

ECOSYSTEM

MANAGEMENT PROGRAM BULLETIN

2019 ISSUE



INTRODUCTION

MOVING FORWARD TOGETHER

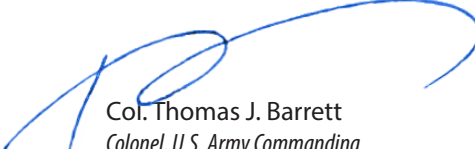
The Hawaiian Islands are the most geographically isolated group of islands on Earth. They are also home to more than 500 federally listed threatened and endangered species and countless cultural and archaeological resources.

A number of these unique resources can be found on U.S. Army installations and training areas. From plants and birds, to snails, bats and insects, the Army's natural resource programs on O'ahu and Hawai'i Island manage more than 120 threatened and endangered species. Likewise, the Army's cultural resource programs in Hawai'i manage more than 3,000 significant cultural resources, including historic sites, structures, buildings and artifacts.


The Ecosystem Management Program Bulletin is designed to educate the public and the military community about the unique resources on Army-managed lands and the Army's efforts to conserve them. Our hope is to encourage a collective conservation ethic, foster innovation and inspire and expand opportunities for collaboration and partnership with academia, industry and beyond.

The Army's core mission is to train our Soldiers so they are ready when called, and this mission is directly tied to the environmental stewardship of the resources in our care. Protecting the environment means sustaining the mission and securing the future.

U.S. ARMY GARRISON HAWAI'I



Col. Thomas J. Barrett
Colonel, U.S. Army Commanding



Kent K. Watase, PE
Director of Public Works

ON THE COVER A blooming *Gouania vitifolia*, an endangered vine that exists only in the Wai'anae mountains of O'ahu. BACKGROUND A native wiliwili tree (*Erythrina sandwicensis*) frames the opening of Kea'au, a valley that sits between Mākaha and Mākua Valley, on O'ahu's leeward side.



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by the Office of the Vice President for Research and Innovation

"In Kea'au, the fire was a disaster. But we must move forward, look at the positives of seeing ma'o hau hele recruitment, and restore the Kea'au forest once again. Wae aku i ka lani."*

**Let the selecting be done in the heavens; take life as it comes*



MISSY VALDEZ

Melissa "Missy" Valdez has worked with the Army Natural Resources Program on O'ahu for more than 10 years. With a master's degree from the University of Hawai'i at Manoa in Natural Resources and Environmental Management and a tendency towards optimism, Missy keeps her team of natural resource management technicians moving forward by focusing on actions where they can make the greatest impact.

Missy is a natural resource field supervisor with the University of Hawai'i, Office of the Vice President for Research and Innovation, working for the U.S. Army Natural Resources Program on O'ahu.



TIMOTHY CHAMBERS

"There is great potential in a seed."

Tim Chambers oversees the operations of the Army's seed conservation lab. Prior to joining the Army's natural resources team, Tim worked extensively in the areas of seed conservation and restoration plant material development in the Eastern United States with Seeds of Success, the Mid-Atlantic Regional Seed Bank and the Greenbelt Native Plant Center, New York City Parks and Recreation.

Tim is a propagule management biologist with the University of Hawai'i, Office of the Vice President for Research and Innovation, working for the U.S. Army's Natural Resources Program on O'ahu.

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The natural resources program at PTA has grown from a team of four in 1995 to nearly 30, and senior program manager, Lena Schnell, has been there from the beginning.

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KEA'AU:

A RIPPLE OF

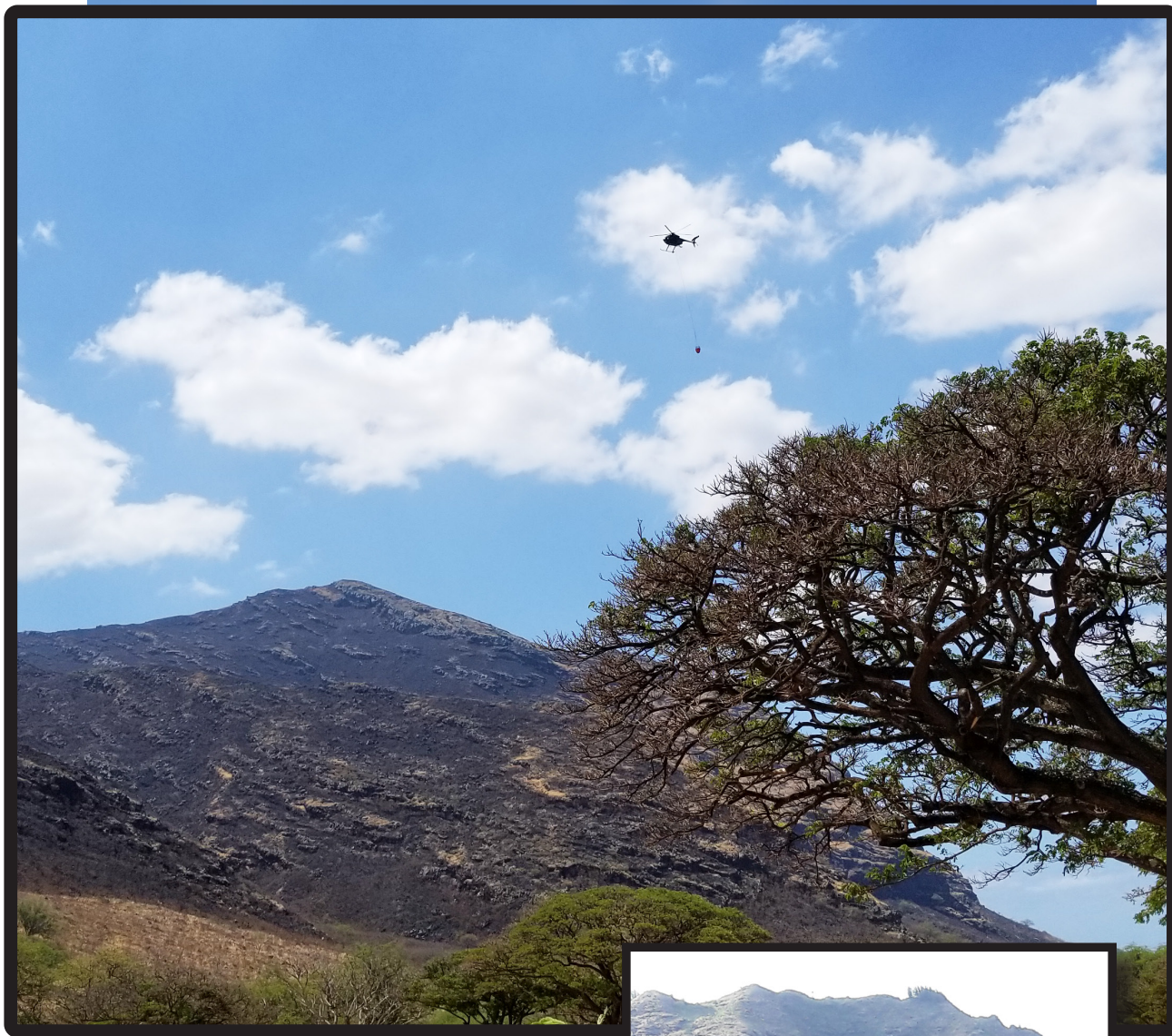
HOPE



IN THE HAWAIIAN DRY FOREST



BY MISSY VALDEZ



ABOVE Flames from a 2018 arson fire started in Wai'anae Valley and swept up and over steep ridgelines to Kea'au, where the fire was finally extinguished by concerted water drops from Army Black Hawks and the natural resources program's contracted helicopters. RIGHT An Army Black Hawk helicopter refills a water bucket from a dip pond in nearby Mākua Valley.



Kea'au

ahupua'a sits on the leeward side of O'ahu between Waikomo and Mākua valleys. Once a thriving dry forest with one of the largest stands of wiliwili (*Erythrina sandwicensis*) on O'ahu, Kea'au has changed drastically over the years.

Most recently, a 2018 arson fire that started in Makaha and spread over Waikomo ridge into Kea'au obliterated the fenced habitat in the upper reaches of the State's Kea'au Forest Reserve, taking hundreds of endangered dry forest plants and their habitat in the process.

Hawai'i's land use history and ongoing threats such as fire and invasive species continue to imperil one of the world's rarest ecosystems—the dry forest—along with its unique inhabitants. Nonetheless, the Army Natural Resources Program continues to support endangered dry forest species through various conservation projects and partnerships. The Army works with more than 30 local, state, and national entities to protect O'ahu's resources.

FIRE IN THE HAWAIIAN ISLANDS

Despite fires from the Hawaiian archipelago's volcanic

formation, naturally occurring fires are relatively infrequent across the Hawaiian Islands. Unlike conifer forests along the western coast of North America, which need to burn to remove understory brush and encourage seedling germination, Hawaiian forests burned infrequently, causing them to have limited adaptations to fire.¹ When native ecosystems and species are not adapted to fire, they do not recover following wildfires, leaving the landscape forever altered.

When the first Polynesians arrived in Hawai'i, forests were burned to create landscapes for agriculture.² With Western contact and the arrival of more people, agriculture and development expanded significantly, further increasing impacts of fire on the landscape.

In addition to agriculture, introduced ungulates, such as pigs, cattle and goats, along with invasive plants, have accelerated the decline of native forests across Hawai'i.

¹Anne Marie LaRosa, et al. 2008. *Fire and nonnative invasive plants in the Hawaiian Islands bioregion*, in: Zouhar, K., Smith, J., Sutherland, S. and Brooks, M. *Wildland fire in ecosystems: Fire and nonnative invasive plants*. Gen. Tech. Rep. RMRS-GTR-42-vol.6 Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 225-242.
²Patrick Kirch, "The impact of the prehistoric Polynesians on the Hawaiian ecosystem." *Pacific Science* 36,1 (1982): 1-14.
³Clay Trauernicht, et al. "The Contemporary Scale and Context of Wildfire in Hawaii." *Pacific Science* 69 (2015):427-444.

Former lowland dry shrublands and grasslands are now dominated by invasive, fire-loving grasses. Invaded habitats in proximity to ignition sources—places inhabited by humans—allow wildfires to spread rapidly into nearby forested areas.³ Lowland and montane dry forests, such as those within the Kea'au Forest Reserve, have been the greatest victim of fire's reach.

On O'ahu, the situation is most dire. Only a few pockets of native dry forests remain and within the past couple of years the leeward side of O'ahu has seen over a dozen fires, many started by arsonists. Fires have become increasingly more common in Hawai'i every year and have led to even more fire-prone grasslands.⁴

ONE OF O'AHU'S LAST DRY FORESTS

Above the Silva family's 'Ōhikilolo Ranch and the Our Lady of Kea'au spiritual center, the Kea'au Forest Reserve was created to preserve one of the precious pockets of dry forest remaining on O'ahu. Over the



ABOVE Victims of the Kea'au 2018 fire included one of the largest remaining stands of the native wiliwili tree (*Erythrina sandwicensis*), light-colored trees in foreground and upslope, along with numerous alahe'e (*Psydrax odorata*), lama (*Diospyros sandwicensis*) and other native dryland forest species. LEFT While this Kea'au fence built by the Army's natural resources staff won't keep the flames in check, it will prevent feral goats and cattle from eating native plants reintroduced after the fire.

³Carla M. Antonio and Peter M. Vitousek. "Biological Invasions by Exotic Grasses, the Grass/Fire Cycle, and Global Change." *Annual Review of Ecology and Systematics* 23 (1992):63– 87.



years, botanists surveyed native patches in Kea'au and found a variety of native plant species including wiliwili, a'ali'i, lama, *Gouania*, alahe'e, and naio. The steep terrain, harsh wind and sun, along with the degraded habitat make it difficult to survey. As a result it was not until 2009 that botanists discovered endangered ma'o hau hele (*Hibiscus brackenridgei* subsp. *mokuleianus*) in the area, its bright yellow flowers barely peeking through thick clusters of invasive Guinea grass. This particular subspecies of ma'o hau hele is unique to the island of O'ahu and one of the taxa under the Army Natural Resources Program's care.

Previous documentation of ma'o hau hele populations by the Army and the state's Division of Forestry and Wildlife were limited to Mākua Valley and various gulches within Waialua. A fire in 2007 along Kaukonahua Road that spread into the mountains wiped out the densest population of ma'o hau hele on O'ahu—approximately 90% of the total plants in the world. The newly discovered Kea'au population then became a top priority to protect and add to the Army Natural Resources Program's ma'o hau hele living collection.

In order to protect the Kea'au forest from goats and cattle, which could trample or consume the ma'o hau hele, Army natural resources staff built a fence around the wild ma'o hau hele and the intact native dry forest. Staff also grew new ma'o hau hele plants from cuttings gathered from wild plants in Kea'au, and one year later, began reintroducing ma'o hau hele plants into the Kea'au fenced enclosure.



ABOVE The underside of an endangered ma'o hau hele blossom (*Hibiscus brackenridgei* subsp. *mokuleianus*) and new flower buds. **OPPOSITE PAGE** Natural resource technician Keith Adams, with the Army's natural resources program on O'ahu, removes highly flammable invasive grasses in the Kea'au management unit. **BELOW** An aerial view of the 2018 scorch zone that extends to Kea'au, the farthest northern extent of the burn.

Since the fence was completed, Army natural resources staff have reintroduced over 100 ma'o hau hele plants and have increased efforts to control invasive Guinea grass and koa haole. This work is essential for improving habitat surrounding the endangered Hibiscus species and decreasing the amount of potential fuel for fires.

KEA'AU, A VICTIM OF FIRE

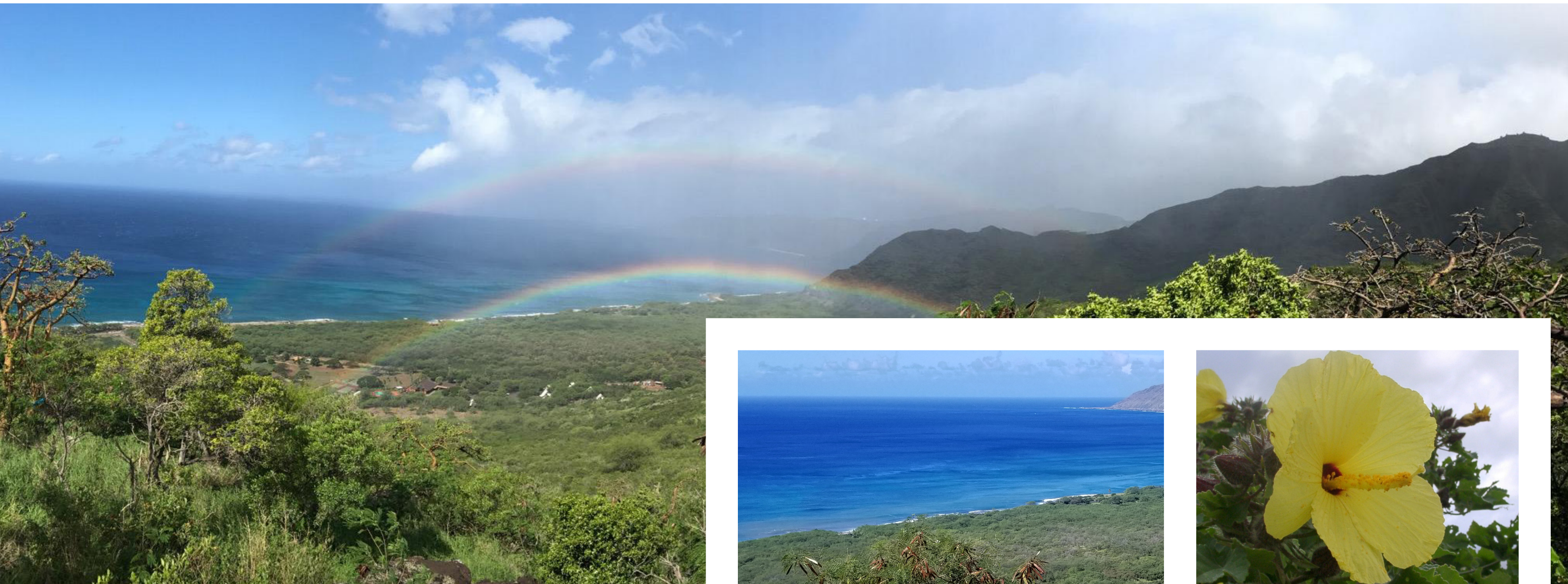
Despite the progress in Kea'au, in August 2018, a fire burned through most of the valley. Started by an arsonist in Wai'anae, the fire jumped over the Waikomo ridge, sweeping across the ma'o hau hele fence and known locations of *Gouania vitifolia*, another endangered species under Army management.

Army Black Hawk helicopters and the natural resources program's contracted helicopter managed to extinguish the Kea'au fire after several days of burning, at which time a total of 5,381 acres within Kea'au, Mākaha and Wai'anae were scorched.

Army and state biologists surveyed the area to determine the damage following the fire. Results from the surveys revealed that the *Gouania vitifolia* population was completely burned and few wild ma'o hau hele survived. In addition, large wiliwili (*Erythrina sandwicensis*) stands were completely demolished.

Despite the impacts to the wild ma'o hau hele individuals, most of the recent outplants were not impacted. In fact, they





were thriving and healthy, likely due to the Army Natural Resources Program's grass removal efforts.

ON THE ROAD TO RECOVERY

Determining how to proceed with management following this disastrous event was challenging, as two dominant species in the habitat, wiliwili and naio, would not recover. Hope sprouted a few months later when staff monitored the ma'o hau hele at the wild and reintroduction sites. To everyone's surprise, the team found over 30 new ma'o hau hele at the wild site. With careful weeding and a good amount of rainfall, the endangered ma'o hau hele sprouted from the ashes, providing eight new ma'o hau hele founders for the Army Natural Resources Program's living collection

and a total of thirty immature plants. Staff have taken other proactive measures by growing ma'o hau hele at the Kahua seed orchard, which has produced thousands of seeds for storage in the Army seed bank at Schofield Barracks (read more about Kahua in Chamber's article beginning on page 14). Securing the ma'o hau hele stock off site through these measures ensures that the species is protected from future catastrophic events.

Nonetheless, as the threat of fire continues in the ma'o hau hele's natural habitat, the Army Natural Resources Program has made it a priority to control grass and koa haole, and to restore the dry forest habitat. In the past year, staff reintroduced over 300 wiliwili, naio, and a'ali'i into Kea'au and planted an additional 300 wiliwili in the



BACKGROUND Looking north towards Ka'ena Point, this iconic symbol of hope provides inspiration for the post-fire restoration work that has begun at Kea'au. **ABOVE** An endangered ma'o hau hele (*Hibiscus brackenridgei* subsp. *mokuleinus*) thrives within a fenced Army natural resources management unit on the leeward coast of O'ahu. **LEFT** These wiliwili (*Erythrina sandwicensis*) trees were outplanted in the Kea'au management unit by the Army's natural resources staff in December 2019.

winter of 2019. More restoration efforts are needed not only at Kea'au but along O'ahu's entire west side. Restoring native forests will reduce potential fire loads.⁵ Ma'o hau hele have shown their resilience in the recent fire at Kea'au. Through a little extra effort in the dry forests that remain, we give future generations the chance to see ma'o hau hele in full bloom.

⁵Clay Trauernicht, et al. "The Contemporary Scale and Context of Wildfire in Hawaii." *Pacific Science* 69 (2015):427-444.



**Schofield's
Native
Orchard
Supports**

**SEED
STORAGE**

By Tim Chambers

In 2017 the Army Natural Resources Program on O'ahu established Kahua, Schofield Barrack's native seed orchard, in an attempt to overcome some of the many challenges associated with making conservation seed collections from wild populations of rare plant species. Accessibility to a plant's remote and sometimes precarious location, low seed set in wild populations, difficulty in identifying mature fruit/seed, and timing seed collection efforts correctly, are all common obstacles when attempting to harvest from wild plants. Seed collection is an invaluable rare plant conservation tool, necessary to provide backup genetic storage in seed banks and as a source of propagules for reintroduction of rare plant resources.

AN INTER SITU APPROACH

Maintaining a seed orchard is an intermediate approach (inter situ) to rare plant conservation that falls between on-site conservation within natural plant populations (in situ) and off-site conservation (ex situ), where plants are maintained in botanic gardens or greenhouses. Inter situ sites for plants are generally locations that fall within the historic range of a given species, but outside of its current range, in settings where plants can be protected and managed and still experience natural climatic variation. Kahua is at the half-way point between highly managed living collections in the greenhouse and wild populations where plants

largely fend for themselves. At an elevation of 290 meters (950 feet) and conveniently located five minutes down the road from the Army's natural resources program baseyard, Schofield's native seed orchard gives staff the ability to make controlled hand pollinations to improve seed production and to make observations on the reproductive biology and phenology of species that are difficult to understand. One challenging species that is currently planted at Kahua is kulu'i (*Nototrichium humile*).

FLOWER OR FRUIT?

When it comes to seed collection, the endangered kulu'i is one of the Army Natural Resources Program's most problematic species. Kulu'i's relatively small flowers appear on slender spikes and the inconspicuous fruit, only two millimeters in diameter, are enclosed by the sepals—leaf-like structure—of the flower. These tricky sepals that surround the small fruit pose the greatest challenge to seed collectors, since they make it virtually impossible to differentiate a flower bud from a mature fruit without dissection and the use of a microscope. Further compounding the issue,

RIGHT Flower spikes of the kulu'i (*Nototrichium humile*).
FAR RIGHT Kulu'i dominates the foreground in the lower corner of Kahua, the Army's native seed orchard, created on the site of a former Schofield landfill.
BELOW AND PREVIOUS PAGE This thriving collection of kulu'i plants at Kahua must be closely monitored by natural resources staff to schedule seed collection.



Kulu'i (*Nototrichium humile*) is an upright or trailing shrub in the Amaranth family (Amaranthaceae) endemic to O'ahu and Maui. It currently occurs in very small populations on the Wai'anae Mountains of O'ahu on both the windward and leeward sides of the Schofield Barracks training complex. The Army's natural resources staff has observed kulu'i in remnant dry forests and shrublands, and it has been recorded at elevations from 200-2,300 feet. To learn more about Hawaiian dryland forests in this publication, turn to page 4.

kulu'i buds, flowers, immature fruits, and mature fruits all occur at the same time, and the fruits disperse seeds promptly at maturity. This rapid seed dispersal makes it very difficult for staff to be in the right place at the right time to harvest kulu'i seeds from wild populations. We do know that flowering is heaviest in the spring and summer; however, very little else is known about kulu'i's reproductive biology. Is this species self-compatible—can it pollinate itself—or are the flowers pollinated by insect or wind? As you can imagine, successful seed collection from wild populations is problematic without a basic understanding of reproductive biology and the means to recognize mature fruit.

In an attempt to overcome the challenges limiting seed collection in the wild, the Army Natural Resources Program decided to establish kulu'i at Kahua. An established inter situ collection of kulu'i will allow staff to make frequent observations of this difficult species, to increase our understanding of kulu'i reproductive biology. In addition, year-round easy access to viable seeds from kulu'i at Kahua facilitates

two primary goals for managing this endangered native Hawaiian plant: ability to preserve a sizable collection of kulu'i seeds in the Army Natural Resources Program's seed bank, enough to replace any wild populations of kulu'i impacted by current threats such as wild fires; and the ability to grow more kulu'i plants for future reintroductions in the wild.

In April 2017 natural resources staff planted 46 kulu'i plants at Kahua, representing the remaining 41 individual plants from two wild populations that are currently managed by staff of the Army's natural resources program. Drip irrigation was installed to supplement natural rainfall at Kahua. To date all of these original kulu'i plants at Kahua are alive and in good health. While flowering and fruiting was negligible in 2018, in March 2019 plants flowered prolifically and natural resources staff made monthly observations and fruit collections from March through July. However, at least one mystery still remains. During this recent spring flowering event, no birds or insects were observed, leaving us in the dark as to the mechanisms of pollination for kulu'i.



CLOCKWISE FROM TOP Flower spikes of kulu'i (*Nototrichium humile*); mature kulu'i fruit, collected from the Army's native seed orchard; processed kulu'i seeds in the Army's seed conservation lab; Army natural resource staff collecting kulu'i fruit from the wild. BACKGROUND Kahua, the Army's native seed orchard, at Schofield Barracks.



RIGHT A kulu'i (*Nototrichium humile*) seedling emerges in the growth chamber inside the Army's rare seed conservation lab at Schofield Barracks.



STAIR TREADS AND COLUMN BLOWERS

The Army's natural resources staff utilized the kulu'i fruit collections from Kahua to experiment with efficient and productive methods for seed extraction and to track number of seeds harvested over time. Kulu'i fruit were subjected to multiple treatments in order to determine the most efficient and productive processing method. Harvested fruit was first allowed to dry at 72 degrees Celsius and 45-55% relative humidity in the seed lab for one week. Fruits were then rubbed over a rubber stair tread mat to pulverize floral and fruit parts and to dislodge the seed. The resulting material was then put in a column blower that uses forced air to separate the "chaff" from the true seed.

Initially staff found that the stair tread process had potential to destroy the seed if too much pressure was applied during the rubbing action. However, as long as staff were careful to apply minimal pressure when fruits were rubbed over the stair tread, this approach, along with the column blower, resulted in a winning combination. By utilizing this stair tread/column blower approach, staff were able to process a collection from kulu'i containing thousands of fruit in approximately two hours from start to finish. The old method of extracting kulu'i seeds involved extracting each individual seed by hand and would take several staff multiple days to process large fruit collections.

With easy access to the fruiting kulu'i at Kahua and new seed processing techniques in effect, natural resources staff were able to make significant additions to the endangered kulu'i seed in storage. Collections made in the spring and summer months of 2019

yielded: 70 seeds on March 25, 25 seeds on April 17, 1,430 seeds on May 14, 4,186 seeds on June 18, and 1,010 seeds on July 17. Of course, what good are seeds if they can't be grown? Staff followed the seed processing with careful germination tests from each collection and found that seeds were indeed viable, with an average germination rate of 72.5%.

LESSONS LEARNED

Using observations made for the kulu'i planted at Kahua and the subsequent kulu'i fruit collection, the Army Natural Resources Program was able to exceed genetic storage goals for kulu'i of 50 viable seeds per wild individual plant for a total of 12 wild plants. The natural resources staff were also able to identify and describe the characteristics of a mature fruit as having brown or tan sepals versus the gray, hairy sepals that can be found on a closed flower or immature fruit.

This refined description of mature kulu'i fruit will help field staff discern whether the kulu'i plant they visit in the field contains fruit that is ready to harvest. However, this information may not guarantee an improvement in wild seed collection efforts given that mature kulu'i fruits disperse promptly, and therefore seed may not be present at the time staff are scheduled to collect from wild plants. The Army Natural Resources Program's success with kulu'i at Kahua demonstrates how inter situ sites can serve as a useful conservation strategy, especially in terms of seed production and collection, and may be the only means to obtain seeds from difficult species where wild collection of seed is not accessible.

RIGHT AND ABOVE To begin the seed extraction process, kulu'i (*Nototrichium humile*) fruit are rubbed between strips of re-purposed stair treads in the Army's seed conservation lab. The resulting mix of chaff (dry, protective casings) and seeds, get placed in the column blower. TOP Propagule research technician Makanani Akiona, who works for the Army's natural resources program on O'ahu, guides the pulverized kulu'i material through the column blower to separate the seed from the chaff.



Baron Yamamoto plants a native hapu'u (tree fern) on a volunteer trip with the Army Natural Resources Program on O'ahu to improve habitat within a rare tree snail enclosure. OPPOSITE PAGE A group of volunteers help outreach/volunteer program specialist Celeste Hanley (yellow shirt, foreground) control a patch of invasive ferns (*Blechnum appendiculatum*) in Kahanahāiki.

A Diverse & Dedicated



Community of Volunteers

Over the last 10 years, volunteers with the Army Natural Resources Program have spent more than 38,000 hours helping with efforts to protect endangered species. 2019 marked a record 4,634 hours of service, with the majority of efforts taking place in the native forest along with projects in the Army's rare plant nursery, seed lab, native seed orchard and Native Hawaiian interpretive garden. From budding conservationists and youth to active duty Soldiers and retired veterans, the diversity of volunteers in the program is as varied as the endangered species in its care!



Students from Nānākuli High School visit Kahua, the Army's native seed orchard at Schofield Barracks, to collect fruit from 'āweoweo (*Chenopodium oahuense*) plants with propagule management biologist Tim Chambers, who works for the Army's natural resources program on O'ahu. The 'āweoweo fruit will be processed and stored in the Army's seed conservation lab for future native forest restoration projects.

ELEMENTARY, MIDDLE AND HIGH SCHOOL STUDENTS

Each year, the Army Natural Resources Program seeks to connect students with the unique natural environments in their backyard. For Nānākuli High School seniors in their school's 'A'ali'i program, volunteering with the program allowed students the opportunity to gain valuable natural resource management skills and meet graduation requirements through hands-on service-learning activities in the mountains. From ecosystem restoration at Kahanahāiki, to predator control at Pālehua, the students discovered what it takes to conserve some of O'ahu's rarest natural resources while actively helping to protect them.

Ke Kula Kaiapuni 'O Ānuenue, Le Jardin Academy, Mililani High School and Wai'anae Intermediate School were among other K-12 participants in the program's volunteer activities in 2019.

SOLDIERS

For active duty service members, volunteering may not be the easiest activity to squeeze into a busy training schedule. Nonetheless, 43 members of Charlie Company, 1st Battalion, 27th Infantry Regiment, 2nd Infantry Brigade Combat Team, 25th Infantry Division dedicated over 344 hours of service to the Army's Natural Resources Program on two separate projects critical to the protection of endangered species.

A group of 28 Soldiers helped with trail improvement at Makaleha within the Mokule'ia Forest Reserve by hauling gravel to fill newly-constructed steps for the trail. By improving the trail, Army natural resources staff and volunteers will have safer access to the site.

"The Soldier workday was an outstanding success!" said Joby Rohrer, a senior natural resource manager with the Research

Corporation of the University of Hawai'i, who works for the Army's natural resources program under a cooperative agreement.

"We moved a massive amount of gravel and quickly completed the project. It was also a great outreach opportunity as we were able to share with them our snail conservation strategies at the Makaleha enclosure."

Makaleha will soon provide a safe haven for endangered O'ahu tree snails once staff have completed a new snail enclosure to keep out non-native predators. The enclosure is one of six fences that the Army has built throughout O'ahu's forests to protect endangered kähuli (*Achatinella* spp.) from predators. In the absence of these safe havens, kähuli are vulnerable to extinction by rats, cannibal snails and Jackson's chameleons—introduced animals that devour the vulnerable species that evolved in the absence of natural predators. The kähuli (*Achatinella mustelina*) is one of the many endangered species the Army protects in order to balance its training mission in Hawai'i.

"The Soldiers had thoughtful questions about our natural resource work and were motivated to help again in the future," noted Rohrer.

Soldiers' participation in these events increases their connection to the precious resources contained within Army training lands on O'ahu.

Beyond trail improvement, an additional 15 Soldiers helped cut down invasive ironwood (*Causarina equisetifolia*) trees and hauled slash piles of cut trees at Kaluakauila, within the Kuaokalā Forest Reserve.

Ironwood is not a new problem in Hawai'i. The species was introduced extensively in the early 1900s for erosion control in the wake of cattle ranching's devastating effects on the land. While it did achieve erosion-control to an extent—albeit to the detriment of native forests, which cannot

compete with the smothering, aggressive growth of the introduced tree—ironwoods have also presented a problem in the context of another major threat to native species: fire.

In the highly altered ecosystems of O'ahu, fuels management is critical in mitigating the threat of fire to endangered plants and animals. Removing fire-promoting species like ironwood, which ignites easily even when green and whose ashes retain heat for long periods of time, helps reduce the risk of fire spreading to native habitat and reduces burn intensity and duration.

Chopping down ironwoods and hauling the slash is no small order for a volunteer group. The trees can grow over 100 feet tall. Following behind the natural resources staff members who chainsawed the larger trees, Soldiers hauled felled trees to consolidate the logs into piles and cut smaller trees with handsaws. The heat of the dry forest habitat did not intimidate the group and they contributed a combined total of 45 hours, hauling and cutting down trees to reduce the fuel load for surrounding native dry forest.

NATIONAL PUBLIC LANDS DAY

On Sept. 26 and 28, volunteers joined the Army Natural Resources Program—along with hundreds of thousands of individuals at sites throughout the country—to take part in the National Environmental Education Foundation's annual National Public Lands Day. National Public Lands Day is the nation's largest, single-day volunteer effort for public lands.

Volunteers had the opportunity to enhance their natural and cultural resource knowledge through interpretation at the Army's rare plant nursery, seed lab, and in the field at Kahanahāiki, along with active stewardship on the land.

Volunteer efforts focused on preparing a place for the Kahanahāiki ko'oko'olau seed orchard. Ko'oko'olau (*Bidens torta*) is a native Hawaiian plant in the Aster (or daisy) family that makes for a useful restoration species in the forest. The seed

The Soldiers had thoughtful questions about our natural resource work and were motivated to help again in the future.



CLOCKWISE FROM TOP Soldiers from Charlie Company, 1st Battalion, 27th Infantry Regiment, 2nd Infantry Brigade Combat Team, 25th Infantry Division partnered with the Army's natural resources staff in 2019 to: control invasive pines along the north rim of Mākua Valley; transport and place gravel along a ridge-line trail to improve access for volunteers; and tour the Army's rare plant nursery with natural resource manager Kapua Kawelo (red shirt) to learn about endangered plant species the Army cares for on O'ahu.



ABOVE Volunteer Kathy Altz (red shirt, foreground), along with staff and other volunteers with the Army's natural resources program, plant ko'oko'olau (*Bidens torta*) seedlings to establish a seed orchard in Kahanahāiki for future restoration efforts. RIGHT A proud group of volunteers and staff celebrate in front of a massive pile of invasive weeds they removed from the area in preparation for the ko'oko'olau seed orchard. FAR RIGHT Koster's Curse (*Clidemia hirta*) is a primary target on the invasive weed control day. Volunteer Mark Tomes does not shy away from the challenge.



orchard at Kahanahāiki will allow ko'oko'olau to grow in an easily accessible area in natural forest conditions, providing optimal seed production and efficient collections for future restoration in more remote areas.

When the fruiting season comes around and it's time to collect, staff and volunteers will not have to search throughout program management units for ko'oko'olau at the right stage. They will look no further than the Kahanahāiki ko'oko'olau seed orchard, which will even isolate particular stock of the species using pollinator exclusion fabric.

Despite the benefits it will bring, making a seed orchard in a natural setting does require extensive preparation. The "black wattle" site at Kahanahāiki, which earned its nickname for the invasive *Acacia* species that used to dominate the area, has some native canopy but is still full of invasive strawberry guava, Koster's

curse and non-native *Nephrolepis brownii* ferns. For the National Public Lands Day outing on Sept. 28, a group of 11 volunteers joined three staff in the field to rid the area of these weeds so that the ko'oko'olau plants have a healthy place to grow in their new mountain home.

In addition to the volunteer support that National Public Lands Day brings, the Army Natural Resources Program received a \$9,400 grant, which allowed the purchase of volunteer tools along with weeding and planting equipment to make the Kahanahāiki ko'oko'olau seed orchard a reality.

THE REGULARS

The forests of O'ahu also receive care from a core group of community members that have made volunteering with the Army Natural Resources Program part of their monthly routine. College students, retired professionals, and avid hiking enthusiasts are just a few of the categories that describe our steadfast regulars. Many of these individuals have been volunteering with the natural resources program for over 10 years.

A small group of these dedicated individuals devotes more than 100 hours of service annually to supporting the Army's endangered

species conservation efforts making them eligible to receive the President's Volunteer Service Award.

Recent recipients of this prestigious award include volunteers Kathy Altz, David Danzeiser, Elaine Mahoney, and Roy Kikuta. Collectively, this foursome contributed 1,097 hours of service to the Army Natural Resources Program from July 1, 2018,

to June 30, 2019. From invasive weed control and planting efforts in the native forest, to a myriad of volunteer tasks in the seed conservation lab, rare plant nurseries, interpretive garden and even snail enclosures, these dedicated individuals have taken action to protect and preserve remaining native forest species on O'ahu.

Mahalo ā nui to all the volunteers who have supported the Army's efforts to protect the endangered plants and animals of O'ahu's native forests over the years.



OPPOSITE PAGE Roy Kikuta, Elaine Mahoney, and Kathy Altz navigate the return hike after a day of volunteering at West Makaleha with the Army's natural resources program. TOP Community volunteers hail from the North Shore, Mililani, Windward O'ahu, and Kalihi Valley to control invasive weeds in the mesic forest of Kahanahāiki. ABOVE Volunteer Elaine Mahoney plants pilo (*Coprosma longifolia*) in the Army's native tree snail enclosure at West Makaleha. LEFT Natural resources staff and volunteers plant a native sedge (*Carex wahuensis*) at Kahua, the Army's native seed orchard on Schofield Barracks.

Lena Schnell:

A Quarter of a Century at Pōhakuloa Training Area

For 25-year veteran of the natural resources mission, Lena Schnell, it's been an interesting journey.

Schnell came to Pōhakuloa Training Area (PTA) on a bicycle, figuratively speaking. She and her spouse were biking across Hawai'i Island on an extended vacation, and funds were running low.

After running out of money, Schnell landed a job with the Peregrine Fund raising Hawaiian Crows for release to the wild. From there she worked volunteer or paid jobs with the U.S. Fish and Wildlife Service; U.S. Geological Survey, Biological Resources Division; and Hawai'i Volcanoes National Park, before finding a home at PTA with the Center for Environmental Management of Military Lands (CEMML) and the U.S. Army.

The Pōhakuloa Training Area (PTA) landscape consists of a dryland forest ecosystem interspersed with lava fields and is situated between Hawai'i Island's tallest dormant volcanoes. INSET Lena Schnell, senior program manager with the Center for Environmental Management of Military Lands (CEMML) at PTA.





The Army's natural resource management work is conducted across approximately 134,000-acres at Pōhakuoloa Training Area (PTA), situated between Mauna Kea (cloud-covered) and Mauna Loa (far right) on Hawai'i Island.

“That was the nineties. I didn’t even know the Army did this kind of work ... frankly I didn’t really know that Natural Resources management was a ‘thing,’” Schnell confessed. “I didn’t know what this job would entail ... or what the experience working with the military would be like.

“It seemed like a stable job,” she said, laughing, as she recalled the decision that led her to becoming the senior program manager for one of the Department of Defense’s most valuable training land’s natural resources program.

HUMBLE BEGINNINGS

In a training area where so many things are happening daily — from military training, recycling, emergency response, and operational flights — it’s a wonder how natural resources remain a focus for the U.S. Army. Enter the PTA natural resources program.

When Schnell came on board in 1995, the program had one Army civilian position, one truck, one computer and four people. Today the team has grown to include 28 local employees supporting five functional program areas: botanical, wildlife, game management, invasive plants, and ecological data and administration.

Much of this expertise comes from a partnership, or cooperative agreement, between the Army and CEMML. CEMML works closely with PTA leadership and staff to manage endangered species and promote the principles and goals of environmental stewardship. Why? The primary and most important reason is to maintain or enhance military training capacity at PTA on the Island of Hawai'i.

“We have field people doing plant and animal detection, and data analysts that are very tech savvy and

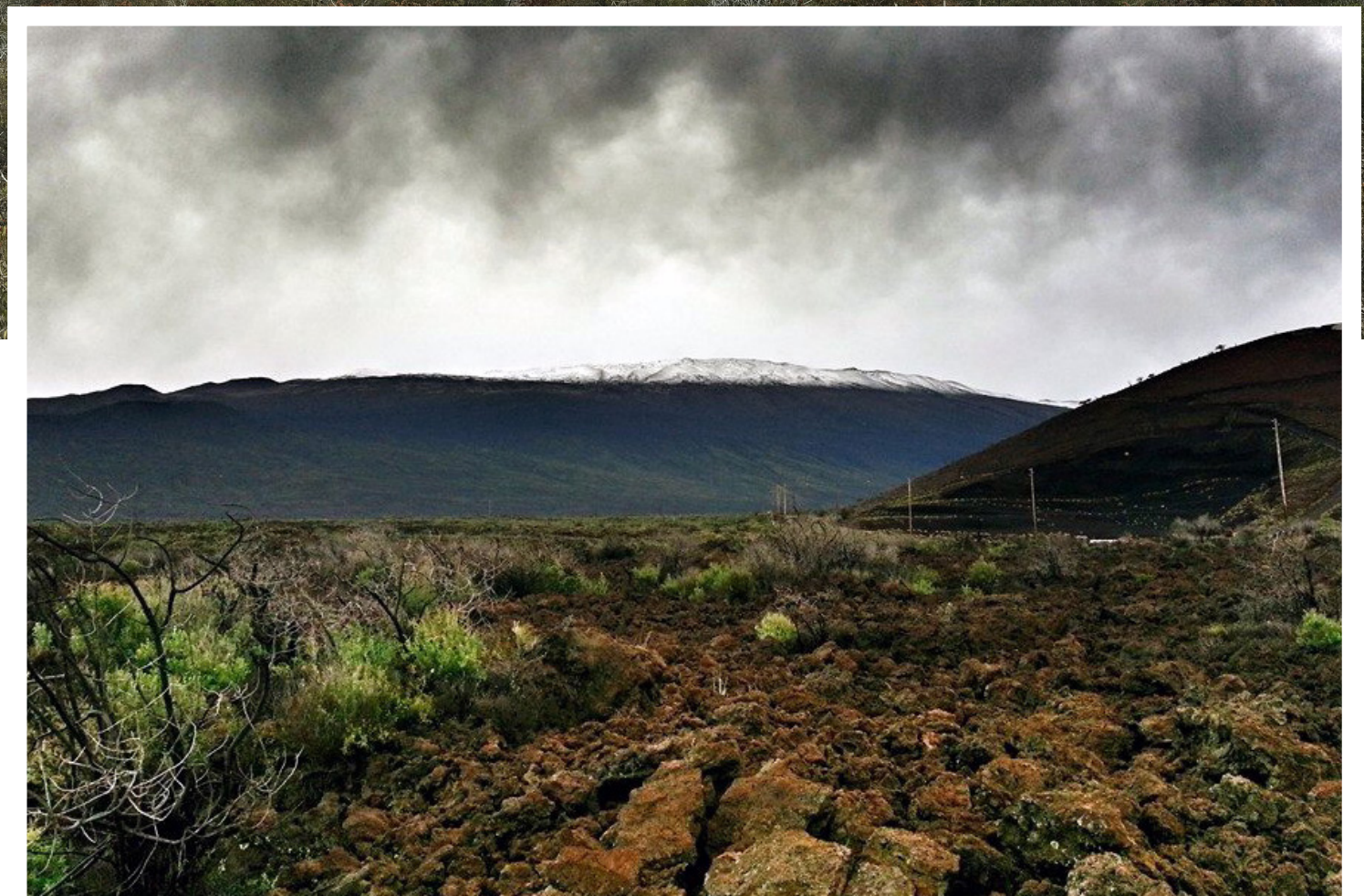
are into statistics, math, cartography and database construction and management,” Schnell said.

The talented team’s work has not gone unnoticed, garnering PTA the U.S. Fish and Wildlife Service’s Military Partnership Conservation Award in 2006.

“The Army is serious about their natural resources program,” Schnell acknowledged. “They definitely fund their program way better than most other programs in the State, and, probably just as important ... they are aware that this is something they should do.”

A CHALLENGING ENVIRONMENT

The natural resources staff’s work, similar to service member training at PTA, is performed in some of the most austere and challenging environments.



A dusting of snow tops the summit of Mauna Kea at an elevation of 13,796 feet (4,205 meters).

There is a reason military units are scrambling to get to PTA and have their Soldiers and Marines train there. The mornings can be cold enough to have trainees looking skyward for snow flurries, and by the afternoon those same trainees could be in danger of severe sunburn. At 6,300-foot elevation, Soldiers training at PTA feel like they can almost reach up and touch the sun.

However, it all comes full circle at 2 p.m. when the ceiling drops, and the clouds come swooping in; then the atmospheric conditions change to a fall-winter feel with temps dropping to the 30s.

These changes in temperature and elevation make PTA a formidable environment for the natural resources work, but they are also part of what

makes studying, preserving, and protecting endangered species on PTA so dynamic.

“PTA is a ruggedly beautiful landscape where different-aged lava flows demonstrate the succession of ecosystem development right before my eyes,” Schnell marveled. “It truly is incredible.”

Incredible doesn't always describe the work, though. The training area is a living, growing system, and according to Schnell, that means it must be constantly managed if the U.S. Army wants sustained effects over a long term. This constant management translates to many repetitive, mundane tasks that can test the natural resource team's motivation.

"It's like, yep – you've got to go cut that fuel break again. Sorry," Schnell chuckled about one of the common, yet crucial, program tasks.

BUT A REWARDING ENVIRONMENT

Speaking of fuel breaks, sometimes the results of this mundane work can be quite rewarding.

Wildland fires are one of the top threats to plant and animal habitat at PTA, especially given PTA's arid conditions as a dryland forest. Additionally, most of the island has been invaded by fountain grass (*Cenchrus setaceus*), which is native to Africa and highly flammable. Fountain grass is incredibly resilient, invading areas that previously burned and growing faster than most native shrubs in the area.

The invasive plants program maintains a system of fuel breaks and weed control buffers across the 134,000-acre training area as part of PTA's integrated wildland fire management plan. The plan maps out fuel breaks in high-risk areas where concentrations of fountain grass dwell. Fuel breaks allow time for firefighters to get to the area and back-burn against an advancing fire head.

In July 2018, the fuel breaks were put to the test when a wildfire was inadvertently ignited during routine training. The fire spread to three adjacent training areas totaling 1,447 acres of training land. It took 13 days before the fire was declared 100% contained.

"Making this situation even more tense was that one of our critically rare species populations, only known to be about a square kilometer in size, was right in the middle of that fire footprint," Schnell said. "If it had burned, we would have had the extinction of a rare species; it's only known in that one spot worldwide."

That rare species is *Tetramolopium arenarium*, a flowering plant in the aster family that was once thought extinct before it was "rediscovered" at PTA.

"When we visited the burned area, we could actually see the line where the fire stopped burning," Schnell said. "It was amazing that our work actually helped to prevent the extinction of a species."

The *Tetramolopium arenarium* is one of 26 threatened and endangered plants and animals CEMML and the Army manage at PTA. While all of these are important, Schnell admits she has a few favorites.

"I enjoy working with the rare seabirds—the Hawaiian Petrel [*Pterodroma sandwichensis*] and the Band-rumped Storm Petrel [*Oceanodroma castro*]," she said.

These species can be difficult to survey and monitor because they only come to land during summer months; they're only active at night; and they nest on rugged terrain, underground, with limited visual cues to show where the nests are located.

"In the early days, we'd camp or stay late in remote areas and listen for birds. In 2007, I implemented new survey techniques using microphones and recording units," Schnell said. "This was one of the first projects to use these techniques in the islands, and the practice has now become very common in the conservation community."



LEFT The *Tetramolopium arenarium*, a rare native Hawaiian plant located at Pōhakuloa Training Area (PTA), is one of many plants and animals the Army manages, to enable and support military training there. BELOW Lena Schnell, senior program manager with the Center for Environmental Management of Military Lands (CEMML) at PTA, explains some of the techniques used in the PTA greenhouse, where hundreds of native plant species are grown from seeds and cuttings to boost populations of threatened and endangered plant species in the wild. BOTTOM Schnell's invasive plants team creates life-saving fire breaks by strategically clearing sections of flammable fountain grass (*Cenchrus setaceus*), creating a no-burn buffer around populations of endangered species at PTA.





ABOVE Lena Schnell, senior program manager with the Center for Environmental Management of Military Lands (CEMML), and Jonathan Sprague, U.S. Fish and Wildlife Service biologist, check on the microphones and recording equipment used to monitor activity of the Band-rumped Storm Petrel (*Oceanodroma castro*), a native seabird that nests on the lava fields of Pōhakuloa Training Area (PTA). RIGHT Endangered nēnē geese (*Branta sandvicensis*) are one of 26 endangered species managed by CEMML personnel at PTA, under the U.S. Army's Cooperative Agreement with Colorado State University. MORE INFORMATION ON THE BAND-RUMPED STORM PETREL ACTIVITY AT PTA CAN BE FOUND IN THE 2018 EDITION OF THE EMP BULLETIN.

Through the recordings, CEMML and the Army have found that there were very infrequent detections of Hawaiian Petrels and concluded there is no breeding colony at PTA. However, they did discover a high number of detections of Band-rumped Storm Petrels.

The team conducted more surveys using things like night vision equipment and a trained detection dog, and confirmed that Band-rumped Storm Petrels actually breed at PTA—a surprising find considering they are seabirds.

“I’ve enjoyed the challenge,” Schnell said of trying to study the birds. “We continue to monitor Band-rumped Storm Petrels to better understand their patterns of attendance at the colony and the extent of the area they use for breeding.”

ALLIES IN THE FIELD

Surprisingly enough, working with units training on PTA has not been as big a challenge to protecting endangered species as one might think. In fact, Schnell believes that the Soldiers and Marines who train at PTA are key partners in PTA’s Natural Resource program.

She regularly briefs Soldier and Marine unit leaders about the endangered species at PTA prior to their training. The Soldiers and Marines then report any species they see in the field, which supplements the natural resources staff’s data collection.

Sometimes these sightings have very real impacts. Schnell recalled a situation in which Soldiers were trying to train but were put in a cease-fire status because a wild Hawaiian goose, a nene, was in the middle of their training area.



“I [said] ‘I’m sorry but if we injure a goose we may have to stop training altogether.’”

“One Soldier stopped me and said, ‘Ma’am, when we deploy to theater we have a lot of things to avoid, so we’ll just pretend the goose is one of those things.’”



ABOVE Each year, more than 13,000 service members train at Pohakuloa Training Area (PTA), one of the premier training areas in the Pacific. Lena Schnell (*inset*), senior program manager, Center for Environmental Management on Military Lands, leads a team of 28 biologists, programmers, technicians and specialists in support of natural resource management across PTA to enable troop training.

“It amazes me how resilient the troops are and how they can take it all in or leave it out,” Schnell said.

FUTURE ENDEAVORS

With the Soldiers and Marines training on PTA every month, business is good for the Natural Resources program, and for Schnell, plans for bigger and greater accomplishments are on the horizon.

“I am really excited about expanding the program. Our U.S. Army biologist has a plan for the future that includes expanding the species-at-risk management. I’d also like to see CEMML do more in early detection and bring in new techniques for identifying endangered species,” Schnell said excitedly.

When environmental issues happen, it’s not a question of throwing some dollars at a problem and walking away. In the living, growing environment of PTA, continuous funding and sustained effort are key to maintaining the balance between military training needs and environmental protection. Partnerships, cooperative agreements and dedicated team members, like Schnell, are key to the U.S. Army continuing its commitment to Mālama i ka ‘āina (care for the land).

Root into your community

HO'OA'A

The U.S. Army Garrison Hawai'i natural resources program staff leads monthly volunteer service trips to protect rare and endangered plants and animals on Army-managed lands. Each educational trip incorporates hiking and a hands-on opportunity to care for Hawai'i's natural resources through invasive weed control in native habitat and occasional planting activities.

BECOME A VOLUNTEER

JOIN THE VOLUNTEER LISTSERV

Contact OUTREACH@OANRP.COM or 656-7741 to be added to the volunteer database.

ORGANIZE A TRIP

Contact OUTREACH@OANRP.COM to organize a service opportunity for your class, hālau or group.



ABOUT THE U.S. ARMY GARRISON HAWAII'

The U.S. Army Garrison Hawai'i is responsible for the day-to-day operations of Army installations and training areas in Hawai'i. The U.S. Army Garrison Hawai'i team provides facility management and quality Soldier and military family services for more than 95,000 Soldiers, retirees, civilians and families across 22 military installations and training areas on O'ahu and Hawai'i Island. These installations include O'ahu-based Schofield Barracks, Wheeler Army Airfield, Fort Shafter, Tripler Army Medical Center, and the Island of Hawai'i-based Pōhakuloa Training Area.



The Directorate of Public Works Environmental Division Office at the U.S. Army Garrison Hawai'i is comprised of two branches: the Compliance Branch and the Conservation Branch, which are dedicated to providing guidance, support and liaison services to those who live, work and train on the installation, while also protecting the environment. The Conservation Branch includes the Army's natural and cultural resource programs, which protect endangered species and cultural resources, respectively, on O'ahu and Hawai'i Island. To learn more about the Army's environmental stewardship mission, visit [HTTPS://HOME.ARMY.MIL/HAWAII/INDEX.PHP/GARRISON/DPW/](https://home.army.mil/hawaii/index.php/garrison/dpw/)



ABOUT THE OFFICE OF THE VICE PRESIDENT FOR RESEARCH AND INNOVATION (OVPRI)

The Office of the Vice President for Research and Innovation (OVPRI) provides leadership, coordination and support of research and innovation efforts throughout the 10-campus University of Hawai'i System, including oversight of extramural funding, compliance, export controls, technology transfer and commercialization, and the Applied Research Laboratory at UH – one of only 13 U.S. Department of Defense University Affiliated Research Centers (UARC). Through a cooperative agreement, OVPRI supports the U.S. Army Garrison Hawai'i Natural Resources Program on O'ahu. For more about OVPRI, please visit: WWW.HAWAII.EDU/RESEARCH/