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Predator-Proof Fencing: Lessons from New Zealand

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In March, Joby Rohrer and Stephen Mosher of the O`ahu Army Natural Resources Program traveled to New Zealand for two weeks to gain first-hand knowledge of predator control methods and techniques used in New Zealand.

One of the control techniques reviewed during the trip was predator-proof fencing.

Hawaii and New Zealand are both unique in originally having only bats as their sole native



Driving Creek Wildlife Sanctuary Predator-Proof Fence.
(Photo by Stephen Mosher, OANRP)

land mammal and in having large numbers of native and endemic bird species.

Both island groups have had intentional and accidental introductions of small mammals that have led to severe declines or extinctions of native forest birds.

In Hawaii and New Zealand, introduced rats (*Rattus* sp.) are major predators of forest birds.

Predator-proof fencing has been designed in New Zealand to exclude invasive introduced small mammals (three species of rats, mice, stoats, feral cats, ferrets, weasels, brushtailed

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possums, rabbits, hares, hedgehogs, and dogs), for the conservation of rare native forest birds, nesting seabirds, native lizards, and rare native



Stephen Mosher examines one of New Zealand's predator-proof fences.
(Photo by Joby Rohrer, OANRP)

insects. Predator-proof fencing also excludes the many introduced species of ungulates, including wild pigs, wild goats and red deer.

With the construction of predator-proof fencing and the removal and control of browsers and seed eaters, forest regeneration and overall forest health has dramatically improved.

Rohrer and Mosher visited five predator-proof fences on the North Island of New Zealand to review fence designs and construction materials.

The first visit was to the Karori Wildlife Sanctuary in Wellington, where 252 ha of native forest was enclosed with 8.6 km of predator-proof fencing.

The Karori enclosure was completed in 1999 and was designed to keep out 14 species of



Landscape view of a New Zealand fence. (Photo by Joby Rohrer, OANRP)

mammals. This fence was one of the first predator-proof fences constructed in New Zealand. Construction material consisted of galvanized blast mesh and a galvanized hood.

Eight species of rare birds and one lizard species (Tuatara) have been reintroduced into the enclosure. Thirty-two additional native and/or endemic species have been found

within the sanctuary, highlighting the importance of this fence.

The next stop was the Maungatautari Ecological Land Trust fence, near Cambridge. This fence enclosed 3,400 ha of forest with 47 km of pest-proof fencing for the protection of the North Island kiwi, Kaka (rare endemic parrot), and other native forest birds, as well as native reptiles and insects. The mesh size of the fence excluded invasive mammals down to the size of house mice. The fence was completed in August 2007.

Rohrer and Mosher visited another fence under construction at the Driving Creek Wildlife Sanctuary on the Coromandel Peninsula. This fence will enclose 1.6 ha for the protection and conservation of the endangered brown teal and other rare and native birds, frogs, reptiles,

insects and fish. Like the Maungatautari fence, this fence will exclude animals as small as mice.

The fences at Maungatautari and Driving Creek Wildlife Sanctuary were both constructed of stainless steel mesh panels and had the same hood design.

A pest-proof fence was constructed at the Opouahi Scenic Reserve for the protection of juvenile North Island brown kiwi as part of Operation Nest Egg.

Operation Nest Egg is a program that acts as a safe-haven for the raising of juvenile kiwi until they reach a size shown to have the highest survival success.

After juvenile Kiwi reach 800 grams they are able to fend for themselves against stoats and other predators. Eggs and chicks are collected from the wild, cared for, and then released back into the wild after reaching the target 800 grams. The Opouahi predator-proof enclosure is one of the areas where these birds are released. Rohrer and Mosher also visited a predator-proof fence being used as a barrier fence to slow the ingress of predators on the Cape Kidnappers peninsula.

This fence was constructed of a galvanized micro-woven mesh, with an additional aluminum coating to extend the fence's life expectancy to between 25 to 70 years.



Maungatautari Ecological Land Trust enclosure. From left: Pim de Monchy, Joby Rohrer (OANRP), and Darrin Peters. (Photo by Stephen Mosher, OANRP)

The mesh size of the fence was designed to exclude mammals larger than mice.

The fence bisects the peninsula with ingress points at the ends of the fence, as well as by un-gated roadways.

Continual trapping inside and outside the fence for stoats and feral cats is ongoing. Once predators are reduced to a manageable

level, North Island brown kiwis will be released, and other native forest birds and seabirds will also be reintroduced into the area.

The peninsula is also home to one of the largest Australasian Gannet colonies in New Zealand. Fence construction was completed in 2007.

During these site visits Rohrer and Mosher learned about the use of different construction materials, as well as the different designs of hoods placed atop the mesh fences to keep predators from getting over the top. They also gained valuable knowledge on construction material compatibility to extend fence longevity.

The compatibility of metal components and material coatings greatly reduces corrosion of fencing materials. The quality and strength of the fencing mesh also greatly extends the lifespan of a fence.

Even after fences are constructed there are high maintenance costs that include: monitoring fences for physical breaches, monitoring for predators inside fences, and controlling predators outside fences to reduce pressure on fence. If there are breaches in the fence, controlling predators that have gotten inside the enclosure is also necessary.

The OANRP is considering using similar technology to improve fencing efforts on Army lands. These valuable lessons learned during the New Zealand site visits will greatly benefit OANRP's direction in the control of rats, feral cats, and mongoose on O'ahu for the protection of rare and endemic plant and animal species. ■



To make a fence truly "pest-proof", all entry-points must be considered, such as this culvert which has been fitted with a covering made of the pest-proof mesh. (Photo by Joby Rohrer, OANRP)

DNA Analysis to Better Plant Conservation

By Erin Foley
Natural Resource Specialist
Colorado State University, PTA

The Pōhakuloa Training Area (PTA) Natural Resources Department is beginning a promising partnership with Dr. Clifford Morden of the botany department at University of Hawai'i at Mānoa.

With the help of PTA environmental staff, Dr. Morden will be collecting DNA tissue samples of all healthy *Kadua coriacea* plants (formerly known as *Hedyotis coriacea*) at PTA.

Currently, PTA contains the only known wild plants of this endemic and federally endangered species, with only 175 surviving plants.

Dr. Morden is looking at the genetic variation of the plants that are believed to have undergone inbreeding depression, or a weakening of genetic variability due to isolation and low plant numbers.



Steven Evans, a botanist at PTA, takes a tissue sample from *Kadua coriacea*. (Photo by Erin Foley, PTA)

Natural recruitment for this species has been negligible in the wild (with only one recorded seedling) and has not been observed in an outplanting site. The genetic analysis of the plants at PTA will enable better management of this species by helping to identify plants suited for cross pollination. When crossed, genetically dissimilar plants may yield more genetically viable seeds that, after germination, may prove more vigorous.

The Army is hopeful that management of this species will improve as a result of this study. ■

Hilo Union Elementary Students Plant the Seeds of Knowledge at Pōhakuloa Training Area

By Tiana Sudduth
PTA Natural Resources Specialist

Since its establishment in 1956, Pōhakuloa Training Area (PTA) has been committed to preserving Hawai'i's natural resources while supporting military training activities.

Pōhakuloa contains the rarest ecosystem on the planet, 15 species of threatened and endangered plants, the nēnē goose, Hawaiian bat, and critical habitat for Palila birds.

To help protect those endangered plant populations, PTA Natural Resources Staff (NRS) promotes an ongoing public outreach and education program. The goals of the program are to inform the public about management activities conducted at PTA and to recruit volunteer assistance from within the community.

On many occasions, outreach opportunities often coincide with other natural resource management initiatives, such as invasive species management and outplanting. A recent visit to Hilo Union Elementary provided the per-



PTA Integrated Training Area Management specialist Shalan Crysedale teaches a student at Hilo Union Elementary how to place 'āweoweo seeds in a seed germination tray. (Photo by Tiana Sudduth, PTA)



Lorna Hewitt, teacher at Hilo Union Elementary School, helps one of her students collect 'a'ali'i seeds for placement in a seed germination tray. (Photo by Tiana Sudduth, PTA)

fect opportunity for PTA NRS to accomplish just that.

On May 8, the fifth grade students at Hilo Union Elementary spent the night at PTA, where they participated in a variety of activities with PTA natural and cultural resources staff, Soldiers,

and PTA firefighters.

To prepare for the overnight, PTA Natural Resources specialists Tiana Sudduth, Sarah Knox, Erin Foley, and Integrated Training Area Management specialist Shalan Crysedale, made a special trip to Hilo Union Elementary. They taught the students in Ms. Hewitt's, Mrs. Kato's, and Mrs. Barber's classes about the rare and native plants and animals found at Pōhakuloa and about how PTA NRS manages those unique resources.

The students then engaged in a hands-on planting activity. Seeds of 'a'ali'i, 'āweoweo and lovegrass were put into planting trays, watered, and left in each classroom for students to care for during the next few weeks.

While the students watched the seeds grow, they had a chance to read about each native plant's life history and cultural uses in the Hawaiian Islands.

Upon arriving at PTA, the students of Hilo Union Elementary worked with NRS to establish a

garden of native plants in front of the PTA Headquarters. The seedlings that germinated in each classroom were transported to PTA for transplanting into the new garden.

As the garden develops, future school groups will add outplantings and will assist with periodic garden maintenance.

The garden will educate visitors about PTA's natural resources, while serving as a bridge between the Army and the local community.

The seeds that the students helped propagate will also make an important contribution to restoring the native plant community at PTA.

The fifth graders of Hilo Union Elementary were also asked to collaborate with PTA NRS on another innovative and exciting project.

Each class was given materials to create a unique stepping stone as part of their contribution to the garden. The stepping stones will all be the same size, but will be designed to represent each individual school and/or classroom.

The finished products will be placed in and around the growing garden, linking together to eventually create a pathway, which will be known as the "Ala e Ho'ona'auao o Pōhakuloa" or "Pōhakuloa's Pathway to Education."

The pathway will guide visitors through the garden, showcasing both Pōhakuloa's natural resources and the hard work of the teachers and students who put them there.

The pathway will serve as a lasting legacy, with the names and dates inscribed in each stepping stone becoming a part of PTA history.



Shalan Crysedale (PTA) talks with Hilo Union Elementary School students about how they can help promote natural resource conservation. (Photo by Tiana Sudduth, PTA)

Public outreach and education benefits Pōhakuloa's unique natural resources, the Army, and the community. Such endeavors have been, and will continue to be, a vital component of PTA's natural resources program. ■

A Helping Hand for *Hesperomannia arbuscula* Pollination

By Lauren Weisenberger,
Propagule Management Specialist
RCUH/PCSU/O'ahu Army Natural Resources Program

Hesperomannia arbuscula is an endangered species in the family Asteraceae (sunflower family), which has recently experienced significant decline in population size. Found only on the island of O'ahu, it is limited to eleven individuals among four locations in the Wai'anāe Mountains.



Flowers of the *Hesperomannia arbuscula*. Each yellow "spike" is a single flower, grouped together in a compound flower. Each spike will develop both male and female flower parts, eventually producing seed, if fertilization is successful. (Photo by Will Weaver, OANRP)

Working with a plant species on the brink of extinction is obviously challenging. Highlighting one of the challenges, O'ahu Army Natural Resources Program (OANRP) staff noticed a problem with *H. arbuscula* over the past several years: a large majority of the flowers died or aborted before mature fruit with healthy seed developed. One potential reason for these high abortion rates was the lack of successful fertilization or pollination. This is likely due to a decreasing number of plants and potentially a decreasing number of receptive flowers at any given time. Additionally, as populations become smaller, the chance of inbreeding, or breeding between closely-related plants, increases. Inbreeding can occur either between closely related individuals or via "selfing," a term used when a flower pollinates itself. For most plant groups, flowers are designed to

promote outcrossing (not inbreeding). If a plant designed for outcrossing ends up inbreeding, it may suffer from reduced health of the next generation of plants.

In February 2007, OANRP staff observed flower characteristics of *H. arbuscula* growing in their greenhouse. What they discovered was flower behavior that suggests this plant is designed to promote outcrossing, rather than inbreeding.

As flowers develop, the pollen-carrying (male) structures emerge; pollen matures and is released.

Two to three days later, the female structures split into two and become receptive to



Pollen is collected from *Hesperomannia arbuscula* flowers to outcross with other remaining individuals. (Photo by Kapua Kawelo, OANRP)

pollen. The lag time between pollen release and receptivity of the female flower structures is exemplary of flower characteristics intended to promote outcrossing.

This finding helped drive recent OANRP conservation work with *H. arbuscula*. Staff from OANRP and the O'ahu Plant Extinction Prevention Program (OPEP) visited the *H. arbuscula* populations during their flowering season. In an effort to help these extremely rare plants develop healthy seed, all the remaining

mature individuals were pollinated by hand, and crossed between each other, to ensure pollination and alleviate inbreeding.

Another challenge in working with *H. arbuscula* is that the pollen type in the Asteraceae family is defined as "trinnucleate." Trinnucleate pollen grains cannot withstand drying and are typically short-lived. Because of this, pollen may be difficult to store, and proper handling is important to extend viability throughout the entire flowering season.

To address this problem, pollen is collected immediately after it is released and is stored undried at 4 degrees Celsius while it is transported between populations.

Over the last year, OANRP efforts included pollinating four *H. arbuscula* plants at two locations (with pollen collected from an additional third location), totaling 11 hand-pollinations. These 11 hand-pollinations produced 72 viable seeds and 60 healthy seedlings as of May 2008.

Since very little viable seed had been collected in previous years, this was an extremely successful pollination attempt, and both OANRP and OPEP decided to continue pollinations for the 2008 flowering season.

So far in 2008, five plants have flowered in three locations, for a total of 58 flowers. Based on this OANRP work, it has been observed that the age of the pollen served as a good indicator for successful germination - pollen over one month old produced very few viable seeds. Further, the percentage of viable seeds appeared higher when timing was optimal for pollination, as opposed to pollinations that were conducted as the flower had begun to expire.

Producing viable seed is essential to propagate these plants for reintroductions, a necessary tool in the recovery effort of this endangered species. The discoveries and hand-pollination success by OANRP and OPEP efforts may be a small step towards overcoming the challenges in working with *H. arbuscula*, but for the species, it revives hope in averting this rare treasure from extinction. ■

Cultural Outreach Program at Pōhakuloa Training Area

By Kelly Leialoha Luscomb
Cultural Resource Specialist
RCUH/ PTA

The Cultural Resources Outreach Program at Pōhakuloa Training Area provides an exploration for students in historic preservation and cultural resource management. The program incorporates site visits within PTA and activities in the Environmental Office and Interpretive Garden.

On May 8, approximately 50 students from Hilo Union Elementary arrived at PTA. The large group and the duration of the visit limited the time and available resources for a typical group visit to PTA. The PTA Cultural Resource staff met these challenges and tailored activities to achieve an engaging educational program for the children.

For the first activity, the students learned how archaeologists map a site and address potential disturbance by mapping mock archaeological sites within the PTA interpretive garden.



Kelly Luscomb directs a mapping activity with students from Hilo Union Elementary. (Photo by Chicpaul Becerra,

The students were then asked to choose a location and construction method for a handicap sidewalk through the garden, that would avoid damage and preserve existing archaeological sites.

The students were then divided into two groups for the subsequent activities, and switched after they completed each activity.

One group was given a site profile drawing and an artifact catalogue to learn about strat-



Students sift through soil samples. (Photo by Chicpaul Becerra, PTA)

igraphy and chronology and how it can yield information during an archaeological excavation.

A museum drawer full of artifacts was presented to the students to match with a list of artifact names; students openly discussed other uses for the artifacts and where they had seen similar objects.

The third activity required the children to sift through a large dirt sample from an imaginary excavation. The students were required to use critical thinking to yield information from artifacts and ecofacts uncovered in the samples.

The students completed the activities with enthusiasm and a better understanding of archaeologists, what they do, and why. They gained a better understanding of the need to protect cultural resources and the value these resources have in providing insight about the past. ■



S

Tis the Season...

U

The Koli'i are blooming! Many tubular-shaped flowers of Koli'i, *Trematolobelia macrostachys*, offer a spectacular display of pink in early summer.

M

A type of lobelia, Koli'i entices native honeycreepers, like the 'I'iwi. 'I'iwi, extremely rare on the island of O`ahu, have been known to follow the blooming Koli'i on the summit of Ka'ala to feed on the flowers' nectar.

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E

After flowering, seed-filled capsules are formed. When the wind blows, seeds are released through small *pukas* in the capsule, much like a salt shaker.

R



VOLUNTEER OPPORTUNITIES

AUGUST 2008

- ▶ **Event:** Kahanahāiki Volunteer Service Project (O`ahu)
Date: Saturday August 9, 2008
Purpose: To control strawberry guava (an invasive weed) within Kahanahāiki, a Mākua Implementation Plan Management Unit.
Participants: Open to the public

- ▶ **Event:** Palikea Volunteer Service Project (O`ahu)
Date: Friday August 22, 2008
Purpose: To control *Crocasmia* (an invasive weed) within Palikea, an O`ahu Implementation Plan Management Unit.
Participants: Open to the public

For more information about O`ahu Natural Resources Program volunteer opportunities, please contact Kim Welch or Candace Russo:
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EMP *Bulletin*

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The success of this newsletter depends on article contributions from the staff of the O`ahu Army Natural Resources Program, O`ahu Army Cultural Resources Program, PTA Army Natural Resources Program, and PTA Army Cultural Resources Program. Mahalo to all staff who have contributed to this issue.

*We will be sending out a call for articles to compile next quarter's issue shortly. If you already have an article or idea in mind, please feel free to contact us! The deadline for articles for the next issue will be **September 15, 2008**.*



A handwritten signature in black ink, appearing to read "Alan Goo".

Alan Goo
Director of Public Works
US Army Garrison, Hawai'i