

Ecosystem Restoration Management Plan

OIP Year 10-14, Oct. 2016 - Sept. 2021

MUs: Kaala Army and Kaala NAR

Overall OIP Management Goals:

- Form a stable, native-dominated matrix of plant communities which support stable populations of IP taxa.
- Control ungulate, weed, predatory snail, rodent, and slug threats to allow for stabilization of IP taxa.

Background Information

Location: Highest peak of Oahu in the central Waianae Mountains

Land Owner: City and County of Honolulu/Board of Water Supply (12.9 acres), State of Hawaii (57 acres), US Army (101.7 acres), FAA site (1.5 acres)

Land Manager: U.S. Army Garrison Hawaii/State of Hawaii (NARS)

Acreage: 178 acres (Kaala Army = 120 acres, Kaala NAR = 58 acres)

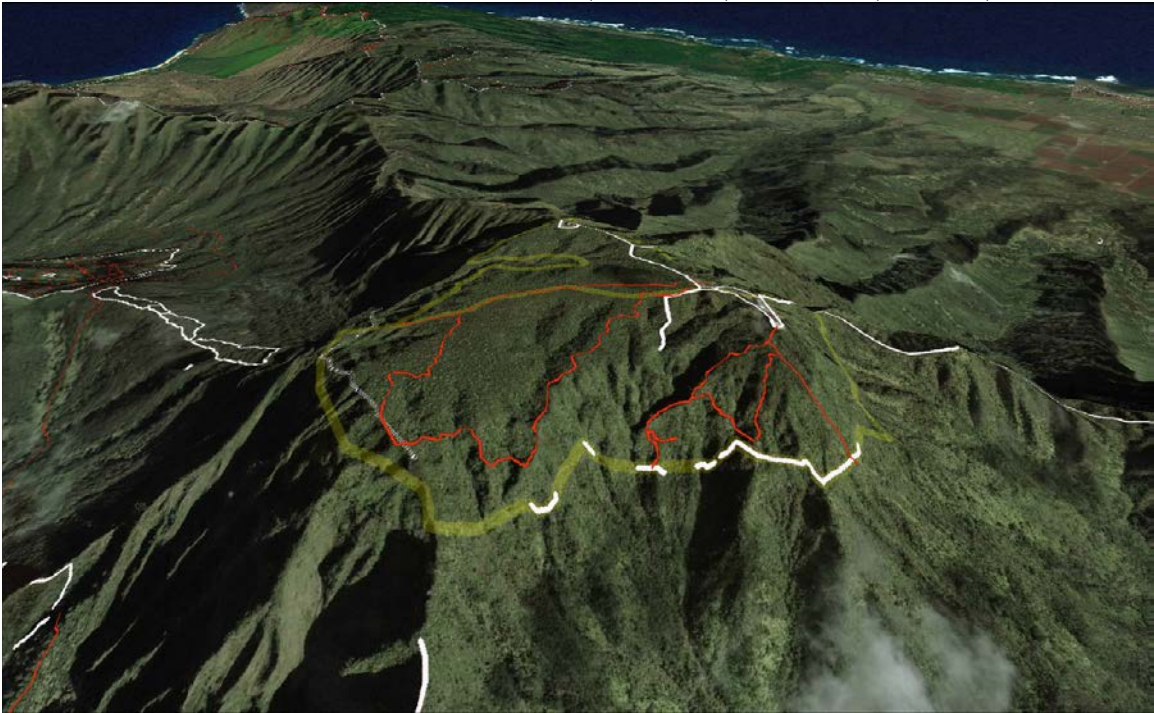
Elevation range: 3,400 to 4,020 ft.

Description: Bog and surrounding montane wet community; plateau and surrounding cliffs of Kaala peak; Moderate to steep slopes and cliffs, including small ridges and gulch bowls. The MU extends down into wet-mesic forest into Haleauau at approximately the 3,000 ft. elevation level. Kaala is a very unique area, the wettest site in the Waianae Mountains, the highest point on Oahu, dominated by wet native forest and home to a variety of rare taxa. Major threats to Kaala are ungulates and weeds. NRS actions have been geared towards mitigating these threats over the years. To accomplish meaningful threat control, NRS must work with the State, as both pigs and weeds cross property boundaries.

Native Vegetation Types

Waianae Vegetation Types
<u>Wet forest</u>
<u>Canopy includes:</u> <i>Metrosideros</i> spp., <i>Cheirodendron</i> spp., <i>Cibotium</i> spp., <i>Ilex anomala</i> , <i>Myrsine sandwicensis</i> , and <i>Perrottetia sandwicensis</i> .
<u>Understory includes:</u> Typically covered by a variety of ferns and moss; may include <i>Melicope</i> spp., <i>Cibotium chamissoi</i> , <i>Machaerina angustifolia</i> , <i>Nertera granadensis</i> , <i>Kadua centranthoides</i> , <i>Nothoperanema rubiginosa</i> , and <i>Broussaisia arguta</i> .
NOTE: For MU monitoring purposes vegetation type is mapped based on theoretical pre-disturbance vegetation. Alien species are not noted.
NOTE: For MU monitoring purposes, vegetation types were subdivided using topography (gulch, mid-slope, and ridge). Topography influences vegetation composition to a degree. Combining vegetation type and topography is useful for guiding management in certain instances.

Aerial views of Kaala with fences (white lines) and trails (red lines)



Primary Vegetation Types at Kaala



Wet forest



Wet forest slope

MIP/OIP Rare Resources:

Organism Type	Species	Pop. Ref. Code	Population Unit	Management Designation	Wild/ Reintroduction
Plant	<i>Cyanea acuminata</i>	ALA:A-D,G-J,N,S,Y	Kaala	MFS T1	Wild
Plant	<i>Labordia cyrtandrae</i>	ALA:A-C, G-W	Kaala	MFS T1	Both
Plant	<i>Phyllostegia hirsuta</i>	ALA-A	Kaala	MFS T1	Reintro
Plant	<i>Schiedea trinervis</i>	ALA:A-E, G, J-T, Y, X	Kaala	MFS T1	Both
Snail	<i>Achatinella mustelina</i>	ESU-D	Kaala	MFS	Wild

MFS= Manage for Stability

GSC= Genetic Storage Collection

*= Population Dead

†=Reintroduction not yet done

Other Rare Taxa at Kaala MU:

Organism Type	Species	Federal Status
Plant	<i>Melicope christophersenii</i>	Candidate
Plant	<i>Neraudia melastomafolia</i>	Species of concern
Plant	<i>Cyanea calycina</i>	Endangered
Plant	<i>Gunnera petaloidea</i>	Species of concern
Plant	<i>Lepidium arbuscula</i>	Endangered
Plant	<i>Lobelia oahuensis</i>	PEP Species
Snail	<i>Auricullela</i> spp. (unknown spp.)	Species of concern
Snail	<i>Kaala subrutila</i>	Species of concern
Bird	<i>Vestiaria coccinea</i>	State Endangered
Insect	<i>Drosophila substenoptera</i> .	Endangered

Rare Resources at Kaala:



Labordia cyrtandrae



Schiedea trinervis



Cyanea acuminata



Achatinella mustelina



Left: Native *Succinea*, and Right: Happy Face Spiders (*Theridion grallator*)

Rare Resources Locations at Kaala

Map removed to protect rare resources. Available upon request

MU Threats to MIP/OIP MFS Taxa:

Threat	Taxa Affected	Localized Control Sufficient?	MU scale Control required?	Control Method Notes
Pigs	All	No	Yes	MU partially fenced
Goats	All	No	Yes	Goats present in Waianae valleys bordering Kaala. Control being planned with the State
Rats	All	Yes	Unknown	Traps installed around AchMus
Predatory snails	<i>Achatinella mustelina</i>	Yes	No	<i>Oxychilus alliarius</i> (garlic snail) is present but not in the vicinity of <i>A. mustelina</i> . <i>Euglandina rosea</i> is not found in this area
Slugs	<i>Cyanea acuminata</i> , <i>Labordia cyrtandrae</i> , <i>Phyllostegia hirsuta</i> , <i>Schiedea trinervis</i>	Yes	No	Sluggo application around LabCyr and PhyHir
Ants	Potential threat to <i>Drosophila substenoptera</i>	Unknown	Unknown	Some available, depends on species

Weeds	All	No	Yes	Multiple control techniques used. Aerial control options, including HBT, are being considered.
Fire	No threat			

*Note: ‘Localized Control’ refers to management in a discrete portion of the MU, such as directly around a rare taxa site, as opposed to ‘MU Scale Control, which refers to management across the entire MU.

Regarding some of the MIP/OIP rare plant taxa, with the new delineation of the Schofield Action Area, species such as *L. cyrtandrae* and *S. trinervis* may be dropped from the list of OANRP managed species in the future following consultation, as Army training impacts to these species is negligible.

Management History:

- 1996-2016: *Hedychium gardnerianum* control including sweeps of WCAs and aerial surveys.
- 1996-2009: Sporadic goat control in Lower Kaala NAR.
- 2006: 90% of Strategic fencing completed mainly in Haleauau Gulch portion of Kaala Summit through partnership effort between BWS, State of Hawaii, TNC and Army NRS.
- 2006-2009: Pig control at Kaala MU using dogs, traps, and snaring.
- 2006-2009: *Sphagnum palustre* control research.
- 2007-2016: *Juncus effuses* and *Crocoshia crocosmifolia* control with volunteers, led by Outreach Program.
- 2009: Goat control efforts initiated along Waianae Kai headwall area.
- 2009: Sphagnum control begins with staff and volunteer efforts.
- 2012: MU fence completed around Lihue, encompassing the area below the Kaala cliffs
- 2012: Snaring initiated in Lihue, significantly reducing ungulate pressure on the Kaala strategic fences.
- 2015: Plans to complete additional fencing on the Waianae Kai and Makaha facing ridges of Kaala are developed; proposed fences are mapped and measured
- 2016: The first small scale rodent trapping grid was installed around the *L. cyrtandrae* ALA-S. A total of 70 traps (35 Victor and 35 KaMate) were installed after observing high take of flowers and fruits by rodents.
- 2016: *Puccinia* rust now significantly impacting *Metrosideros* spp. First detected on Oahu approximately in 2008.
- 2016: Site visit conducted and area selected for a tree snail predator enclosure near tram tower on Army land.
- 2016: Initial *Sphagnum* control completed on Army land. Annual retreatment and monitoring phase ongoing.
- 2016: Construction of ungulate control fence along Kaala road started.

Ungulate Control

Identified Ungulate Threats: Pigs, Goats

Threat Level: High

Primary Objectives:

- Maintain MU as pig and goat free.

Strategy:

- Eradication of pigs in the MU. Eradication of all pigs within Lihue fence (SBW) and population reduction of goats through aerial and ground hunting efforts in the headwaters of Waianae Kai and Makaleha will reduce pressure on the Kaala fences and minimize potential ingress through strategic fence sections of Kaala.
- Construct fenceline along upper rim of Waianae Kai to eliminate ingress.
- Construct fenceline along Kaala Road from summit area to 3 pts. fence to segment goat and pig populations and facilitate removal efforts.
- Set and monitor snares to control any pigs that enter Kaala around the strategic fences.

Monitoring Objectives:

- Biannual fence checks completed in Kaala from 2009-2015. Quarterly fence checks done in Lihue since 2013.
- Detect any pig sign in the summit fence area while conducting rare plant monitoring or other weed control work in the MU.
- Monitor pig transect along the transect trail quarterly.

Management Responses:

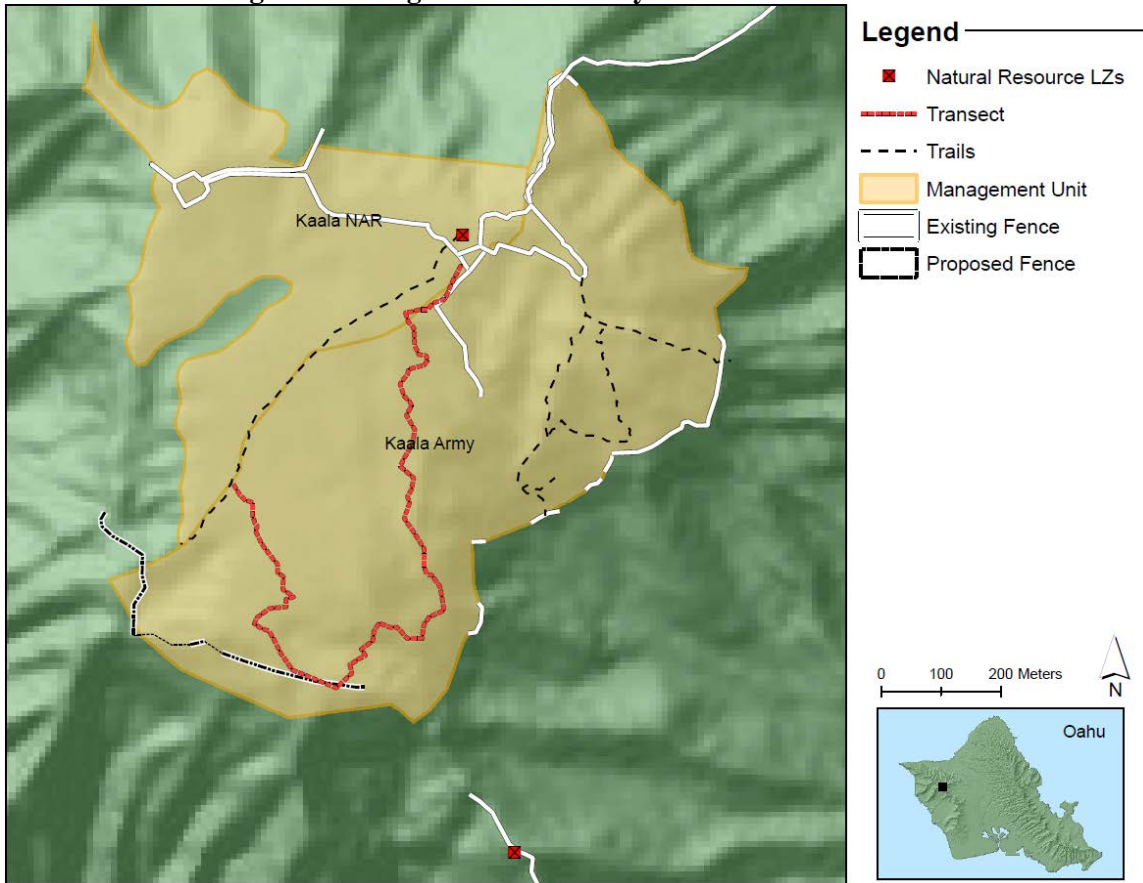
- If any ungulate activity is detected within the fenced unit, scale up snaring efforts and implement more frequent snare checks.

Maintenance issues

The MU fenced area takes advantage of large and small cliffs to strategically protect the area. The major threats to the fence include streams carrying rocks down gulches into the fence, fallen trees, and pigs uprooting areas beneath the fenceline. Access to the area is significantly restricted, so vandalism is not a problem.

Fence integrity will be monitored four times annually. All fence sections are checked during bi-annual snare checks. Fences are also checked after extreme rainfall events. In particular, the Haleauau area fence line requires regular checks because of many streams in the area. Monitoring for ungulate sign also occurs during the course of other field activities. As of 2016, the Kaala road fence is under construction with completion slated by the end of calendar year 2016. The State of Hawaii will have responsibility for the maintenance of this watershed/NAR fence. In 2017, OANRP will contract the construction of a small fence linking the strategic fence above South Haleauau to the end of the boardwalk area. The purpose of this fence will be to eliminate pig ingress from the headwaters of Waianae Kai into the summit area. This last fencing project should make the summit area of Kaala pig free. Maintenance of this fence will be done by OANRP since the majority of the fenceline is on Army land (see proposed fence on map below)

Ungulate Management and Survey Locations at Kaala MU



Metrosideros polymorpha



Epiphytes

Weed Control

Weed Control actions are divided into 4 subcategories:

- 1) Vegetation Monitoring
- 2) Surveys
- 3) Incipient Taxa Control (Incipient Control Area - ICAs)
- 4) Ecosystem Management Weed Control and Restoration Actions (Weed Control Areas - WCAs)

These designations facilitate different aspects of MIP/OIP requirements.

Vegetation Monitoring

Vegetation monitoring has not been initiated yet for the Kaala MU, but WorldView satellite imagery may be an option for future monitoring. Monitoring has not been done given the sensitivity of the habitat to trampling, the difficulty of hiking through dense, steep, and dissected terrain, and the predominately native habitat of the Kaala summit area.

Surveys

Army Training: Infrequently

Other Potential Sources of Introduction: NRS, pigs, birds, recreational hikers

Survey Locations: Roads, Landing Zones, Camp Sites, Fencelines, High Potential Traffic Areas

Management Objective:

- Prevent the establishment of any new invasive alien plant or animal species through regular surveys along roads, landing zones, camp sites, fencelines, trails, and other high traffic areas.

Monitoring Objectives:

- Conduct road surveys, including parking areas, every year (RS-Kaala-01).
- Survey two transects for weeds annually; Boardwalk (WT-Kaala-01) and Transect Trail (WT-Kaala-03).
- Quarterly surveys of the Kaala campsite (OS-Kaala-01) and Landing Zone (LZ-SBW-082) .
- Annual aerial surveys (as needed) mainly for ginger detection
- Note unusual, significant, or incipient alien taxa during the course of regular field work.

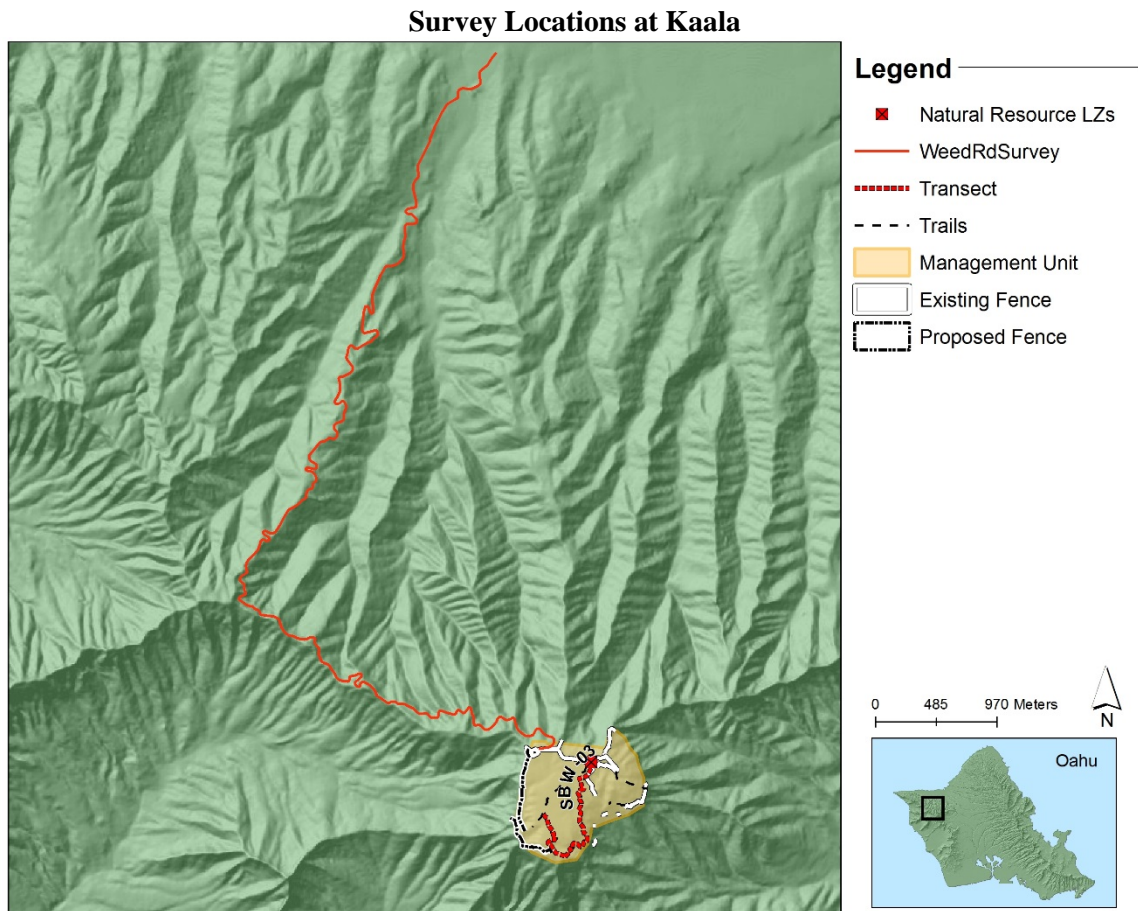
Management Responses:

- Any significant alien taxa found will be researched and evaluated for distribution and life history. If found to pose a major threat, control will begin and will be tracked via Incipient Control Areas (ICAs)

Surveys are designed to be the first line of defense in locating and identifying potential new weed species. Roads, landing zones, fencelines, and other highly trafficked areas are inventoried regularly to facilitate early detection and rapid response; Army roads and LZs are surveyed

annually, non-Army roads are surveyed annually or biannually, while all other sites are surveyed quarterly or as they are used.

The Kaala road will be surveyed annually, since it is heavily used by staff, and may rarely be used by the Army. There is one LZ at Kaala, located just off the road, outside of the FAA gate, next to the boardwalk trailhead. It is rarely used, as permission must be granted by the FAA. If used, the LZ should be surveyed, not to exceed once per quarter. The State maintains a shelter just off the road; this grassy clearing is used as a campsite. Staff will survey the campsite whenever used, not to exceed once per quarter. There are two weed transects in the MU. One is along the boardwalk, the most heavily used trail. The other is along a trail/ungulate transect. Both are surveyed annually. See the *Survey Locations at Kaala* map.



Incipient Taxa Control (ICAs)

Management Objectives:

- As feasible, eradicate species identified as high priority incipient invasive aliens in the MU by 2021.
- Conduct seed dormancy trials for all high priority incipients by 2021.

Monitoring Objectives:

- Visit ICAs at stated re-visitation intervals. Control all mature plants at ICAs and prevent any immature or seedling plants from reaching maturity.

Management Responses:

- If unsuccessful in preventing immature plants from maturing, increase ICA re-visitation interval.

Incipient Control Areas (ICAs) are drawn around each discrete infestation of an incipient invasive weed. ICAs are designed to facilitate data gathering and control. For each ICA, the management goal is to achieve complete eradication of the invasive taxa. Frequent visitation is often necessary to achieve eradication. Seed bed life/dormancy and life cycle information is important in determining when eradication may be reached; much of this information needs to be researched and parameters for determining eradication defined. Staff will compile this information for each ICA species.

The table below summarizes incipient invasive taxa at Kaala. Note that this MU was not described in the original MIP, and therefore is not included in Appendix 3.1 of the MIP, which lists significant alien species and ranks their potential invasiveness and distribution. This table supplements Appendix 3.1 by identifying target species for Kaala. While the list is by no means exhaustive, it provides a good starting point for discussing which taxa should be targeted for eradication in the MU. Three management designations are possible: Incipient (small populations, eradicable), Control Locally (significant threat posed, may or may not be widespread, control feasible at WCA level), and Widespread (common weed, may or may not pose significant threat, control feasible at WCA level).

ICAs have been identified for ten taxa at Kaala. Most of these species are located close to the FAA facility or along a road, trail, or transect (see ICA map below). One ICA, for *Elaeocarpus grandis*, has been eradicated, but 33 ICAs remain active. Since the State conducts management in the Kaala NAR MU, OANRP efforts focus in the Kaala Army MU; however, OANRP does conduct work at several roadside ICAs on State land. Wherever possible, staff utilize volunteers to conduct ICA work; volunteers control many of the *Crocasmia x crocosmiiflora*, *Juncus effusus*, and *Sphagnum palustre* ICAs. Details on taxa and ICAs are in the table below. Actions for each ICA are listed in the Action Table at the end of this document.

Summary of Target Taxa

Taxa	Management Designation	Notes	No. of ICAs
<i>Anthoxanthum odoratum</i>	Incipient	Alien grass discovered in 2009. First record on Oahu. Highly invasive in pastures on the Big Island. The population appears to be limited to the beginning of the boardwalk and the trailhead/LZ. Very few plants have been seen in recent years, but detection can be difficult when the grass is vegetative.	1
<i>Araucaria columnaris</i>	Incipient	One tree, likely planted. Potential for invasiveness has been observed elsewhere. No recruitment has been seen on site. Removing the tree is not currently a control priority, but should be considered in future.	0
<i>Begonia foliosa</i>	Widespread	Observed across the MU. NRS don't know how serious a threat this taxon poses, but control this taxa around rare taxa sites. This plant is thought to grow from cuttings, and control methods need to be researched.	0
<i>Begonia hirtella</i>	Widespread	Observed across the MU, primarily in drainages, less common than <i>B. foliosa</i> . Low priority for control. Control methods not well known.	0
<i>Clidemia hirta</i>	Widespread	This is one of the dominant weeds at Kaala, Control in WCAs, particularly around rare taxa sites.	0

<i>Crocosmia x crocosmifolia</i>	Incipient	This species likely escaped from ornamental plantings at the FAA enclosure. Eradication will be difficult to achieve, as the population includes areas inside the FAA enclosure, on State land, and on Army land. However, NRS feel preventing the spread of <i>C. crocosmifolia</i> is an important goal; NRS have seen it dispersing down the boardwalk and it can displace all other understory species in dense infestations. This taxon appears mostly to spread vegetatively, via corms, but does occasionally set seed. Seed viability was studied and seeds do not persist longer than 3 months. Control is ongoing with volunteer groups. The primary control technique is manual removal of bulbs. Herbicide sprays are being tested, and are needed to achieve eradication.	6
<i>Diplazium esculentum</i>	Incipient	This invasive fern thrives in wet areas and can grow to several feet in height. It has been found in two areas, one along road and one below FAA enclosure. Difficult to identify, but easy to control by handpulling or spraying.	2
<i>Elaeocarpus angustifolius</i>	Incipient	One tree, likely planted. Potential for invasiveness has been observed elsewhere. Tree was treated and is now dead. No recruitment observed. ICA declared extirpated in 2012.	(1 – extirpated)
<i>Festuca arundinacea</i>	Incipient	This highly invasive grass is difficult to identify when it is vegetative. The primary infestation is found along the radio tower road and around the radio tower enclosure. Outlier sites have been found around the FAA enclosure. This grass is controlled via foliar spraying or handpulling	4
<i>Fraxinus uhdei</i>	Control locally	While few <i>T. ciliata</i> are known from the bog flats, many trees have been seen during aerial surveys in valleys backing up to Kaala. This taxon should be treated wherever found, as part of regular WCA efforts. This is a candidate for aerial control, if an effective herbicide/ application method is identified.	0
<i>Hedychium coronarium</i>	Incipient	This taxon is a huge problem in the Koolau mountains, although it is considered less invasive than <i>H. gardnerianum</i> . One patch, around 10x20m in size, was known from State land near the radio towers. This patch rarely flowered, and no seed were seen. The State has conducted some control work on the patch, and therefore it is not an OANRP priority. If requested, OANRP will assist the State with further control efforts.	0
<i>Hedychium gardnerianum</i>	Control locally	Originally planted as an ornamental near the FAA facility, this species has spread widely. It is found across the bog flats (on both Army and State lands) and has spread down cliffs and into Haleauau (Lihue). Aerial surveys in 2009 showed that it had not spread into Makaha and Waianae Kai. Eradication would be extremely difficult/impossible to achieve without a major increase in resources. This species is highly invasive and poses a major threat to rare taxa and native forest integrity. Control is ongoing in WCAs. Candidate for aerial herbicide control on cliffs, remote areas of Lihue.	0
<i>Juncus effusus</i>	Incipient	This taxa is known from sites around the radio tower enclosure, the FAA enclosure, the boardwalk, and the transect trail. In addition, large patches have been known from State land just north of the boardwalk. This sedge is highly invasive and poses a significant threat to the area. OANRP conducted a buried seed trial and found that seeds form a persistent seed bank, lasting at least 7 years in soil. This highlights the threat posed, but also suggests that eradication may be very difficult to achieve. Volunteers conduct most <i>J. effusus</i> control, digging out roots and bagging seed heads (taken to H-power for disposal). Efforts have been effective, but plants are still found at most ICAs.	9

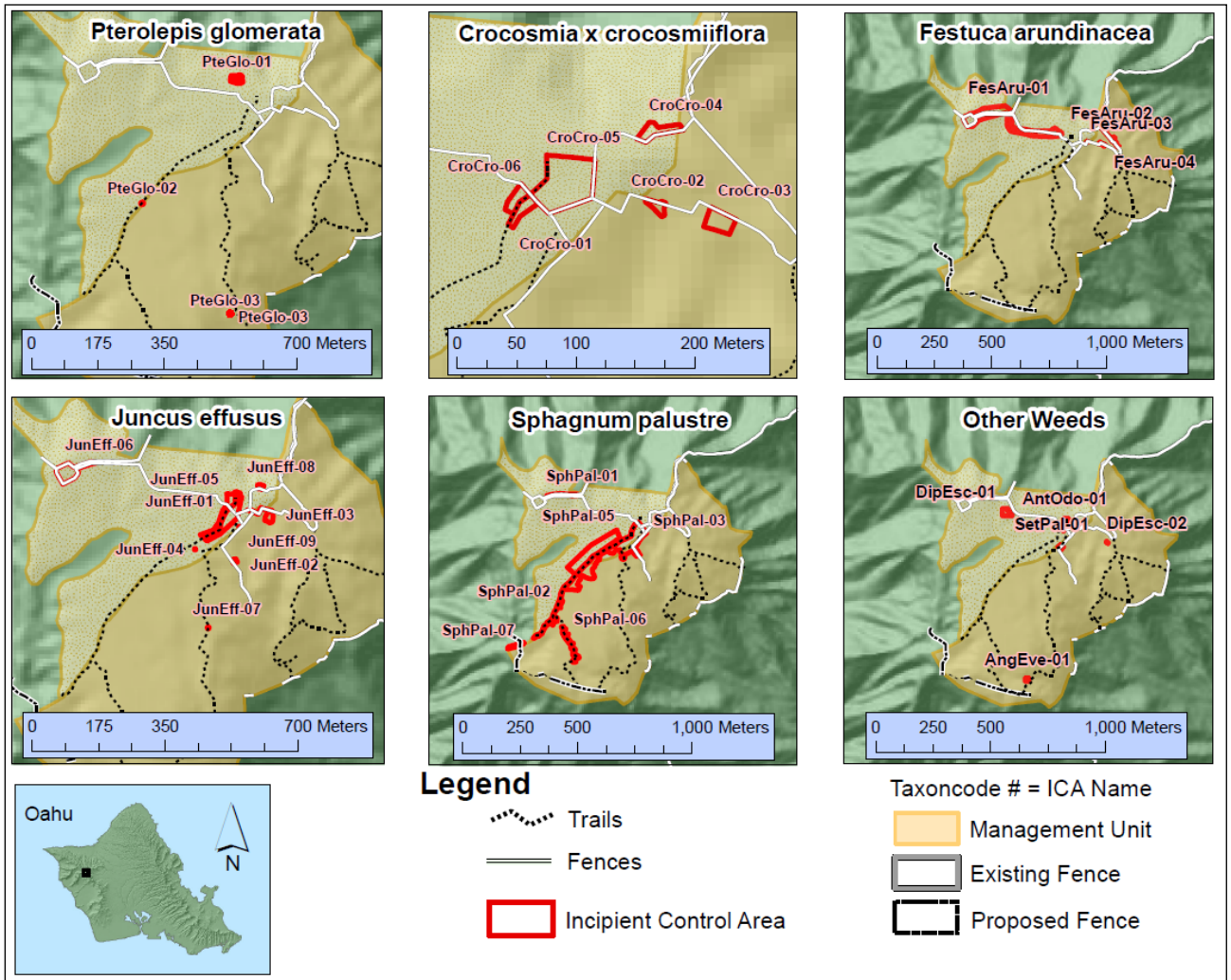
<i>Leptospermu m scoparium</i>	Control locally	Several plants were found in the bog flats during WCA sweeps in 2002-2005. There is a moderate-sized infestation known from the Kumaipo ridge; this is likely the source population. No plants have been seen in the bog flats on subsequent sweeps, but the Kumaipo infestation is still thriving and is an ICA in the Makaha MU. Control was conducted at Kumaipo around 2003-04 but aerial surveys in 2009 noted the population had rebounded. Interagency control efforts are needed at the Kumaipo site. Aerial treatment techniques need to be identified to use at Kumaipo. At Kaala, if any new plants are found, new ICAs may be created. Plants that are felled do not resprout and do not require herbicide treatment.	0
<i>Meleleuca quinquenervia</i>	Control locally	Plants occasionally were found during WCA sweeps in the early 2000s, but no plants have been found recently. No large stands known nearby; unclear where plants are dispersing from. This taxon should be controlled whenever found during regular WCA sweeps.	0
<i>Odontonema cuspidatum</i>	Control locally	This shrub appears to have originated from plantings outside the FAA enclosure and spreads vegetatively. Since no flowers or fruit were seen at the site, staff collected cuttings, which were grown until they flowered, resulting in positive identification. While this taxon is highly invasive and forms dense stands, it appears to have a limited distribution at Kaala and is in a degraded site. Control is conducted with volunteers as part of a restoration project in WCA-02. Plants are handpulled, and slash is sprayed with glyphosate. Cut stumps are treated with herbicide.	0
<i>Psidium cattleianum</i>	Widespread	Patches of this invasive tree are scattered across Kaala. These stands tend to be small, and are targeted by NRS during WCA sweeps.	0
<i>Pterolepis glomerata</i>	Incipient	Highly invasive, this groundcover is well-established in the Koolaus, but is incipient in the Waianaes. Three sites are known in the MU; one at the campsite, one on the boardwalk, and one on the transect trail. Just outside of the MU, another site is known on the trail leading to Kumaipo. This taxon may have been introduced to the MU via staff or recreational hikers or both. This species spreads quickly and is difficult to eradicate due to its cryptic nature and suspected seed persistence. Despite this, control efforts have been effective. No plants have been seen at the boardwalk site since 2014, only 1 plant has ever been seen at the transect trail site, and very few plants are found at the camp site at any one time. This taxon continues to be a high priority for eradication	3
<i>Rubus argutus</i>	Widespread	The bane of NRS at Kaala. This taxon is the most common weed in the MU, forms dense stands, and is a thorny hazard to staff. Control techniques have been tested, but it is difficult to achieve 100% kill with any known techniques. New trials were installed in 2016 to test clip and drip options. Although this taxon is highly invasive, it is a low priority for control due to its density. It is controlled at rare taxa sites.	0
<i>Setaria palmifolia</i>	Incipient	Only one site is known for this taxa, an invasive grass that thrives in wet, shady conditions. All known plants were killed, and no recruitment has been seen. Since this grass can be difficult to spot, and seed persistence is unknown, the ICA needs to be monitored for 10 years before it can be declared eradicated (2019)	1
<i>Sphaeropteris cooperii</i>	Control locally	This invasive tree fern is widespread across Oahu, but uncommon at Kaala. In aerial surveys in 2009, many plants were seen in valleys backing up to Kaala, particularly Haleauau. This fern should be controlled whenever found, particularly during WCA sweeps. Plants can simple be cut down, no herbicide is necessary. This is a candidate for targeted aerial control.	0

<i>Sphagnum palustre</i>	Incipient	Originally planted along the boardwalk, this invasive moss spread across a large portion of the bog flats on both Army and State land. OANRP efforts focus on Army land, but include treating both sides of the boardwalk to reduce the likelihood of dispersal, as well as controlling a satellite infestation along the radio tower road and occasionally assisting NEPM staff with sprays in the State core. On the Army side of the boardwalk, initial control has been completed and staff are now in the process of re-treating scattered patches of moss. Volunteers control the moss in a 3m buffer along the boardwalk, while staff sweep the area beyond that buffer. Staff also treat two outlier sites, one along the transect trail, and one along the Kumaipo trail. Foliar sprays of a 10% dilution of Burnout (formerly St. Gabriel's Mosskiller) are effective, although efficacy is reduced if the moss is in standing water.	6
<i>Toona ciliata</i>	Control locally	While not common in the Kaala MUs, many trees were seen during 2009 aerial surveys in valleys backing up to Kaala. This tree should be controlled as part of WCA efforts. This is a candidate for aerial control, if an effective treatment is found.	0

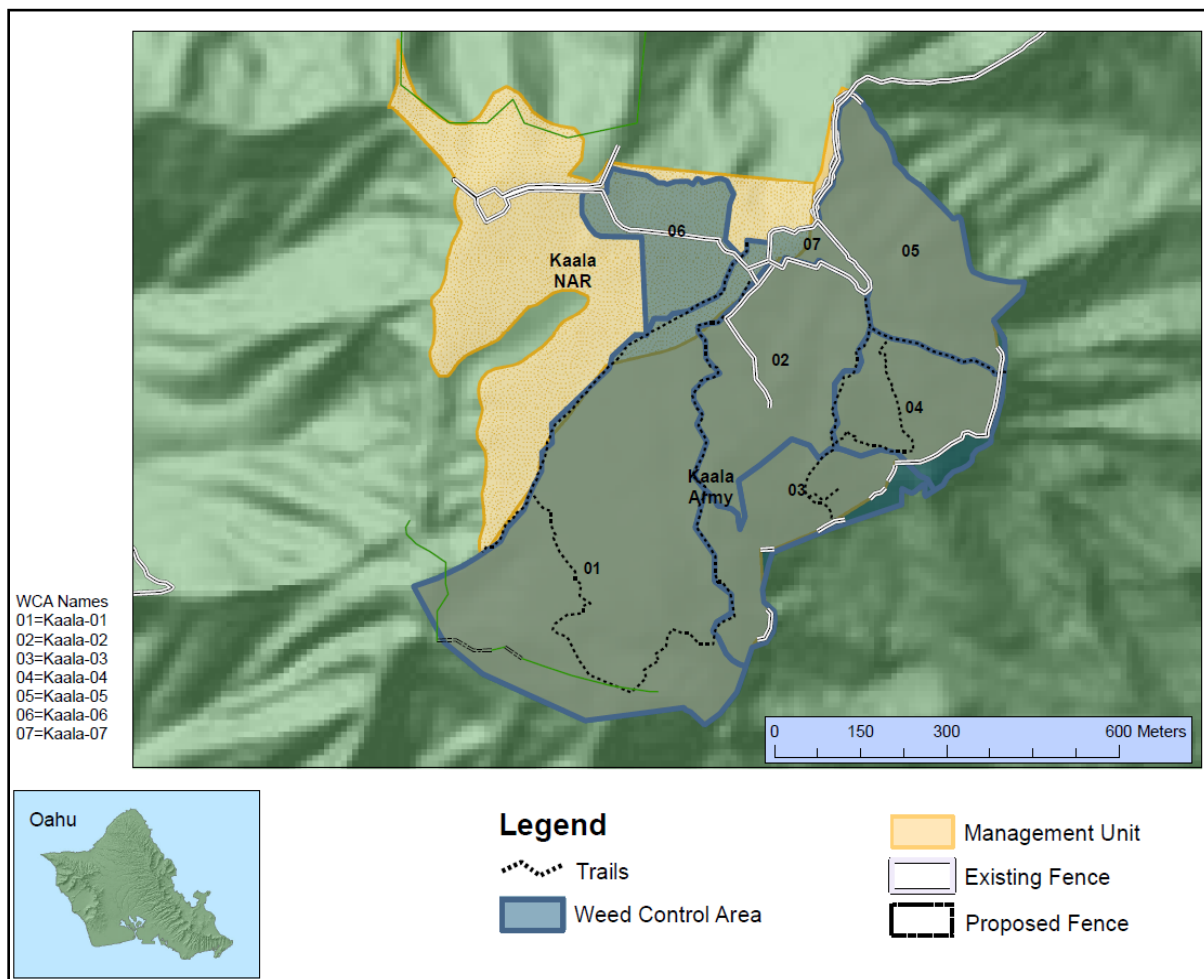


C. crocosmifolia volunteer trip at Kaala

Incipient Control Areas at Kaala



Weed Control Areas at Kaala



Ecosystem Management Weed Control (WCAs)

OIP Goals:

- Within 2m of rare taxa: 0% alien vegetation cover
- Within 50m of rare taxa: 25% or less alien vegetation cover
- Throughout the remainder of the MU: 50% or less alien vegetation cover

Management Objectives:

- Determine whether alien vegetation cover goals are being met around rare taxa and across the MU.
- Maintain/reach 50% or less alien vegetation cover in the understory and canopy across the MU.

Management Responses:

- Increase/expand weeding efforts if shorter intervals are needed between weeding efforts.

The Kaala MUs are two of the few MUs in the Waianae Mountains dominated by native vegetation. Kaala is divided into two MUs along the boardwalk, which generally follows the property line: Kaala Army (the eastern portion of the summit of Kaala, from the boardwalk to Lihue) and Kaala NAR (the western portion of the summit, owned and managed by the State). OANRP conducts relatively little work in Kaala NAR MU, which is actively managed by NEPM, and focus management in the Kaala Army MU. Although MU vegetation monitoring has not been conducted at Kaala, NRS observe that it is likely that it meets the 50% or less alien cover goal for the OIP. Vegetation across the MU includes *Metrosideros polymorpha*, *Cheirodendrom platyphyllum*, *Cheirodendron trigynum*, *Broussasia arguta*, *Melicope clusiifolia*, *Ilex anomala*, *Cibotium* spp., *Machaerina angustifolia*, *Dianella sandwicensis*, and numerous other native ferns, herbs, and mosses. Most of the MU is divided into WCAs to facilitate data tracking and control efforts (see Incipient and Weed Control Areas map above).

The primary weed threats at Kaala are *H. gardnerianum*, and *P. cattleianum*. Since both taxa are found throughout the MU, weed sweeps are conducted to find and treat individual plants. Generally, a sweep involves staff lining up several meters apart at a fixed starting point, such as the boardwalk, then surveying at a set bearing across the WCA. The sweep stops at a set point, then the group flips around and sweeps back to the starting point, parallel to the first bearing. The goal of a sweep is to have high confidence that all target weeds are found and treated in the surveyed area. Often a hip chain is used along one edge of a sweep to ensure that no gaps occur when the line flips. In steep terrain, sweeps must go around cliffs and avoid other hazards. A modified sweep, utilizing spotters at vantage points (often with binoculars) can ensure good coverage even in steep areas. Aerial surveys are sometimes used to identify outlier targets as well.

The *H. gardnerianum* control strategy has evolved over the years. Initial plans were ambitious (sweeping each WCA every other year) and have been modified to take into account the large size of the WCAs, steepness of terrain, thick vegetation, and competing priorities. Staff estimate that a three year re-visitation cycle would allow *H. gardnerianum* plants to be treated before maturing and setting seed. This means that one or two of the Kaala Army MU WCAs (1-5) must be swept each year. The Green team is the lead on WCA sweeps. To assist them, the EcoRest team has taken over sweep duties at the largest WCA, Kaala-01. NRS track numbers of all treated *H. gardnerianum*, divided by size class. This data is helpful in determining whether control efforts are resulting in fewer plants found in a given area.

Aerial and ground surveys show that there are many large, mature patches of *H. gardnerianum* in steep areas, on the Kaala cliffs, and below Kaala in Haleauau (Lihue MU). Ideally, all locations of *H. gardnerianum* must be treated to effectively protect rare resources in both the Kaala and Lihue MUs. Currently, efforts focus on all hikable areas of Kaala, . Aerial sprays are necessary to treat plants growing on cliffs and in Lihue. A couple aerial treatment techniques have been tested, with some success, but further trials are needed. Staff worked with Dr. James Leary (CTAHR) to test the efficacy of Herbicide Ballistic Technology (HBT) on cliff-side ginger. Projectiles with the active ingredient imazapyr were used, based on a successful trial Dr. Leary conducted on Kauai. Unfortunately, the remote nature of the ginger made it difficult to monitor, and the imazapyr projectiles had a short shelf life, making them logistically difficult to work with. Staff will continue to work with Dr. Leary on HBT, as this is the most promising option for treating plants on cliffs. Staff also worked with an Army contractor to spray a large monotypic ginger patch in Lihue with a ball sprayer. The treated plants died back, but required follow-up treatment. There is always a risk of non-target impact with aerial treatment; staff need to determine how to mitigate this risk, particularly to rare taxa, before using aerial treatment techniques

Psidium cattleianum is scattered sparsely across the MU, with most stands found on the slopes and gullies bordering the bog flats. It has the potential to expand its range at Kaala, and is a control priority. Due to the wet environment, cut *P. cattleianum* slash can resprout, and both slash and stumps must be treated with herbicide. Staff may experiment with using a cocktail of Garlon 4 and Milestone to reduce the likelihood of resprouts. Other tree weeds are occasionally found on Kaala, including *M. quinquenervia* and *T. ciliata*. All canopy weeds should be controlled during WCA sweeps.

WCA: Kaala-01 (Boardwalk to Transect Trail)

Veg Type: Wet Forest

OIP Goal: 25% or less alien cover (rare taxa in WCA). No monitoring has been conducted, but it is likely this goal has been met.

Targets: *Hedychium gardnerianum*, *P. cattleianum*, *M. quinquenervia*, *L. scoparium* and *C. hirta* in areas where it is not abundant.

Notes: Also known as the Bog Flats, this WCA encompasses the top of Kaala, on Army land and is bounded on two sides by the boardwalk and the transect trail. This is a largely intact area dominated by *Metrosideros polymorpha* (ohia). Other dominant natives include *Cheirodendron platyphyllum* (lapalapa) *Cheirodendron trigynum* (olapa) *Coprosma ochracea* (pilo) and *Ilex anomala* (kawau). Rare taxa include *S. trinervis*, *C. acuminata*, *L. cyrtandrae*, *L. oahuensis*, and *C. calycina*. There is one large outplanting of *L. cyrtandrae* within this WCA, and keeping the area surrounding outplants free of grass and *R. argutus* is a priority.

H. gardnerianum is the primary threat. Previous control efforts have been effective at reducing numbers of mature plants, particularly along the boardwalk. Past control data suggests that *H. gardnerianum* is not evenly distributed across the entire WCA, however portions of the WCA have never been surveyed. NRS will use previous sweep records and new surveys to identify if there is a *H. gardnerianum* zone. If there is, NRS will sweep this zone every three years, and will treat the remaining portion of the WCA at a longer interval (perhaps every six years). *P. cattleianum* is relatively uncommon in the bog flats portion of the WCA, but is much more common on the slopes; it is also a high priority for control during sweeps. *M. quinquenervia* and *L. scoparium* have been found in this WCA in the past, albeit in very small numbers. The major understory weed threats are *C. hirta* and *R. argutus*; these will be treated primarily around rare taxa sites. The EcoRest field team will sweep the entire WCA in 2016-2017 for all major targets.

At the trailhead, there are several incipient species in an open, weedy area. Removing the alien grasses and herbs allows volunteers to more easily find and remove incipient taxa, but maintaining open ground is not sustainable, as other weeds continually colonize the site. NRS are experimenting with common native transplants to rehabilitate the bare ground, reduce grass cover, and hopefully displace incipient taxa.

Control of the incipient invasive moss *S. palustre* has created open areas along the boardwalk trail, some of which have been colonized by alien grasses. These grasses will be treated, as necessary, to prevent further alien grass incursion into the bog.

WCA: Kaala-02 (Transect Trail to Rainbow Ridge)

Veg Type: Wet Forest

OIP Goal: 25% or less alien cover (rare taxa in WCA). No monitoring has been conducted, but it is likely this goal has been met.

Targets : *Hedychium gardnerianum*, *P. cattleianum*, and *C. hirta* in areas where it is not abundant.

Notes: This WCA includes some gulches and steep terrain which pose major challenges for conducting weed sweeps. The area is native dominated, but the gulches are thick with *R. argutus*. Rare taxa include *S. trinervis*, *L. cyrtandrae* and *C. calycina*. The primary weed target is *H. gardnerianum*. NRS plan to sweep all hikable portions of the WCA once every three years. Hopefully, this will facilitate control by allowing NRS to treat plants before they mature, and look for plants larger than seedling size. In those areas too steep to reach, NRS will investigate alternative methods to survey and treat *H. gardnerianum*.

WCA: Kaala-03 (Lower Rainbow Ridge)

Veg Type: Wet Forest

OIP Goal: 25% or less alien cover (rare taxa in WCA). No monitoring has been conducted, but it is likely this goal has been met.

Targets : *Hedychium gardnerianum*, *P. cattleianum*, and *C. hirta* in areas where it is not abundant.

Notes: This WCA is steep and ends abruptly in cliffs which lead down into Central Haleauau. *Schiedea trinerva*, *L. cyrtandrae* and *C. acuminata* are present, as well as *G. petaloidea* in gulches. A high number of *L. cyrtandrae* are found in this WCA, including part of an outplanting. *Cyanea calycina*, *N. melastoma*, *L. hypoleuca* are also present. There are many mature *H. gardnerianum* patches in the WCA. It is not possible to sweep the entire WCA, as parts of it are too steep. *Rubus argutus* is thick in the draws and slopes. NRS will experiment with alternative survey/control methods on the steep slopes. This is one of the most challenging WCAs in which to control weeds, as many large patches of *H. gardnerianum* are found on inaccessible cliff areas and in close proximity to rare plants, making aerial spraying risky and difficult. Additionally, weed sweeps of the lower cliff areas are complicated by rare snails, which are present on weed species that are targeted for removal, including *H. gardnerianum* and *P. cattleianum*.

WCA: Kaala-04 (Rainbow Ridge to Blue Trail)

Veg Type: Wet Forest

OIP Goal: 25% or less alien cover (rare taxa in WCA). No monitoring has been conducted, but it is likely this goal has been met.

Targets: *Hedychium gardnerianum*, *P. cattleianum*, and *C. hirta* in areas where abundant.

Notes: This WCA is steep and ends abruptly in cliffs which lead down to Central Haleauau. It is bordered on two sides by access trails. Rare taxa present include *S. trinervis*, *L. cyrtandrae*, *P. hirsuta*, and *G. petaloidea* in gulches. *Rubus argutus* is thick, especially in gulches. Much of this area is too steep to safely sweep. NRS will prioritize treating mature *H. gardnerianum* in hikable areas and will investigate alternative techniques for surveying and treating cliffside plants. There are numerous patches of *H. gardnerianum* below the fenceline, in Haleauau (Lihue MU). NRS will seek to control these through aerial techniques. This is a frequently visited WCA, as there are outplantings of *L. cyrtandrae* and *P. hirsuta*, and general weeding along trails is conducted while doing rare plant actions. This WCA has many flat bowls around the upper elevations and aerial surveys are beneficial for finding mature *H. gardnerianum* patches that are not visible from the ground.

WCA: Kaala-05 (Blue Trail to Kamaohanui)

Veg Type: Wet Forest

OIP Goal: 25% or less alien cover (rare taxa in WCA). No monitoring has been conducted, but it is likely this goal has been met.

Target: *Hedychium gardnerianum*, *P. cattleianum*, and *C. hirta* in areas where it is not abundant.

Notes: This WCA is very steep, and there is little hikable area. Rare taxa present include *C. acuminata*, *S. trinervis*, *L. cyrtandra*, *C. calycina* and *G. petaloidea* in gulches. One outplanting of *L. cyrtandra* is located within this WCA. *Rubus argutus* is thick, especially in gulches and *H. gardnerianum* is the primary weed target. NRS prioritizes control of *H. gardnerianum* throughout the WCA, however, steep areas above the cliffs and the area on the cliffs themselves are loaded with mature *H. gardnerianum*. There is no effective way to control these patches at present, as staff currently do not have a valid Aerial Spray Statement of Need for the project. The steepness and high winds along the cliffs make aerial spraying challenging, but not impossible. A combination of ball spraying and HBT may be effective. Additional methods could include rappelling, however, this is very time consuming and only worthwhile to weed around endangered plants. There are also numerous patches of *H. gardnerianum* below the cliffs in Lihue.

WCA: Kaala-06 (North of Boardwalk/Road)

Veg Type: Wet Forest

OIP Goal: 25% or less alien cover (rare taxa in WCA). No monitoring has been conducted, but it is likely this goal has been met.

Target: *Hedychium gardnerianum*, *P. cattleianum*, and *C. hirta* in areas where it is not abundant.

Notes: This WCA is located on State land. Rare taxa present include *S. trinervis* and *M. christophersenii*. NRS will work with NEPM and support State weed control efforts, as feasible and as requested. This may include joint aerial surveys for *H. gardnerianum* and canopy weeds. This WCA is also home to sizable infestations of *S. palustre* and *J. effusus*, which have hampered sweep efforts, as both taxa are easily dispersed by staff walking through the area. Parts of this WCA lie outside the fenced portion of Kaala; in these areas, pig damage is considerable. Parts of the WCA are steep, and parts are thick with *R. argutus*. The campsite and shelter are included in this WCA; actions at the campsite include surveys for incipient weeds and maintaining the grass surrounding the shelter area (shared between OANRP and NEPM).

WCA: Kaala-07 (FAA Enclosure)

Veg Type: Wet Forest

OIP Goal: N/A. This enclosure is a built area, not a natural area.

Targets: *Hedychium gardnerianum*.

Notes: The FAA enclosure is dominated by grass and has little other vegetation. It is regularly mowed by facility staff. Occasionally, patches of *H. gardnerianum* establish inside of the fence. Much of the enclosure can be visually surveyed from outside the fence, but NRS must seek permission from the National Guard and Federal Aviation Administration (FAA) to enter the enclosure to control any *H. gardnerianum* seen. Staff should monitor the site during the course of other field activities, but also should check it thoroughly once every 2-3 years.

WCA: Kaala-08 (Radio Tower Reintros)

Veg Type: Wet Forest

OIP Goal: 25% or less alien cover (rare taxa in WCA). No monitoring has been conducted, but it is likely this goal has been met.

Targets: *Hedychium gardnerianum*, *Clidemia hirta*, *Rubus argutus*, *Psidium cattleianum*.

Notes: Sandwiched between the Radio Tower Road to the south and the Kaala Road to the north this WCA is on Kaala NAR. The area is dominated by native vegetation and home to non-MFS reintroductions of *S. trinervis* and *L. cyrtandrae*. These reintroductions have not thrived, and are not being maintained. Staff may assist with weed control efforts led by the State, but are not otherwise planning to conduct weed control. This may change if the Army is tasked with managing *M. christophersenii*, which occurs in the WCA.



Left: *Cheirodendron platyphyllum* canopy. Right: *Dianella sandwicensis* fruit

Taxa Considerations for Restoration Actions

Native Taxon	Outplant?	Seedsow/ Division/ Transplant?	Notes
<i>Cheirodendron</i> spp.	Yes	No	Tree. There are two taxon at Kaala, <i>C. trigynum</i> and <i>C. platyphyllum</i> . Test utility of either or both species as restoration plantings.
<i>Cibotium</i> spp.	Unknown	Division/ Transplant	Fern. Staff collected trunk buds and planted them near the trailhead. They are very slow-growing, and may or may not be effective as restoration plantings.
<i>Cyperus polystachios</i>	Unknown	Unknown	Sedge. This sedge recruits naturally in disturbed areas, and may be a good candidate for seed sows.
<i>Dianella sandwicensis</i>	Yes	Division/ Transplant	Herb. This species has been used in other MUs for restoration plantings, but transplants at Kaala have not always thrived, possibly because the ground at the trailhead is especially wet. It might be a good candidate at other planting sites.
<i>Gunnera petaloidea</i>	Unknown	Unknown	Herb. This large-leaved plant forms dense clumps, and may effectively shade out weeds. Propagation techniques need to be investigated.
<i>Machaerina angustifolia</i>	Unknown	Division/ Transplant	Sedge. This sedge forms large clumps, up to a meter across, and likely would physically displace weeds. Some transplants have been done at Kaala, with limited success. This taxon should be investigated further.
<i>Metrosideros polymorpha</i>	Yes	Unknown	Tree. One of the most common trees at Kaala, this taxon may be slow growing in the wet, bog habitat. Test utility as a restoration planting.

Rodent Control

Species: Black rats (*Rattus rattus*)

Threat level: High

Control method: Victor and KaMate traps

Seasonality: N/A

Number of snap grids: 1

Primary Objective:

- To implement rodent control if determined to be necessary for protection of rare plants and tree snails.
- Construct predator enclosure for long-term protection of *Achatinella mustelina*

Monitoring Objective:

- Monitor rare plant (*Labordia cyrtandrae* and *Cyanea acuminata*) populations and *Achatinella mustelina* populations to determine impacts by rodents.

Rodent Control:

- Potentially threatened resources are widespread throughout the Kaala MU. The habitat quality is very high in the Kaala MU. Rare plant populations have been impacted by rodents in the past and no rodent control was in place. Airlayers on the branches of some *L. cyrtandrae* plants have been eaten in the past and it is strongly suspected that rodents have girdled the bases of plants and eaten the fruit off of some *C. acuminata* and possibly *L. cyrtandrae* fruits. Recent observations for the *L. cyrtandrae* revealed a high number of flowers and fruits predated by rodents. In February 2016, OANRP implemented a localized small scale rodent trapping grid, consisting of a total of 70 traps (35 Victor and 35 KaMate) around *L. cyrtandrae* population ALA-S. Additional traps will need to be installed around wild and reintroductions sites in the future, following pollination for fruit collection. Also, rat trapping will be conducted around a future snail jail in Kaala MU. Traps will be checked and re-set every 6 weeks during each quarter; however during flowering and fruiting season (May-August & December-February), traps will be checked and re-set every 2 weeks.



Labordia cyrtandrae flowers



Predated fruit (bagged) of *L. cyrtandrae* ALA-S

Slug Control

Species: *Lehmannia valentiana*, *Deroceras leave*, *Limax maximus* and *Milax gagates*

Threat level: Low (slugs are observed in low densities in this area)

Control level: Localized

Seasonality: Probably year-round as area is extremely wet

Number of sites: Two; *Labordia cyrtandrae* reintroduction and *Phyllostegia* reintroduction

Primary Objective:

- Keep slug populations to a determined level to facilitate germination and survivorship of threatened rare taxa.

Management Objective:

- Control slugs; using Sluggo around the *L. cyrtandrae* populations as needed.

Monitoring Objectives:

- Annual census monitoring of *L. cyrtandrae* populations to monitor slug damage.

Effective molluscicides have been identified (Sluggo) and initial control programs are ongoing in other MU's. A slug control program has also been initiated in Kaala MU, following surveys for rare snails, as slugs are observed feeding on *L. cyrtandrae* reproductive structures. Given rarity, slow growth and long lifespan of *L. cyrtandrae* leaves, and the dioecism of *L. cyrtandrae* species any slug damage can be significant.

Other rare plant populations like *C. acuminata* may also benefit from slug control. However, it remains to be determined whether the proximity of native snails would preclude application of molluscicides widely in this area.

Predatory Snail Control

Species: *Euglandina rosea* (rosy wolf snail), *Oxychilus alliarus* (garlic snail)

Threat level: Low (*E. rosea* not found in MU, *O. alliarus* not found near *Achatinella*)

Control level: Localized

Seasonality: Unknown

Number of sites: 1 *Achatinella mustelina* site

Acceptable Level of Activity: Unknown

Primary Objective:

- Keep predatory snail populations to a low enough level that *A. mustelina* survival is unaffected.

Management Objective:

- Continue to develop better methods to control predatory snails
- Keep sensitive snail populations safe from predatory snails via currently accepted methods (such as hand removal of alien snails, construction of barriers which prevent incursion from alien snails)
- Construct predator enclosure near FAA station and remove all predatory snails.

Monitoring Objectives:

- Annual or every other year census monitoring of *A. mustelina* population to determine population trend.
- Annual searches for predatory snails to confirm their absence in proximity to *A. mustelina*.
- Follow *Euglandina* search effort flow chart for enclosure.

No baits have been developed for the control of predatory snails. Little is known regarding their distribution and prey preference. Control is limited to hand removal. Visual searches are time-consuming, difficult, and not feasible over large areas and in steep terrain. It is also unknown whether predatory snail populations are reduced by hand removal. Fortunately, searches to date show no *E. rosea* in the Kaala MU. *Oxychilus alliarus* is present but restricted to an area <0.5 acres in the vicinity of the FAA tower and a short distance along the boardwalk where it likely threatens other rare snails such as *Kaala subrutula*



Oxychilus alliarus

Ant Control

Species: *Solenopsis papuana*, *Ochetellus glaber*, *Tetramorium simillimum*, *Cardiocondyla venustula*, *C. wroughtoni*, *C. minutior*

Threat level: Low

Control level: Only for new incipient species

Seasonality: Varies by species, but nest expansion observed in late summer, early fall

Number of sites: 3 (Campsite, Boardwalk, Road)

Acceptable Level of Ant Activity: Acceptable at present densities

Primary Objective:

- Eradicate incipient ant invasions and control established populations when densities are high enough to threaten rare resources.

Management Objective:

- If incipient species are found and deemed to be a high threat and/or easily eradicated locally (<0.5 acre infestation) begin control using a bait containing Hydramethylnon (Amdro, Maxforce or Seige).

Monitoring Objective:

- Continue to sample ants at human entry points (landing zone, fence line) a minimum of once a year. Use samples to track changes in existing ant densities and to alert OANRP to any new introductions.
- If *Drosophila substenoptera* found, annual survey for ants needed to determine threat to immature larvae.

Ants have been documented to pose threats to a variety of resources, including native arthropods, plants (via farming of Hemipterian pests), and birds. The distribution and diversity of ant species in upland areas on Oahu, Kaala, has only begun to be studied and changes over time. Impacts to the rare species present in Kaala remain unknown, but it is likely they are having some type of effect on the ecosystem at large. The OANRP has already conducted some surveys across Kaala to determine which ant species are present and where they are located. Surveys were conducted using a standardized sampling. No ants found on the boardwalk, only rarely along road at elevations between 1500-2500 ft.

Fire Control

Due to the very low threat from fire, no actions are proposed at this time.

Action Table

The table below is a comprehensive list of threat control actions planned for the MU for the next five years. Actions are grouped by type; for example, Ungulate Control or Ant Control. Weed control actions are grouped into the following categories: General Survey, ICA, or WCA code. Cells filled with hatch marks denote the quarters in which an action is scheduled. IP years run from October of one year through September of the next. Therefore, Quarter 4 (October-December) is listed first for each report year, followed by Quarter 1 (January-March), Quarter 2 (April-June), and Q3 (July-September). Species names are written as six-digit abbreviations, such as 'JunEff' instead of *Juncus effusus*, for brevity.

Action Type	Actions	OIP Year10 Oct 2016- Sept2017				OIP Year 11 Oct 2017- Sept2018				OIP Year 12 Oct 2018- Sept2019				OIP Year 13 Oct 2019- Sept2020				OIP Year 14 Oct 2020- Sept2021			
		4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3
Restoration	Develop plan and schedule for common reintroductions																				
General Survey	RS-Kaala-01: Survey road from the first gate to the FAA enclosure. If see any soil/fill stockpiles, survey carefully around them and note location.																				
	WT-Kaala-01: Survey Kaala boardwalk annually, starting from gate at trailhead to end of boardwalk around 720m.																				
	WT-Kaala-03: Survey transect on Kaala summit, annually. Transect intersects boardwalk around 590, and loops south then north to hit old spur fence near boardwalk trailhead.																				
	OS-Kaala-01: Survey Kaala campsite whenever used, not to exceed once per quarter. If not used, do not need to survey.																				
	LZ-SBW-082: Survey Kaala LZ whenever used, not to exceed once per quarter. If not used, do not need to survey																				
ICA AngEve	Kaala-AngEve-01: Monitor/Control AngEve on transect trail annually. Prevent any plants from reaching maturity.																				
ICA AntOdo	Kaala-AntOdo-01: Monitor/control AntOdo near trailhead twice a year.																				

Action Type	Actions	OIP Year10 Oct 2016- Sept2017				OIP Year 11 Oct 2017- Sept2018				OIP Year 12 Oct 2018- Sept2019				OIP Year 13 Oct 2019- Sept2020				OIP Year 14 Oct 2020- Sept2021			
		4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3
ICA CroCro	Kaala-CroCro-01: [Volunteer] Monitor/control CroCro along Army side of boardwalk. Focus on keeping CroCro out of bog. Pick and remove from field any potentially viable fruit.																				
	Kaala-CroCro-02: [Volunteer] Monitor/control CroCro at site on southwest of FAA. Focus on forest edge and drainage area. Pick and remove from field any potentially viable fruit.																				
	Kaala-CroCro-03: Monitor/control CroCro at site on southeast of FAA. Experiment with chemical control. Pick and remove from field any potentially viable fruit. (trial pending)																				
	Kaala-CroCro-04: Monitor/control CroCro at site on southeast of FAA. Experiment with chemical control. Pick and remove from field any potentially viable fruit. (trial pending)																				
	Kaala-CroCro-05: [Volunteer] Monitor/control CroCro at LZ/trailhead. Focus on forest edge. In short term, keep off fence and trail. Pick and remove from field any potentially viable fruit. Experiment with chemical control. Experiment with backhoe/manual control. Low priority action																				
	Kaala-CroCro-06: [Volunteer] Monitor/control CroCro on state side of boardwalk at trailhead. Coordinate actions with State. Focus on keeping CroCro out of bog; target forest edge. Pick and remove from field any potentially viable fruit.																				
ICA DipEsc	Kaala-DipEsc-01: Monitor/control DipEsc at site along Kaala road 2-4x year, as needed. Treat via handpulling, clip&drip w/G4, or targeted foliar sprays (glyphosate).																				

Action Type	Actions	OIP Year10 Oct 2016- Sept2017				OIP Year 11 Oct 2017- Sept2018				OIP Year 12 Oct 2018- Sept2019				OIP Year 13 Oct 2019- Sept2020				OIP Year 14 Oct 2020- Sept2021			
		4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3
	Kaala-DipEsc-02: Monitor/control DipEsc at site by zombie tunnels 2-4x year, as needed. Treat via handpulling, clip&drip w/G4, or targeted foliar sprays (glyphosate).																				
ICA FesAru	Kaala-FesAru-01: Monitor/control FesAru across entire ICA quarterly. Coordinate control efforts with National Guard mowing schedule, as feasible. Treat with glyphosate, monitor effectiveness. Consider using pre-emergent along road.																				
	Kaala-FesAru-02: Monitor/control FesAru at site on Kamaohanui side of FAA quarterly. Coordinate control efforts with National Guard mowing schedule, as feasible. Treat with glyphosate, monitor effectiveness. Consider using pre-emergent along fence.																				
	Kaala-FesAru-03: Monitor/control FesAru at site in corner of FAA fence, on south side, quarterly. Coordinate control efforts with National Guard mowing schedule, as feasible. Treat with glyphosate, monitor effectiveness. Consider using pre-emergent along fence. Allow kikuyu to take over area.																				
	Kaala-FesAru-04: Monitor/control FesAru at site close to tower in FAA fence, on southeast side, quarterly. Coordinate control efforts with National Guard mowing schedule, as feasible. Treat with glyphosate, monitor effectiveness. Consider using pre-emergent along fence. Allow kikuyu to take over area.																				
ICA JunEff	Kaala-JunEff-01: [Volunteer] Monitor/control JunEff along boardwalk core. Sweep entire area 2x year (or less if warranted). Handpull plants and remove from field; take to H power for incineration.																				

Action Type	Actions	OIP Year10 Oct 2016- Sept2017				OIP Year 11 Oct 2017- Sept2018				OIP Year 12 Oct 2018- Sept2019				OIP Year 13 Oct 2019- Sept2020				OIP Year 14 Oct 2020- Sept2021			
		4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3
	Kaala-JunEff-02: Monitor/control JunEff at Wing Fence annually. Handpull plants and remove from field; take to H power for incineration. Long lived seeds; consider eradicated when 20 years with no seed (2023).																				
	Kaala-JunEff-03: [Volunteer] Monitor/control JunEff at northeast site (south of FAA) 2x year. Handpull plants and remove from field; take to H power for incineration.																				
	Kaala-JunEff-04: [Volunteer] Monitor/control JunEff at west outlier off boardwalk (transect tag 160) annually. Handpull plants and remove from field; take to H power for incineration. Long lived seeds; consider eradicated when 20 years with no seed (2028).																				
	Kaala-JunEff-05: [Volunteer] Monitor/control JunEff along State side of boardwalk and trail/culvert. Handpull plants and remove from field; take to H power for incineration. Spray large plants in culvert when needed. Communicate with state for all activities here.																				
	Kaala-JunEff-06: Monitor/control JunEff around Radio tower, on state side of Kaala, 2x year. Handpull plants and remove from field; take to H power for incineration.																				
	Kaala-JunEff-07: Monitor/control JunEff on transect trail at tag #510 every 6 months/annually. Handpull plants and remove from field; take to H power for incineration. Long lived seeds; consider eradicated when 20 years with no seed.																				
	Kaala-JunEff-08: Monitor/control JunEff on north side of FAA enclosure, near USGS marker, every 6 months/annually. Handpull plants and remove from field; take to H power for incineration. Long lived seeds; consider eradicated when 20 years with no seed (2024).																				

Action Type	Actions	OIP Year10 Oct 2016- Sept2017				OIP Year 11 Oct 2017- Sept2018				OIP Year 12 Oct 2018- Sept2019				OIP Year 13 Oct 2019- Sept2020				OIP Year 14 Oct 2020- Sept2021			
		4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3
	Kaala-JunEff-09: Monitor/control JunEff at beginning of Spur Fence annually. Handpull plants and remove from field; take to H power for incineration. Long lived seeds; consider eradicated when 20 years with no seed.																				
ICA PteGlo	Kaala-PteGlo-01: Monitor/control Ptego at Kaala State camp site quarterly. Pick and remove from field any potentially mature fruit. Consider using pre-emergent herbicides.																				
	Kaala-PteGlo-02: Monitor/control Ptego at boardwalk site, station 430 quarterly. Pick and remove from field any potentially mature fruit. Consider using pre-emergent herbicides. Consider digging up soil around plants.																				
	Kaala-PteGlo-03: Monitor/control Ptego at transect trail site, by LabCyrALA-W, quarterly. Pick and remove from field any potentially mature fruit. Consider using pre-emergent herbicides. Consider digging up soil around plants.																				
ICA SetPal	Kaala-SetPal-01: Monitor/control SetPal along spur fence from FAA annually. Handpull and remove plants from the field.																				
ICA SphPal	Kaala-SphPal-01: [Volunteer] Monitor/control sphagnum along radio tower road. Communicate with State about work at this site. Utilize handpulling and St. Gabriel's moss killer for control. Spray is ineffective in standing water, so time efforts for when moss and culvert/ depression are dry.																				
	Kaala-SphPal-02: [Volunteer] Control Sphpal along boardwalk, on State side of MU, as requested by State. Control only in boardwalk corridor, (1-2m from boardwalk). Spray with moss killer. Exercise care to prevent the spread of Sphpal via footwear or gear.																				

Action Type	Actions	OIP Year10 Oct 2016- Sept2017				OIP Year 11 Oct 2017- Sept2018				OIP Year 12 Oct 2018- Sept2019				OIP Year 13 Oct 2019- Sept2020				OIP Year 14 Oct 2020- Sept2021			
		4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3
	Kaala-SphPal-03: [Volunteer] Control Sphpal along boardwalk, on Army side of MU, within 3m of boardwalk or to infestation edge (especially in 0-140m, 460-520m, 560-610m, 630-740m). Spray with moss killer. Exercise care to prevent the spread of Sphpal via footwear or gear. Re-treatments should be at least 6 months after initial control.																				
	Kaala-SphPal-03: Control Sphpal core along boardwalk, on Army side of MU once a year. Spray with citric/clove moss killer. Exercise care to prevent the spread of Sphpal via footwear or gear. Outreach treating all areas within 3m of boardwalk. Only work in following zones on boardwalk, rest covered by Outreach: 140-460m, 520m-560m, 610-630m. Treat identified hotspots. Follow up control efforts should be at least 6 months after treatment.																				
	Kaala-SphPal-03: Take photopoints annually in the Sphpal infestation.																				
	Kaala-SphPal-03: Sweep defined 30m buffer. GPS and control any sphagnum found, and modify buffer shape as needed. Ensure all outlier hotspots are monitored.																				
	Kaala-SphPal-05: Assist State with Sphpal control beyond boardwalk corridor, on State side of MU, AS REQUESTED ONLY. Follow State treatment procedures (survey for native land snails prior; use citric/clove moss killer). Exercise care to prevent the spread of Sphpal via footwear or gear.																				

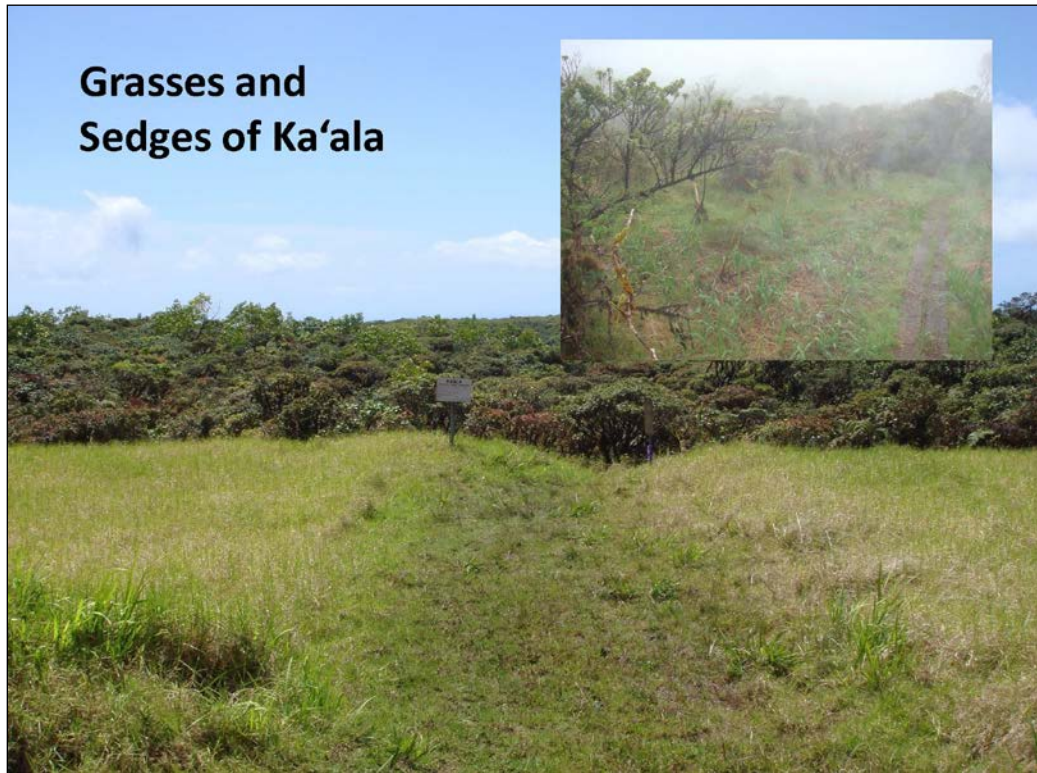
Action Type	Actions	OIP Year10 Oct 2016- Sept2017				OIP Year 11 Oct 2017- Sept2018				OIP Year 12 Oct 2018- Sept2019				OIP Year 13 Oct 2019- Sept2020				OIP Year 14 Oct 2020- Sept2021			
		4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3
	Kaala-SphPal-06: Control SphPal along transect trail between stations 1430 to 1380. Spray with mosskiller, or carefully pull and bag and remove from field. Exercise care to prevent the spread of Sphpal via footwear or gear. Always monitor for sphagnum when walking transect trail.																				
	Kaala-SphPal-07: Survey Kaala to Kumaipo trail, between boardwalk and boulder cable section, for sphagnum outlier patches 1-2 times a year. Treat any patches found with St. Gabe's Mosskiller. Exercise care to prevent the spread of Sphpal via footwear or gear.																				
Kaala-01: Boardwalk to Transect Trail	Control weeds across WCA once every 3 years. Target Hedgar (top priority), Psicat, Melqui, and any other canopy weeds found. Record number/reproductive status of Hedgar found. Treat Clihir as second priority.																				
	Control grasses and other weeds in open area at trailhead and along fence, quarterly or as needed; coordinate with Outreach. This complements ICA control and restoration efforts. Grass: handpull, weedwhack or use glyphosate formulation suitable for wet areas. Other weeds: clip and drip with Garlon or if very wet, handpull and stack slash in pile away from water and spray pile. Coordinate with Foundation or Green staff for specialized tasks, like grass spraying, as needed.																				
	Control weeds around LabCyr ALA-W reintro annually, or as needed. Target Clihir, Rubros, Hedgar, and any other weeds encroaching on rare taxa.																				
Kaala-02: Transect Trail to Rainbow Ridge	Control weeds across entire WCA once every 3 years. Target Hedgar (top priority), Psicat, Melqui, and any other canopy weeds found. Record number/reproductive status of Hedgar found. Treat Clihir as second priority.																				

Action Type	Actions	OIP Year10 Oct 2016- Sept2017				OIP Year 11 Oct 2017- Sept2018				OIP Year 12 Oct 2018- Sept2019				OIP Year 13 Oct 2019- Sept2020				OIP Year 14 Oct 2020- Sept2021			
		4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3
	Control sprawling OdoCus in bowl just south of FAA enclosure. Reproduces prolifically vegetatively and has multiple rooting points. Cut and pile plants, then spray pile and cut stump area with foliar spray (backpack or handheld) of glyphosate. Alternatively, treat rooting points with herbicide, standard clip&drip. Allow any missed rooting points to leaf out, then spray foliarly on follow-up visits. Goal is eradication. Whenever working in area, always treat any HedGar found (record #s treated).																				
Kaala-03: Lower Rainbow Ridge	Control weeds across entire WCA once every 3 years. Target Hedgar (top priority), Psicat, Melqui, and any other canopy weeds found. Record number/reproductive status of Hedgar found. Treat Clihir as second priority.																				
	Control weeds around LabCyr ALA-S reintro annually, or as needed. Target Clihir, Rubros, Hedgar, and any other weeds encroaching on rare taxa.																				
	Control weeds around LabCyr ALA-W reintro annually, or as needed. Target Clihir, Rubros, Hedgar, and any other weeds encroaching on rare taxa.																				
Kaala-04: Rainbow Ridge to Blue Trail	Control weeds across entire WCA once every 3 years. Target Hedgar (top priority), Psicat, Melqui, and any other canopy weeds found. Record number/reproductive status of Hedgar found. Treat Clihir as second priority.																				
	Clear/maintain fence. Remove downed trees, spray grass, treat thick understory, as needed.																				
	Control weeds around PhyHir ALA-A and LabCyr ALA-S reintro annually, or as needed. Target Clihir, Rubros, Hedgar, and any other weeds encroaching on rare taxa.																				

Action Type	Actions	OIP Year10 Oct 2016- Sept2017				OIP Year 11 Oct 2017- Sept2018				OIP Year 12 Oct 2018- Sept2019				OIP Year 13 Oct 2019- Sept2020				OIP Year 14 Oct 2020- Sept2021			
		4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3
Kaala-05: Blue Trail to Kamaohanui	Control weeds across entire WCA once every 3 years. Target Hedgar (top priority), Psicat, Melqui, and any other canopy weeds found. Record number/reproductive status of Hedgar found. Treat Clihir as second priority. Portions of WCA very steep; use aerial surveys, spotters, to guide control.																				
	Control sprawling OdoCus in on north side of blue trail. Reproduces prolifically vegetatively and has multiple rooting points. Cut and pile plants, then spray pile and cut stump area with foliar spray (backpack or handheld) of glyphosate. Alternatively, treat rooting points with herbicide, standard clip&drip. Allow any missed rooting points to leaf out, then spray foliarly on follow-up visits. Goal is eradication. Whenever working in area, always treat any HedGar found (record #s treated).																				
Kaala-06: North of Boardwalk/Road	Assist State in controlling weeds on NAR side of boardwalk, as requested. Target Hedgar (top priority), Psicat, Melqui, and any other canopy weeds found. Record number/reproductive status of Hedgar found.																				
	Control weedy grasses and understory species Mow grass around the Kaala Shelter in quarters 2 and 4. State staff will be mowing in quarters 1 and 3.																				
Kaala-07: FAA Enclosure	Control all Hedgar inside of the FAA enclosure. Obtain permission prior; may need to submit letter to gain access. Visit every 3 years.																				
Kaala-08: Radio Tower Reintros	Control weeds across WCA every 2-3 years. Focus efforts around reintroductions. (not MFS site, low priority, not scheduled)																				
Rodent Control	Monitor rare plants and tree snails for predation by rats																				

Action Type	Actions	OIP Year10 Oct 2016- Sept2017				OIP Year 11 Oct 2017- Sept2018				OIP Year 12 Oct 2018- Sept2019				OIP Year 13 Oct 2019- Sept2020				OIP Year 14 Oct 2020- Sept2021			
		4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3
Slug/Snail Control	Determine need for and feasibility of slug control at Kaala for <i>L. cyrtandrae</i> (and possibly other rare plant species)																				
	Determine if any <i>E. rosea</i> or <i>O. alliarus</i> snails are present at the <i>A. mustellina</i> SBW-R site or at other <i>A. mustellina</i> sites in the Kaala MU																				
Ants	Conduct surveys for ants across MU with bait cards as needed																				
Ungulate	Monitor ungulate transect																				
	Check Snares ALA-A/B/C/E																				

Appendix 1: Invasive Grasses of Kaala

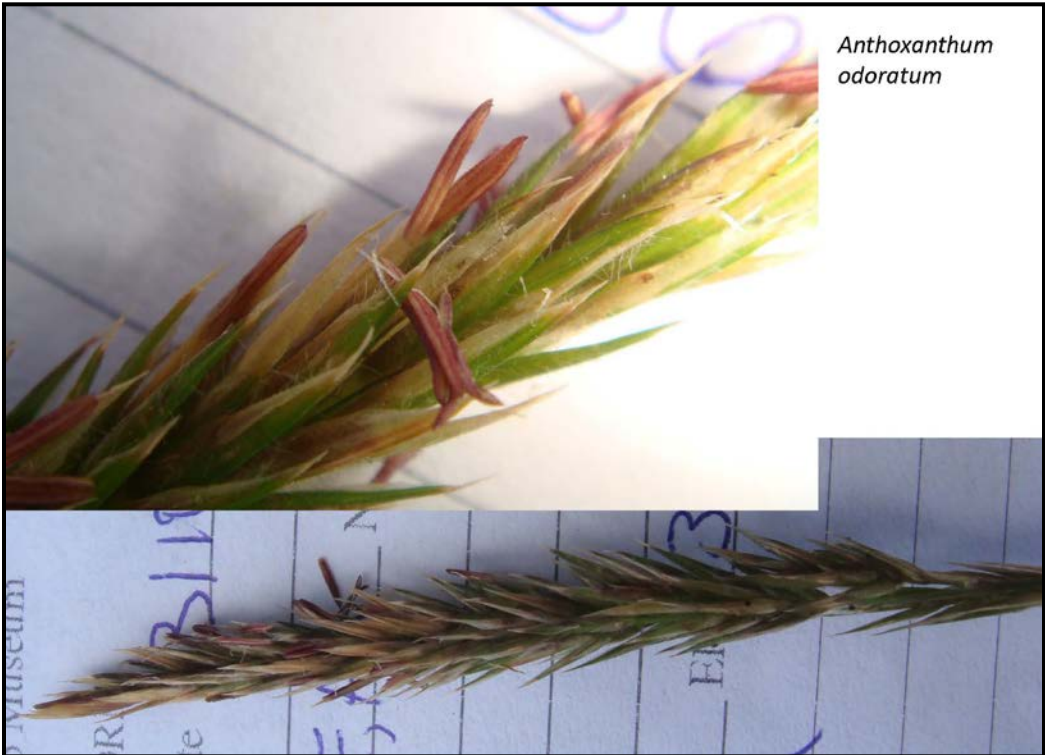


Festuca arundinacea



Festuca arundinacea







Anthoxanthum odoratum



Pennisetum clandestinum, kikuyu grass



Vulpia bromoides



Setaria parviflora



Holcus lanatus