HAWAII ARMY NATIONAL GUARD

NATURAL RESOURCES CONSERVATION. SMALL INSTALLATION

INTRODUCTION AND BACKGROUND

Stretching across several island sites, the Hawaii Army National Guard's (HIARNG's) statewide installation is small, but the challenges of natural resources conservation (NRC) management in this tropical environment should not be underestimated. The HIARNG installation is comprised of seven readiness centers, two Army Aviation Support Facilities (AASF), Regional Training Institute (RTI), Regional Training Site Maintenance (RTSM), six shops, three training sites and headquarters. All together, these sites encompass under 1300 acres. The primary training sites where NRC activities are conducted are Keaukaha Military Reservation (504 acres), Kekaha Firing Range (68 acres), Ukumehame Firing Range (39 acres) and the RTI on Oahu (48 acres). These training sites are home to a number of unique biological resources. Keaukaha Military Reservation (KMR) contains 229 acres of lowland wet forest, an increasingly rare ecosystem in Hawaii, as well as endangered Hawaiian hawks and Hawaiian hoary bats. At Kekaha Firing Range (KFR), the NRC program manages for endangered Niihau panicgrass and threatened sand dune habitat. The seasonal wetlands on Ukumehame Firing Range (UFR) attract endangered bird species, several of which are also present at the RTI. Throughout all the training sites, however, the most consistent challenge has been eradicating invasive and non-native species that continually threaten precarious ecosystems and impede training access. To that end, the NRC program has implemented a multi-faceted invasive species management program that achieves holistic benefits at the ecosystem level and creates training access. With training land at such a premium, every acre matters.

Focusing on invasive species has proven to benefit all native habitat and species on the HIARNG installation, and after a targeted multi-year effort, the NRC program can point to clear victories against these noxious plants.

Over the past 2 years, the NRC program has removed around 100,000 miconia plants, restoring acreage that had been completely overrun and rendered unusable. Over 5000 long-thorn kiawe plants and around 4000 albizia have also been eradicated; these plants represent some of the greatest challenges to both ecology and training access on the installation because they spread so quickly and create virtually impenetrable understory. To simply treat the acreages affected by these species was to fight a losing battle, however; the NRC program's strategy has emphasized removal of mature seeding plants followed by vigilant removal of seedlings without significant herbicide application. Though time and labor-intensive, this approach is proving to achieve the actual ecosystem transformation required to save these invasive-threatened habitats. Last year, the NRC program began integrating a new technique into its invasive-species arsenal, introducing goat and sheep grazing as a cost- and resource-effective approach to invasive species eradication. The project has slashed the use of herbicides and safeguarded sensitive habitat from adverse maintenance impacts; at the same time, this technique has re-opened large sections of KMR to training access.

The threat of invasive species to training sustainability is recognized throughout the HIARNG directorates and command. Apart from the environmental harms they cause, these plants had significantly curtailed access on training sites that are already quite small. When 15 acres out of a total 68 acres cannot be used, for example, the training impact is intensely felt. Responding to the enmeshed priorities of NRC and training, HIARNG has fully integrated the Environmental directorate (HIARNG ENV) into all planning and operations. NRC, compliance and pollution prevention staffs within HIARNG ENV work cross-functionally to support the broader sustainability goals of the entire installation. The HIARNG ENV's active participation on the Environmental Quality Control Committee (EQCC) teams allows for fuller integration of NRC measures throughout HIARNG with the support of commanders and directorate heads. In total, 20 senior leaders and commanders and 11 HIARNG ENV staff members participate in these meetings and the decision-making process; a second tier of EQCC teams integrates unit EOs into NRC activities.

Invasive species priorities are also reflected in the HIARNG's Integrated Natural Resources Management Plan (INRMP), which is fully implemented and will begin its 5-year update in FY18. The INRMP guides management with the understanding that invasive species remain the greatest threat to Hawaii's ecosystems broadly speaking, and a particular threat to the HIARNG's operations. Eradicating these species is the foundation for restoring habitat and protecting threatened and endangered (T&E) species.

The NRC program has been particularly successful in establishing partnerships to achieve its goals. The Big Island Invasive Species Committee (BIISC) and Kauai Invasive Species Committee (KISC) have been critical partners in targeting miconia, albizia and kiawe, providing the labor and expertise needed to contain these plants without resorting to enormous quantities of herbicide that could also threaten native plants. The NRC program pays these organizations for services and field support, but the costs are a fraction of what private contractors would run. USDA Animal Plant Health Inspection Service (APHIS) is another important partner, and their management of permit processes helps HIARNG to remain fully compliant with Section 7 of the Endangered Species Act, the Migratory Bird Act and Bird Aircraft Strike Hazard (BASH) prevention.

The new grazing project represents a significant cost savings over conventional land management employed at KMR. Goats and sheep cost just 10% compared to hiring contractors for mechanical and chemical invasive plant removal and one-third of the lower cost alternative of inmate labor previously employed.

	Contractor Cost	Inmate Labor Cost	Grazing Cost
Cost per acre	$5,000	$1,500	$500
Cost for 46 acres (FY16)	$230,000	$69,000	$23,000

The cost benefits of the NRC program are hard to calculate, but also difficult to overstate. In addition to the avoidance of thousands and thousands of dollars each year in ongoing chemical control costs—and the attendant environmental risks of sustained, heavy herbicide application—the NRC program's seed source eradication approach helps to limit the spread of

these invasive plants to other HIARNG sites via equipment. As eradication efforts begin to cross the pivotal point from active treatment to monitoring and management, HIARNG will actually see its invasive species control costs plunge, while training access is improved and preserved.

Of the KMR training site's 504 acres, 245 comprise some of the most endangered lowland wet forest ecosystems. The ʻōhiʻa/lama forest community is a closed canopy forest that is currently only found on the eastern side of the island of Hawaiʻi. It is dominated by ʻōhiʻa (*Metrosideros polymorpha*) and lama (*Diospyros sandwicensis*) in the overstory, and various shrubs, small trees and ferns in the midstory and understory. However, numerous non-native species have invaded these forests, most notably the trees miconia, albizia, strawberry guava, bingabing and melastoma. These forests are also home to **three endangered species**—the Hawaiian hawk, Hawaiian hoary bat and Haiwale shrub. The KMR forest is also home to a variety of endemic species that are found nowhere else in the world. With such a sensitive habitat in HIARNG's hands, the NRC program has been particularly dedicated to implementing a management approach that supports both wildlife and HIARNG training.

Invasive albizia trees along training area roads at KMR. Albizia are fast growing and can grow up to 120 feet in height. High winds easily topple the albizia trees due to shallow root systems.

Years of conventional invasive species treatment on KMR had gained the HIARNG little traction in eradicating noxious plants and restoring habitat. **In response, the NRC program developed a more strategic approach, focusing on one invasive species at a time and aiming for elimination of seed sources entirely.** Miconia was the first target, followed by albizia, kiawe and strawberry guava. Albizia is a particularly problematic species because it not only degrades habitat, but is also extremely vulnerable in hurricanes. Though the tree grows to 100 to 120 feet in height, its shallow root system means a 50-mile-per-hour wind can uproot it, resulting in blocked roads and damaged structures and utilities. In one hurricane event, the NRC program found that 90 percent of the downed trees were albizia, and the damage to power lines cut electricity for weeks. **Albizia is considered to be the most invasive and damaging invader of Pacific island wet forests**, and this plant has become the focus of state-wide eradication or control campaigns by state, federal and private agencies.

Albizia trees removed along the same training area roads at KMR. Goats and sheep are used as part of the Integrated Pest Management Program to maintain areas where invasive species once dominated training lands. The grazing program reducesthe use of herbicides and emissions into the environment and is a cost savings for the HIARNG.

The NRC program has achieved near **eradication of miconia** in about 5 years of targeted attention; over the past 2 years, HIARNG has turned the corner on this species and is able to convert now from treatment to monitoring. Working with BIISC and recruiting volunteers from the HIARNG ENV and personnel at KMR, the NRC program conducted transect surveys to identify adult miconia populations. These trees produce thousands of seeds, enabling rapid spreading. These trees were, thus, the first priority for removal to control the seed base. Over the past 2 years, the NRC program completed removal of all mature trees and turned its attention to juveniles and seedlings, emphasizing manual removal. The elimination of

adult trees has all but eliminated the need for herbicide treatment, in fact, **slashing herbicide use by 95 percent.** This year, the NRC program used only 1.5 gallons of concentrated herbicide to manage several hundred acres of previously overrun habitat. This same approach has been successfully rolled out to HIARNG's other training sites with miconia populations.

While miconia at last is all but eliminated on the installation, the NRC program has been able to simultaneously accelerate treatment of the next invasive species targets. Albizia is a tree that grows aggressively in disturbed areas, making it a particularly effective impediment to training as it overruns vehicle corridors and pass-through areas. The NRC program has removed 4000 adult and juvenile albizia trees over the past 2 years, employing the same seed-base eradication technique that has proven so effective with miconia. Addressing albizia over the past 2 years, the NRC program now counts this invasive species as fully controlled. The strawberry guava tree is another priority because it overruns training areas with dense, rapid growth. People on the island enjoy the tree's fruit—but so do feral pigs, which have contributed to the tree's widespread impacts. Working with USDA, the NRC program has introduced strawberry guava treatment via a biological control agent of the species using a scale insect, Tectococcus ovatus, to create galls on young leaves that eventually reduces fruit production. HIARNG has begun using this process at various locations within the KMR forest, and the NRC program continues working with USDA to research the control's effectiveness. The use of **biological control** along with the seed-base eradication will reduce the use of pesticides and increase training land over time. **For all three species, the NRC program is now able to revert to monitoring and management.** Currently, the program is evaluating use of unmanned aerial vehicles (UAV) to conduct efficient annual monitoring and identify any future treatment needs.

The eradication of these trees has direct benefit to wildlife on the installation. These trees destroy the native forest that supports endangered Hawaiian hawk and Hawaiian hoary bat. The NRC program has worked with USGS to conduct bat surveys over the past 8 years to identify foraging habits and avoid any training conflicts. The restoration of native forest increases the plants required by the bats and have helped to maintain population levels on KMR.

Though the threat of invasive species has been largely defeated in the KMR forest, a new hazard is on the horizon for this ecosystem. The ʻōhiʻa tree is an endemic native tree and the dominant canopy species in the ecosystem, but a new fungal disease has been introduced to the island and is spread by beetles, resulting in rapid tree loss. The NRC program is investigating alternative species that could be propagated to compensate for the loss of ʻōhiʻa as well as coordinating with other state agencies to seek treatments that will kill the disease-spreading fungus. There is no known treatment for the disease at this time, so prevention of its spread is key. The NRC program has initiated new soldier training in equipment inspection and cleaning to minimize spread.

Endangered Hawaiian hawk foraging in areas cleared of invasive plant species. The Hawaiian hawk is one of three endangered species located within the KMR forest.

The invasive species program at KFR is another success story. The NRC program worked with KISC to target **long-thorn kiawe**, a highly invasive,

noxious shrub that can grow to 30-feet tall with 3 to 4 inch thorns capable of piercing shoes and truck tires. Each plant is capable of producing thousands of seeds per year. Growing in dense thickets that crowd out native species and create impenetrable training barriers, eradicating kiawe was a key priority. The plant also posed a threat to fragile dune critical habitat. Over the past 2 years, around 5000 of these plants on 15 acres were removed with the assistance of KISC, focusing on seedlings that continue to emerge from a long soil seed bank. After a total of about 4 years of focused removals, this plant, too, has been all but eradicated and is now in the monitoring-and-management phase.

The arrival of goats and sheep at KMR. Grazing is used at various locations throughout KMR to reduce costs and herbicide applications.

Introduction of **grazing management** last year has been incredibly impactful in non-forested areas on KMR, particularly in areas where terrain limited maintenance and pesticides were routinely used. These sites were then reviewed to ensure no threatened or endangered species were at risk from grazing and to protect endemic plants from impacts; a plant density comparison was also completed. The NRC program also researched grazing animals' diets to ensure that the invasive plants would be attractive to the animals.

In FY16, 46 acres began management with a 194-animal herd. The animals are enclosed in portable paddocks of electric hog netting powered by solar panels. The efficiency of the herd was dramatic: the goats and sheep clear an average of one acre with a density of 6-month plant growth in just 1.5 days. They are also able to clear areas with terrain that is difficult for machines to access. The elimination of machines for species removal also means reduction in petroleum products and emissions as well as prevention of any equipment leaks or spills of fuel or hydraulic fluids. **Herbicide use has been eliminated** for the 46 acres currently under grazing management as well.

The NRC program continues working with APHIS to protect wildlife and plants from pest species like feral pigs, cats and dogs. APHIS assists on predator controls to protect the Nene goose at UFR and with feral pig trapping to protect pollinator habitat at RTI. Control of these species, via trapping and removal, is essential to protecting migratory birds and T&E species.

More than 46 acres were cleared of invasive plants species within KMR lowland wet forest to provide increased training area for HIARNG soldiers.

To put it simply, the greatest threat to training on the HIARNG installation has been invasive plants. These species overran training corridors with impassable, dense growth, posed actual harms to soldiers and their equipment and destroyed buildings and infrastructure when storms hit. The eradication of these priority species across the installation has been essential to restoring and protecting HIARNG's training mission and sustainability. At KFR alone, nearly 20 percent of the training site had been overrun by long-thorn kiawe; now the full site is usable for perhaps the first time in its history. The NRC program has achieved a true turning point for the statewide installation, achieving total control of the priority invasive species so that active treatment can give way to spot-management and monitoring—and the cost savings of this protocol (rather than constant treatment) amount to tens of thousands of dollars each year while still protecting training access. The goat grazing program creates a similar benefit: cost-efficient removal of invasive species allows critical funds to be redirected to other environmental and training land support projects. The NRC program coordinates with trainers to prioritize sites for clearance, deploying herds to meet anticipated access needs. The use of the grazing

herds also effectively reduces fire fuel loads, thereby minimizing the risk of fires that interrupt training, as well as soldier access in forested areas. The goats and sheep remove understory while keeping mid- and upper-canopies intact according to natural resources management goals. In a context where elephant grass grows at a rate of a foot per week, keeping areas cleared for soldiers is essential.

The successes of the NRC program can be transferred to virtually any installation challenged by invasive species management, but they are particularly important for other land-owning agencies in Hawaii. On most public lands on the Big Island of Hawaii, miconia has become so infested, the state has given up trying to address it. The NRC program proves, however, that a dedicated program that targets the species seed bank can eliminate the species in just a few years. The HIARNG's KMR is now the only site of healthy endemic habitat on the island—but it could become the model for others. Beyond Hawaii, the strategy of seed-bank elimination and herbicide-free eradication could easily be adopted by many installations. HIARNG's implementation of animal controls for invasive species management is another technique that could be readily adopted by other installations seeking to manage large tracts of land in a cost-effective, resource-efficient manner.

The NRC program's internal continuity is grounded in coordinated management across directorates with environmental accountability and awareness instilled throughout all installation facilities through customized training. An environmental component in HIARNG's SharePoint system has allowed for easier access and updating of electronic copies of all environmental plans, policy memoranda and EO supplemental training.

The HIARNG installation is not open to the public, but the NRC program has developed other ways to work with its community and encourage NRC awareness. Most critical in this outreach has been the longstanding partnerships with KISC and BIISC, with those agencies also serving as public ambassadors for the state's goals of invasive species eradication. This partnership has supported internships for local students to participate in onsite fieldwork.

The NRC program also works with the University of Hawaii at Hilo's environmental studies and biology departments, assisting students with research access on HIARNG properties. One student recently completed a 5-year study on hybrid ecosystem impacts; the NRC program has been able to share that research's models to begin considering alternate plant assortment options and carbon storage possibilities. Providing access and support to these students directly benefits their education, while the NRC program benefits from cutting-edge data and techniques.

Also in collaboration with the University of Hawaii, the NRC program participates in a program involving local school children. Fifth grade students are paired with university researchers to develop and conduct a long-term environmental research project that takes place on a HIARNG training site. The students continue working with their mentors all the way up through high school graduation, establishing relationships within the university and HIARNG as they develop a level of expertise that many college graduates would envy. While this program has been under the university's management, it is now moving under the HIARNG ENV's oversight.

The HIARNG ENV also hosts events associated with National Public Lands Day and Earth Day, which have brought students and community members onto the installation for litter pickup, tree planting and habitat restoration projects. The HIARNG ENV is also a partner for HIARNG's Youth Challenge Academy for at-risk teens, organizing native planting activities and beach cleanups with youth participants. In all these efforts, the NRC program is dedicated to instilling a broader appreciation and accountability for preserving the unique habitats of Hawaii.