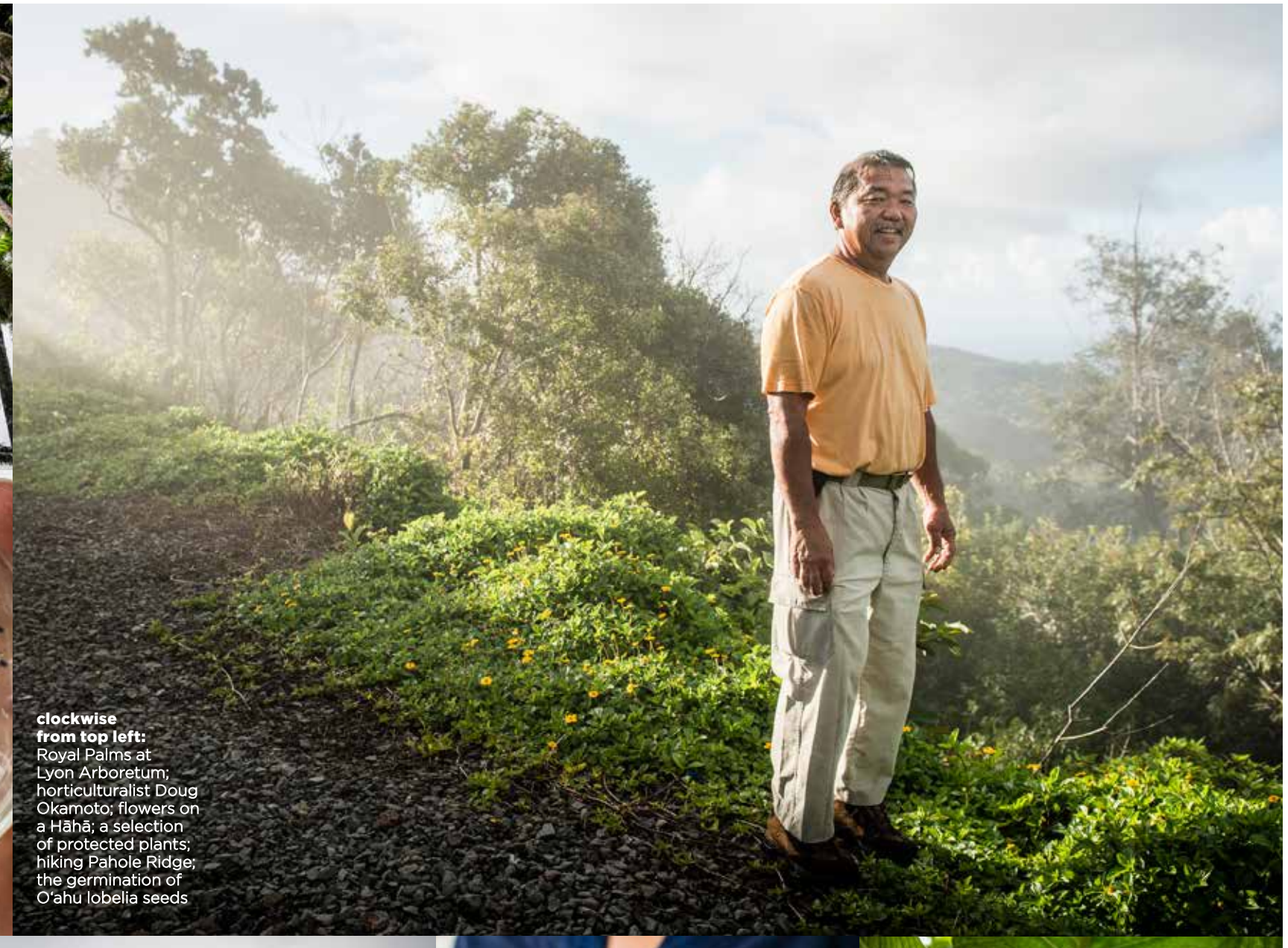
but Sugii estimates that, like the ha‘iwale, half of the programme’s plants are displaced—a much larger number than desired. “Sometimes a plant comes in without a restoration project,” Sugii explains. “[Field biologists] find populations or plants that are imperilled, so they do collections out of desperation but not necessarily for a particular project.”

Sugii and her team maintain plants until an exit strategy and secure habitat are in place, but even then challenges abound, from lifelong management to continued protection from threats. Yet conservationists agree that these endangered plants should remain in Hawaii, in the island ecosystem they evolved to inhabit. “You’d rather try at home first,” says Sugii. “When you move a plant to another place, it has the potential to become a big problem, like our beach naupaka—in Florida it’s an invasive. You have to be very careful.”

Others believe it’s unethical to relocate plants that are not only best suited to Hawaii’s environment but also considered culturally essential. “Native plants evolved in the context of the Hawaiian ecosystem,” says Kawika Winter, director of NTBG’s Limahuli Preserve on Kaua‘i. “Not only are they important components of biodiversity and the ecosystem, but also of cultural history. Every time a fern goes extinct, a word in the Hawaiian language will also be lost.”

SEEDING THE WAY

Two downstairs rooms hold the research and storage units of Lyon’s flourishing seed bank, begun 18 years ago by now-retired ecologist Alvin Yoshinaga. “The conventional wisdom was that seeds of native Hawaiian plants could not be stored, because it was known that seeds of plants from wet tropical areas are hard to store,” says Yoshinaga, who soon discovered that assumption to be erroneous—many seeds could indeed be stored by simple methods,



clockwise from top left: Royal Palms at Lyon Arboretum; horticulturalist Doug Okamoto; flowers on a Hāhā; a selection of protected plants; hiking Pahole Ridge; the germination of O‘ahu lobelia seeds

EUROPE

SEED SAVERS | U.K.’s Kew Gardens

In partnership with 80 countries, U.K.–based **Kew Gardens Millennium Seed Bank** has collected more than 11 percent of the world’s seed-bearing plant species, and is aiming for 25 percent—75,000 species—by 2020. Lyon Arboretum is laying groundwork to join Kew’s Millennium Seed Bank Partnership, which has targeted at-risk plants threatened by climate change and human activity in vulnerable mountain, dryland, coastal and island ecosystems, making native Hawaiian plants a natural fit.

FAST FACTS

- World’s largest **wild plant** seed bank
- Can store any **rare, threatened** plant species
- Has reintroduced **420 plant species** into the wild
- Has supplied **4,600 seed samples** for research and conservation
- Has analysed **seed data** for 9,200 species
- Has **saved** 33,491 species and **stored** 1,951,215,177 seeds (as of December 2013)

For more . . .
www.kew.org/science-conservation/save-seed-prosper/millennium-seed-bank

FOUR SEASONS MAGAZINE / ISSUE 1 / 2014

providing a powerful tool for native forest restoration and rare plant conservation.

"Because Hawaii is an isolated island chain in the middle of the Pacific, the seeds that colonized this land had to travel with the jet stream, birds and currents over thousands of miles of ocean, and survive that journey," says seed bank manager Tim Kroessig. "That helped to select for long-lived seeds." Approximately 90 percent of the seeds from Hawaiian flora that have been studied can be stored. The method depends on the type of seed—some keep best under refrigeration, others in the freezer, and some could go longer in cryogenic storage over liquid nitrogen, a technology Lyon doesn't currently possess. Regardless of the technique, this storage has time limits—some seeds keep for five to 10 years, others for 100—but it helps buy time for restoration and outplanting to supplement wild populations. "At some point, these seeds are going to become unviable, so we need to use them before then," says Kroessig. "They need to be withdrawn, and then germinated and grown out."

Clear communication between collectors, field biologists and Lyon's facility is key to determining how best to rescue native plants—revitalize them in the nursery, store their seeds in the seed bank or keep them alive in the tissue culture lab.

> *"Native plants evolved in the context of the Hawaiian ecosystem. Not only are they important components of biodiversity, but also of cultural history. Every time a fern goes extinct, a word in the Hawaiian language will also be lost."*
>
> **—Kawika Winter**

A HOPEFUL FUTURE

In the wild, the ha'iwale is just a modest understory shrub. Though it doesn't play a significant role in Hawaiian culture or the forest community, it quietly helps balance its native ecosystem. The plant was thought to be extinct until 15 years ago, when a field biologist discovered it in its sole habitat—Oahu's northern Ko'olau Mountains. Today just eight to 10 ha'iwale exist in the wild, all of them on one privately owned, unfenced and unprotected property. The owner wants to sell the land and lacks the inclination to host a restoration project. There are no alternative sites. So, like many others on Lyon's wire racks, the ha'iwale waits, watched over by passionate scientists fighting in the background to save it.

"Hawaii has so many species on the endangered list as well as potentially to be listed," says Sugii. "And there are whole sets of species in certain families we have no real good information about. There's a lot more work to be done." ■

Christine Thomas *is a Honolulu-based travel, culture and food writer who moonlights as a book critic and fiction writer. She recently edited and contributed to* Don't Look Back: Hawaiian Myths Made New, *a collection of Hawaiian myths reimagined by contemporary authors.*

right: the beautiful Makua Valley amid the Wai'anae Mountains of O'ahu