Ecosystem Restoration Management Plan

OIP Year 10-14, Oct. 2017 – Sept. 2022

MU: Koloa

Overall OIP Management Unit Goals:

- Form a stable, native-dominated matrix of plant communities which support stable populations of IP taxa.
- Control weed threats to support stable populations of IP taxa.

Background Information

Location: Summit of Northern Koolau Mountains

Land Owner: Hawaii Reserves Inc.

Land Managers: OANRP, Hawaii Reserves Inc.

Acreage: 176 acres

Elevation Range: 1950 ft - 2400 ft

Description: The Koloa MU is bordered by the Koolau Summit Trail to the south, Kaipapau to the east, and Wailele to the west. The land to the north (makai) lies within the same Koloa gulch, but is separated from the exclosure by a series of waterfalls. The Koloa MU is a wet forest dominated by native vegetation. Perhaps due to its relatively flat topography, lacking the extremely steep walls and deep valleys like that of Kaipapau, the Koloa MU has a large number of IP taxa, including in situ populations of *Euphorbia rockii, Phyllostegia hirsuta, Cyanea koolauensis,* and reintroductions of *Labordia cyrtandrae.* The Koloa MU can be accessed via the Kawailoa and Laie trails, however due the length of these unmaintained trails, OANRP uses helicopters to access the MU to do management. Due to lack of military training OANRP is no longer required to manage Tier1 and Tier 2 taxa. However, the majority of the Tier 1, 2, and 3 rare taxa in Koloa overlap thus, management actions will provide benefits for native and rare taxa across the MU.

Native Vegetation Types

Koolau Vegetation Types	
Wet forest	Canopy includes: *Metrosideros* spp., *Cheirodendron* spp., *Cibotium* spp., *Ilex anomala*, *Myrsine sandwicensis*, and *Perrottetia sandwicensis*. Understory includes: Typically covered by a variety of ferns and moss; may include *Dicranopteris linearis, Melicope* spp., *Cibotium chamissoi, Machaerina angustifolia, Nertera granadensis, Kadua centranthoides, Nothoperanema rubiginosa, Sadleria* spp., and *Broussaisia arguta*.
NOTE: For future MU monitoring purposes vegetation type is mapped based on theoretical pre-disturbance vegetation. Alien species are not noted.	

Terrain and Vegetation Types at Koloa

From Northern LZ looking NW towards Laie.

From the northern fenceline looking east

From the NW corner looking SE.

OIP Rare Resources at Koloa

Organism Type	Species	Pop. Ref. Code	Population Units	Management Designation	Wild/ Reintroduction
Plant	*Euphorbia rockii*	KOL-A,B, D,E,G,H,J,L	Kawainui to Koloa and Kaipapau	T2	Wild
Plant	*Cyanea koolauensis*	KOL-A,B,C,D, E,F,H,J,K,L,N,O	Koloa	MFS/T1	Wild
Plant	*Cyrtandra viridiflora*	KOL-A,B,C,D, F,H,I,K	Kawainui to Koloa and Kaipapau	T2	Wild
Plant	*Hesperomannia sweyzei*	KOL-A,D	Koloa	MFS/T1	Wild
Plant	*Huperzia nutans*	KOL-B,O	Koloa	T2	Wild
Plant	*Labordia cyrtandrae*	KOL-A,B	Koloa	MFS/T1	Reintro
Plant	*Myrsine judii*	KOL-B	Kaukonahua to Kamananui-Koloa	T2	Wild
Plant	*Phyllostegia hirsuta*	KOL-A,B,C	Koloa	MFS/T1	Wild and Reintro
Plant	*Viola oahuensis*	KOL-A,B,C, D,	Koloa	T2	Wild

MFS = Manage for Stability *= Population Dead T1 = Tier 1
MRS = Manage Reintroduction for Genetic Storage GU = Geographic Unit T2 = Tier 2

Other Rare Taxa at Koloa

Organism Type	**Species**	**Status**
Plant	*Cyanea humboldtiana*	Endangered
Plant	*Cyanea calycina*	Endangered
Plant	*Cyanea lanceolata*	Endangered
Plant	*Joinvillea ascendens* ssp. *ascendens*	Endangered
Plant	*Lobelia gaudichaudii* ssp. *gaudichaudii*	Species of Concern
Plant	*Myrsine fosbergii*	Endangered
Plant	*Zanthoxylum oahuense*	Endangered
Snail	*Achatinella livida*	Endangered
Insect	*Drosophila* nr. *truncipenna*	Rare
Insect	*Drosophila nigribasis*	Rare
Insect	*Drosophila oahuensis*	Rare

Rare Resources at Koloa

Labordia cyrtandrae

Cyanea koolauensis

Euphorbia rockii

Viola oahuensis

Achatinella livida

Huperzia nutans

Zanthoxylum oahuense

Locations of Rare Resources at Koloa

Map removed to protect rare resources

Threats to OIP MFS Taxa

Threat	Rare Taxa Affected	Management Strategy	Current Status, 2017
Pigs	All	Across MU	No animals within fence
Slugs	*Euphorbia rockii, Cyrtandra viridiflora, Cyanea acuminata, Hesperomannia swezeyi, Labordia cyrtandrae, Myrsine judii, Phyllostegia hirsuta, Viola oahuensis, Cyanea koolauensis*	No Control	No control necessary at this time. FerroxxAQ is available for local control if area has been surveyed by an experienced malacologist to determine whether native snails are present. However, damp conditions would render the FerroxxAQ moldy quickly and reduce its efficacy.

Ants	Unknown	No control	No control necessary at this time, no ants found during survey.
Weeds	All	Rare taxa sites primarily, across MU secondarily.	Regular maintenance required several times per year.
Fire	None	N/A	Fire is expected to be highly unlikely given the wet habitat at Koloa. In the unlikely event of a fire, OANRP will assist by providing information on rare resources and trails to incident command, and may also provide air support. The most likely ignition source is a campfire set by recreational hikers.
Rats	All	No control	Rat control is available but management has not been implemented unless damage to rare taxa is observed.

Management History

- 1993: HIHNP conducts rare resource surveys along Koolau Summit Trail through Koloa
- 1997: First OANRP record of an endangered plant in Koloa.
- 1998: First OANRP record of *Achatinella livida.*
- 1998: Incipient weed taxa *Hedychium* spp. control begins. Species found is believed to be *Hedychium coronarium* but unconfirmed.
- 2002: Predator control around *Achatinella livida* begins.
- 2002: Staff control *Leptospermum scoparium* around the Puu Kainapuaa/Norton LZ, in areas which later become WCA KaiwikoeleEleNoMU-01.
- 2007: Staff control *Leptospermum scoparium* around the Puu Kainapuaa/Norton LZ, in areas which later become WCA KaiwikoeleEleNoMU-01.
- 2011: MU fence construction begins and WCA boundaries are drawn. Container cabin was flown to Puu Kainapuaa to serve as fence contractor campsite.
- 2011: Staff control *Leptospermum scoparium* around the Puu Kainapuaa/Norton LZ, in areas which later become WCAs KawainuiNoMU-01, KaiwikoeleEleNoMU-01, and WaileleOmaoNomU-01.
- 2012: Fence completed, ungulate control initiated. One volunteer hunt conducted catching several pigs. No pigs caught in several hundred snares.
- 2012: Container cabin used at Puu Kainapuaa was flown to site of the former Kahuku cabin to facilitate natural resource staff management in MU.
- 2012: OANRP ends rodent control grid and bait stations around *Achatinella livida* populations. Rodent control responsibility is appointed to the Snail Extinction Prevention Program (SEPP)
- 2012-2013: Weed control begins in MU. Staff target *Angiopteris evecta* and *Psidium cattleianum*.

- 2013: Cabin construction completed.
- 2013: First reintroduction of *Labordia cyrtandrae* (from Waianae stock) to Koolau Mountains
- 2013: Due to Army training level changes and a decrease in funding OANRP no longer work with Tier 2 or 3 Taxa. OIP taxa in Koloa only to include *Cyanea koolauensis*, *Hesperomannia swezeyi*, *Huperzia nutans*, *Labordia cyrtandrae* and *Phyllostegia hirsuta*. OANRP no longer manages for *Euphorbia rockii*, *Cyrtandra viridiflora*, *Myrsine juddii* and *Viola oahuensis*.
- 2014: First reintroduction of *Phyllostegia hirsuta*.
- 2015: Second reintroduction of *Phyllostegia hirsuta* happens at same site as the previous year.
- 2016: Koloa cabin locked due to increase in public use and rat infestation.
- 2016: Northern LZ discontinued for use due to poor infrastructure.
- 2016: Ecosystem Restoration team assists in *Psidium cattleianum* control.
- 2017: Koloa cabin vandalized. It is scheduled to be fixed later this year.
- 2017: As a result of a significant decline of *Labordia cyrtandrae* at the first reintroduction site, a second reintroduction of *Labordia cyrtandrae* was planted at a different site closer to the Koloa cabin.

Ungulate Control

Species: *Sus scrofa* (Pigs)

Threat Level: High

Management Objective:

- Maintain MU as ungulate-free.

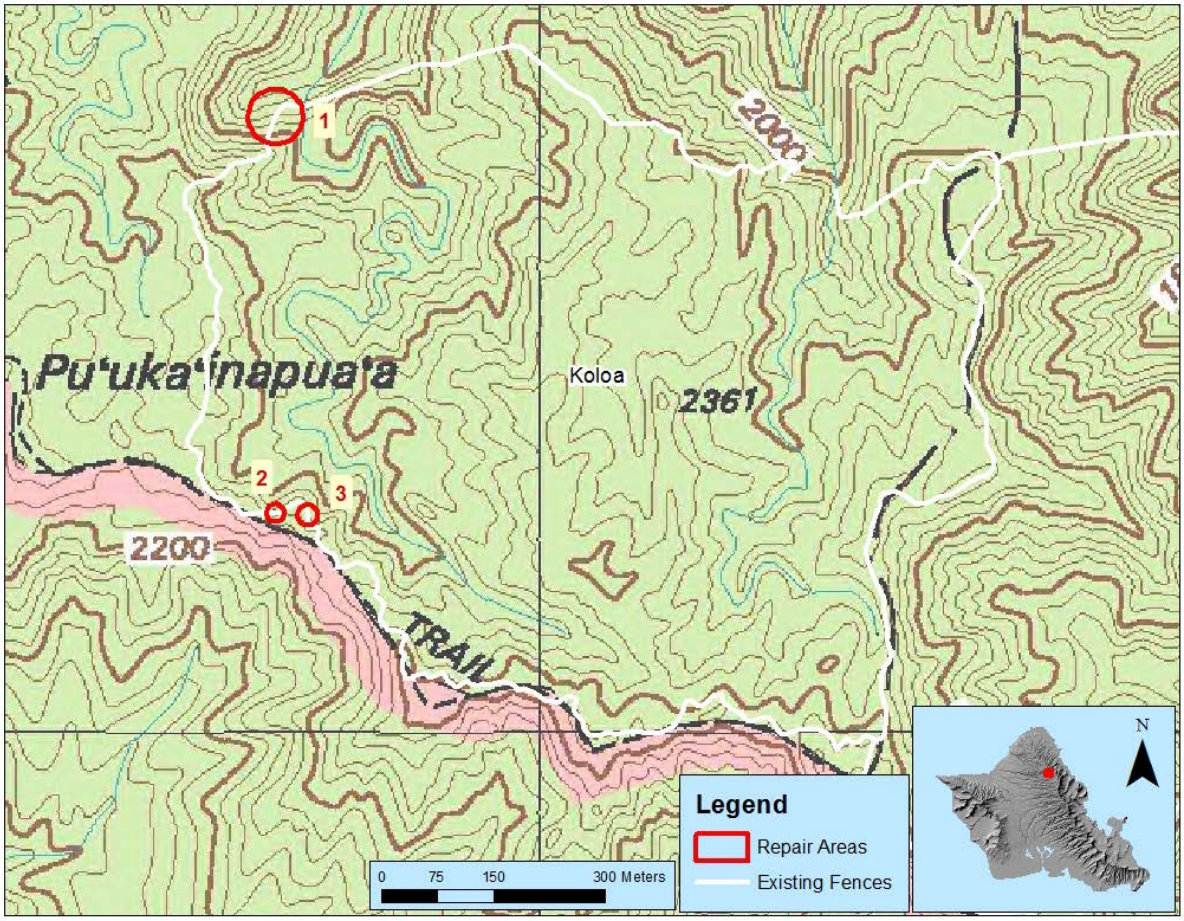
Strategy and Control Methods:

- Maintain the fenced area as ungulate-free by maintaining fence and monitor for sign while conducting other management actions. Conduct quarterly fence checks and monitor stream crossings after storms.
- Note any pig sign while conducting day to day actions within fenced MU. If any pig activity is detected in the fence area, implement snaring program. Fence construction started in September 2011 and was completed in the beginning of 2013.

Discussion: The MU fence is 4.5 kilometers long and encompasses 164 acres. The major threats to the perimeter fence include fallen trees, landslides, vandalism, stream crossings, and flooding. Waterfalls in Koloa provide excellent natural barriers against ungulates. The fence ties in to these strategic areas to avoid the need to cross streams. Special emphasis will be placed on checking the fence after extreme weather events. Monitoring for ungulate sign will occur during the course of other field activities. After the fence was completed, snares were set and monitored for two years. No ungulates were caught during this time and there was no activity within the fence. The fence is ungulate free. However, there are lots of pig sign along the outside of the fence line especially along the summit trail towards the northwest end. The fence will be kept clear of vegetation (especially grasses) to facilitate quarterly monitoring. This weed control is discussed in the Weed Control section.

The terrain in Koloa is steep and highly precipitous. Heavy rain storms have been an issue causing landslides and rock falls to occur causing damage to the fence. If a landslide or rock fall is not detected quickly, pigs can easily enter the Koloa MU. In 2017 three significant landslides occurred causing damage to the fence line (see map below). Repairs were completed and no ungulate sign has been observed.

Map of fence repairs at Koloa



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 protocols used in other MUs may not be feasible in the Koloa MU. Due to the relatively intact condition of the Northern Koolau summit region, current monitoring practices would increase traffic through the MU and may negatively impact the area by introducing weedy species normally found in the fence corridors and trails. Possible alternatives to transect monitoring may be aerial monitoring surveys (UAV), remote vegetation mapping, gigapan, or a combination. Utilizing new technologies and methodologies to develop vegetation monitoring protocols is a priority for this MU.

Objectives:

- Develop vegetation monitoring protocol for Koloa MU.
- Conduct vegetation monitoring for Koloa MU every three years.
- Produce vegetation map every three years for comparative analysis of weeding efforts.

Surveys

Potential Vectors. The Army conducts helicopter training in Kawailoa, immediately south and west of Koloa. The nearby Norton LZ is not currently used by the Army but if the Army gets permission to land there, we will resume surveys. Also, a high number of recreational hikers pass along the summit and Koloa trails, as well as OANRP staff, ungulates, rats and birds.

Management Objective:

- Prevent the establishment of any new invasive alien plant or animal species through regular surveys along trails, LZs, campsites and other high traffic areas (as applicable).

Strategy and Control Methods:

- Quarterly surveys of LZs (if used, LZ Norton once annually).
- Quarterly survey of Koloa Cabin campsite (if used).
- Annual survey of the Koolau Summit Trail/fenceline.
- Note unusual, significant or incipient alien taxa during the course of regular field work. Map and complete Target Species form to document sighting.
- Novel alien taxa found will be researched and evaluated for distribution and life history. If taxa found to pose a major threat, control will begin and will be tracked via ICAs.

Discussion: Surveys are designed to be the first line of defense in locating and identifying potential new weed species. Koloa currently remains unaffected by highly invasive weed species that infect surrounding areas, such as *Falcataria moluccana* and *Leptospermum scoparium* in Wailele, Kaiwikoele, and Kawainui. In the past, OANRP has controlled *F. moluccana* and *L. scoparium* in the surrounding areas to prevent their spread west into the Koloa MU. Time permitting, these species may be controlled in the future. A transect is in place (WT-Koloa-01) on the southern portion of the fence, that follows the Kooalu Summit Trail from the Koloa Cabin to the western corner of the fence, which is a high traffic area for recreational hikers, as well as NRS. NRS will monitor new incoming taxa and evaluating the threat of new taxa to MU.

Incipient Taxa Control

All weed control geared towards eradication of a particular invasive weed is tracked via Incipient Control Areas, or ICAs. Each ICA is species-specific and geographically defined. One infestation may be divided into several ICAs or one ICA, depending on infestation size, topographical features, and land ownership. Some ICA species are incipient island-wide, and are a priority for ICA management whenever found. Others are locally incipient to the MU, but widespread elsewhere. In either case, the goal is eradication of the ICA. The goals, strategies, and techniques used vary between ICAs, depending on terrain, surrounding vegetation, target taxon, size of infestation, and a variety of other factors.

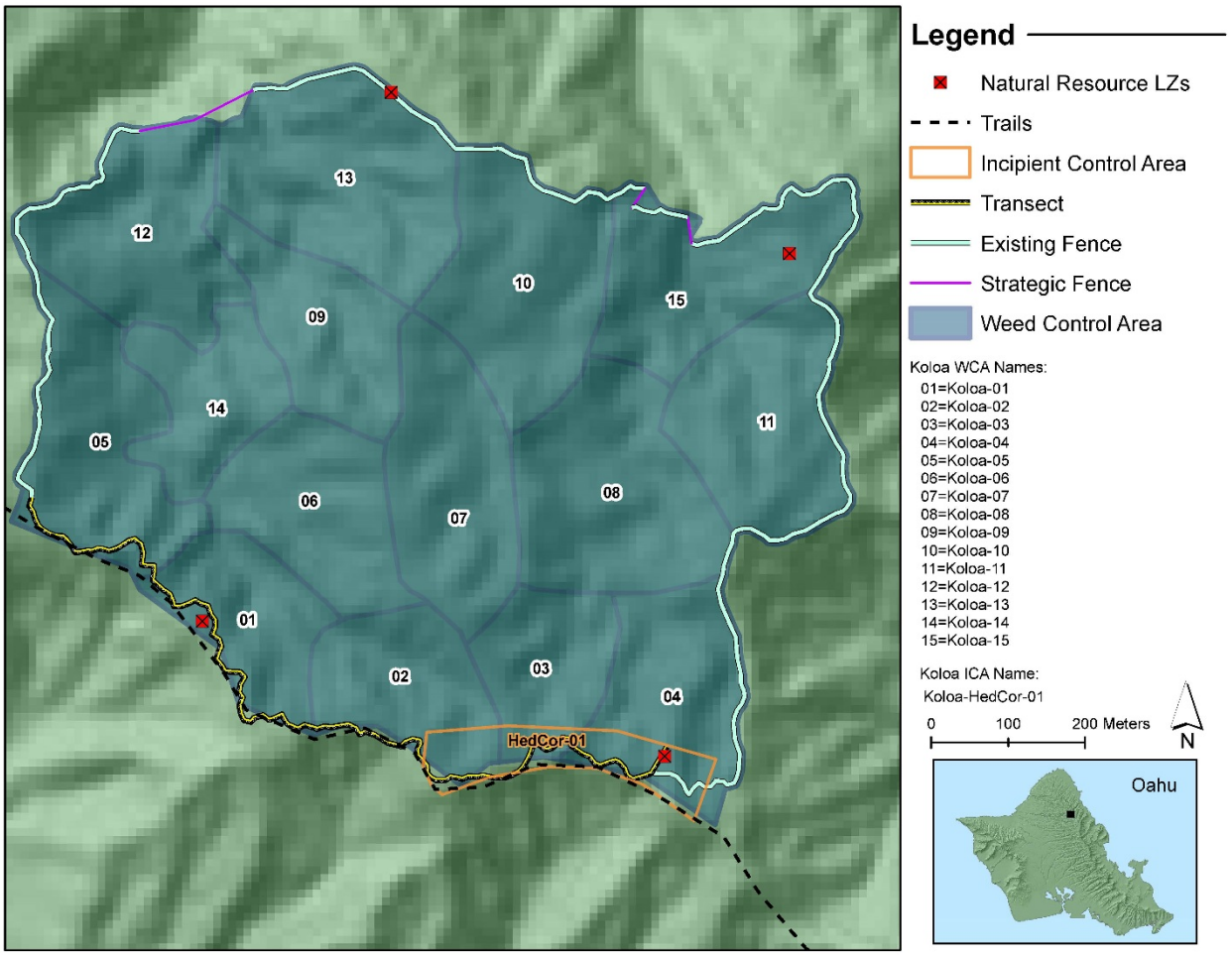
Management Objectives:

- Eradicate ICAs through regular and thorough monitoring and treatment. In the absence of any information about seed bank longevity for a particular species, eradication is defined as 10 years of consistent monitoring with no target plants found.
- Study seed bank longevity of ICA taxa, and revise eradication standards per taxon.
- Evaluate any invasive plant species newly discovered in MU, and determine whether ICA-level control is warranted. Factors to consider include distribution, invasiveness, location, infestation size, availability of control methods, resources, and funding.

Strategy and Control Methods:

- Species and ICAs are listed in the table below. History and strategy is discussed for each species.
- Monitor the progress of management efforts, and adjust visitation rates to allow staff to treat plants before they mature. Remember that one never finds 100% of all plants present.
- Use aggressive control techniques whenever possible.

Incipient, Transect and Weed Control Areas Map



Summary of Target Taxa and ICAs

Taxon	ICA Code	Control Discussion
Hedychium coronarium	Koloa-HedCor-01	There is one site of this taxa in Koloa along the Summit trail. Area needs to be surveyed again and the boundary of this ICA still needs to be defined as exact known locations of hotspots were lost due to staff changes. This is a high priority for control, as ginger thrives in wet environments. Aerial surveys in 2009 revealed large patches of all 3 species of ginger on many windward cliffs to the south.

Ecosystem Management Weed Control

All weed control geared towards general habitat improvement is tracked in geographic units called Weed Control areas, or WCAs. The goals, strategies, and techniques used vary between WCAs, depending on terrain, quality of native habitat, and presence or absence of rare taxa.

OIP Goals:

- Within 2m of rare taxa: 0% alien vegetation cover, except where removal causes harm.
- 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:

- Maintain 50% or less alien vegetation cover in the understory across the MU.
- Reach 50% or less alien canopy cover across the MU in the next 5 years.
- In WCAs within 50m of rare taxa, work towards achieving 25% or less alien vegetation cover in understory and canopy.
- Increase/expand weeding efforts if MU vegetation monitoring (conducted periodically, interval and technique to be determined) indicates that goals are not being met.

Discussion: Although no monitoring has been done, based on the quality of the habitat, we assume that native canopy cover is over 50% and alien canopy cover is under 50%. Goal is to further reduce alien canopy to 10% or less. The major weed threat in the MU is *P. cattleianum*, which has the potential to form dense monotypic stands, and is a dominant presence in other areas of the Koolau Mountains. Weed control in Koloa will focus on conducting ground sweeps across all walkable portions of the MU, targeting *P. cattleianum* and other weeds (listed in the Summary Target Taxa table below). The entire MU has been divided into Weed Control Areas (WCAs) to assist in tracking and scheduling control efforts. WCAs will be weeded on a rotational basis given the difficulty of access, terrain, and limited staff resources. *P. cattlenianum* sweeps will conducted by two separate teams: the Ecosystem Restoration team and the Green team. Staff will use aerial and ground surveys to guide control efforts.

Areas that are most accessible, have the gentlest terrain, the large amounts of rare resources, and the fewest weeds will be prioritized first for control.

In general, weed sweeps involve all staff lining up and walking in a phalanx across a WCA, treating every target weed seen. In the dense and often steep terrain of the Koolaus, this method is modified, with some staff acting as ‘spotters’ from ridges and other vantage points, directing other staff to the target weeds. Binoculars are critical for this spot-and-treat method. The goal of a sweep is to survey and achieve complete coverage of a WCA.

The table below summarizes invasive weeds found at Koloa, excluding ICA species. While the list is by no means exhaustive, it includes the species targeted/prioritized for control. The distribution of each taxon is estimated as: Widespread (moderate to high densities of individuals, common across MU), Scattered (low densities across all or much of the MU), or Restricted (low or high densities, all in one discrete location).

Summary of Target Taxa

Taxa	Distribution	Notes
Andropogon virginicus	Scattered	Scattered along trails and cliffs. Goal is to keep off of cliffs, as it is difficult to control in such steep environments.
Angiopteris evecta	Scattered	Incidental observations of *A. evecta* around the MU have been made. Plants seen should be GPSed and removed manually or with 100% Polaris applied directly to the brain on discovery. The adjacent Kaipapau MU is infested with this taxa, which feeds spores into Koloa. Control is a high priority. Control any plants found during regular weed sweeps. Also control plants seen outside the MU, if near the fence. Conduct aerial surveys as needed to guide ground treatments.
Clidemia hirta	Widespread	Widespread throughout the Koloa MU. OANRP does not currently target it for control, except in the vicinity of rare taxa.
Erigeron karvinskianus	Scattered	Status of this species in the MU is unknown. Note locations of *E. karvinskianus* during regular control work. Evaluate whether species should be a target once have additional distribution information. This taxa is a threat to open cliff communities.
Falcataria moluccana	Scattered	Not known in Koloa at this time, but known from adjacent area in Kawainui. If seen, plants are GPSed and added to target species layer and will become a target for control during regular weed sweeps.
Leptospermum scoparium	Unknown	Not known in Koloa at this time, however a large population exists to the northwest and keeping it out of the MU is a priority. Historically, *L. scoparium* was controlled around Puu Kainapuaa.
Melaleuca quinquenervia	Scattered	A few trees were treated in adjacent Wailele gulch by KMWP in 2010. Species has been seen once in MU, taxa will be targeted during regular weed sweeps.
Pterolepis glomerata	Widespread	This melastome is ubiquitous across the Koolaus. It thrives in disturbed areas, particularly pig wallows. NRS do not currently target it for control but now that pigs have been excluded, hopefully native vegetation will colonize *P. glomerata* zones, as occurred in Opaeula fence.
Psidium cattleianum	Widespread	Patches scattered across Koloa. Primary target of WCA sweeps. In the Koolaus, *P.* cattleianum take on a multi-trunked clump form and have the proclivity for slash to resprout. The largest and thickest stands tend to be in gulches and draws. Currently, best practice is to treat with G4 20% with 1% Milestone. In areas with difficult terrain, staff will investigate alternative control techniques, such as Herbicide Ballistic Technology and aerial ball spraying.
Sphaeropteris cooperi	Scattered	No plants known in MU, but individuals known from scattered locations across the Koolaus. *S. cooperi* will be targeted during regular weed sweeps. No herbicide is necessary, plant can just be cut down.

WCA: Koloa-01

Veg Type: Wet Montane

OIP Goal: 25% or less alien cover (rare taxa in WCA)

Target: *P. cattleianum*, tree weeds

Notes: High priority for control due to amount of rare taxa and habitat is generally better. Weed sweeps can be performed in this WCA from the Summit Trail north and down to the river. However the north side of the stream is too steep to do sweeps. To minimize the impact to the area, and for safety concerns

of our staff, sweeps will be done via spot-and-treat method: spotting from open ridges with binoculars and directing other staff to the plants for treatment (as described above).

WCA: Koloa-02

Veg Type: Wet Montane

OIP Goal: 25% or less alien cover (rare taxa in WCA)

Target: *P. cattleianum,* tree weeds

Notes: High priority for control due to amount of rare taxa and habitat is generally better. This WCA is the most fragile in the MU, and contains large populations of *V. oahuensis, E. rockii, C. humboltiana, C. calycina,* and the *H. nutans,* among others. There has been a recent introduction of *L. cyrtandrae* into this WCA and weed control will be conducted around this planting site. To minimize the impact to the area, *P. cattleianum* sweeps will be done via the spot-and-treat method with extreme care taken to minimize disturbing native habitat.

WCA: Koloa-03

Veg Type: Wet Montane

OIP Goal: 25% or less alien cover (rare taxa in WCA)

Target: *P. cattleianum,* tree weeds

Notes: High priority for control due to amount of rare taxa and habitat is generally better. This WCA is home to a large population of *E. rockii,* and a reintroduction of *P. hirsuta*. The area in this WCA consists of many small ridges and gulches. Weeding efforts are concentrated around *P. hirsuta.* Weed sweeps can be performed across the entire WCA.

WCA: Koloa-04

Veg Type: Wet Montane

OIP Goal: 25% or less alien cover (rare taxa in WCA)

Target: *P. cattleianum,* tree weeds

Notes: High priority for control due to amount of rare taxa and habitat is generally better. This WCA surrounds the camp site, borders the Kaipapau MU, and consists of more endangered species than any other WCA. Plants found in this WCA include *Cya. calycina, Cya. koolauensis, Cyr. viridiflora, H. swezeyi, L. gaudichaudii* ssp. *gaudichaudii, V. oahuensis, Z. oahuense,* and a large population of *E. rockii.* Half of this WCA is relatively open and weed sweeps in this area can be completed quickly with no damage to the endangered taxa. In the other half, to minimize the impact to the area, weed sweeps will be done via the spot-and-treat method.

WCA: Koloa-05

Veg Type: Wet Montane

OIP Goal: 25% or less alien cover (rare taxa in WCA)

Target: *P. cattleianum*, tree weeds

Notes: High priority for control due to amount of rare taxa and habitat is generally better. This WCA is the most southwest in the MU and consists of many small gulches and ridges. Weed sweeps can be performed in this entire WCA from the Summit Trail to the north, and from the west fence line to the East boundary, which is the river. The Ecosystem Restoration Team primarily conducts sweeps in this WCA.

WCA: Koloa-06

Veg Type: Wet Montane

OIP Goal: 25% or less alien cover (rare taxa in WCA)

Target: *P. cattleianum*, tree weeds

Notes: High priority for control due to amount of rare taxa and habitat is generally better. Part of this WCA consists of extremely degraded pasture like habitat which makes weed sweeps quick. The area likely will benefit from being pig-free, and native vegetation may recover on its own. Sweeps for *P. cattleianum* and other tree weeds will be conducted. Photopoints should be installed to document any potential vegetation recovery.

WCA: Koloa-07

Veg Type: Wet Montane

OIP Goal: 25% or less alien cover (rare taxa in WCA)

Target: *P. cattleianum*, tree weeds

Notes: High priority for control due to amount of rare taxa and habitat is generally better. Part of this WCA consists of extremely degraded pasture like habitat which makes weed sweeps quick. This WCA would benefit greatly from common plant reintroductions. The area likely will benefit from being pig-free, and native vegetation may recover on its own, otherwise sweeps for *P. cattleianum* and tree weeds will be conducted. Photopoints should be installed to document any potential recovery.

WCA: Koloa-08

Veg Type: Wet Montane

OIP Goal: 25% or less alien cover (rare taxa in WCA)

Target: *P. cattleianum*, tree weeds

Notes: High priority for control due to amount of rare taxa and close proximity to summit and cabin. To minimize impact to the area, and for safety concerns of our staff, sweeps will be done via spot-and-treat method. The Ecosystem Restoration Team primarily conducts sweeps in this WCA.

WCA: Koloa-09

Veg Type: Wet Montane

OIP Goal: 25% or less alien cover (rare taxa in WCA)

Target: *P. cattleianum*, tree weeds

Notes: Low priority for control due to large area, difficult terrain, and more weeds. This WCA is steep. To minimize the impact to the area, and for safety concerns of our staff, sweeps will be done via the spot-and-treat method. This area may be a candidate for remote/aerial control techniques.

WCA: Koloa-10

Veg Type: Wet Montane

OIP Goal: 25% or less alien cover (rare taxa in WCA)

Target: *P. cattleianum*, tree weeds

Notes: Low priority for control due to large area, difficult terrain, and more weeds. This WCA for the most part is relatively flat; full weed sweeps can be conducted.

WCA: Koloa-11

Veg Type: Wet Montane

OIP Goal: 25% or less alien cover (rare taxa in WCA)

Target: *P. cattleianum*, tree weeds

Notes: Low priority for control due to large area, difficult terrain, and more weeds. To minimize the impact to the rare plants in this area, and for safety concerns of our staff, sweeps will be done via the spot-and-treat method. This WCA borders Kaipapau gulch.

WCA: Koloa-12

Veg Type: Wet Montane

OIP Goal: 25% or less alien cover (rare taxa in WCA)

Target: *P. cattleianum*, tree weeds

Notes: Low priority for control due to large area, difficult terrain, and more weeds. This WCA is in the northwest corner of the fence and is very steep. To minimize the impact to the area, and for safety concerns of our staff, sweeps will be done via the spot-and-treat method. The area has not been well surveyed yet. There is a reintroduction of *L. cytandrae* near the stream bottom that will be maintained via focused weed control.

WCA: Koloa-13

Veg Type: Wet Montane

OIP Goal: 25% or less alien cover (rare taxa in WCA)

Target: *P. cattleianum*, tree weeds

Notes: Low priority for control due to large area, difficult terrain, and more weeds. This WCA is very steep. To minimize the impact to the area, and for safety concerns of our staff, sweeps will be done via the spot-and-treat method. The area has not been well surveyed yet. There is a reintroduction of *L. cytandrae* near the stream bottom that will be maintained via focused weed control.

WCA: Koloa-14

Veg Type: Wet Montane

OIP Goal: 25% or less alien cover (rare taxa in WCA)

Target: *P. cattleianum,* tree weeds

Notes: Low priority for control due to large area, difficult terrain, and more weeds. The West boundary of this MU is the river at the bottom of the west gulch. To minimize the impact to the area, and for safety concerns of our staff, sweeps will be done via the spot-and-treat method. The area has not been well surveyed yet.

WCA: Koloa-15

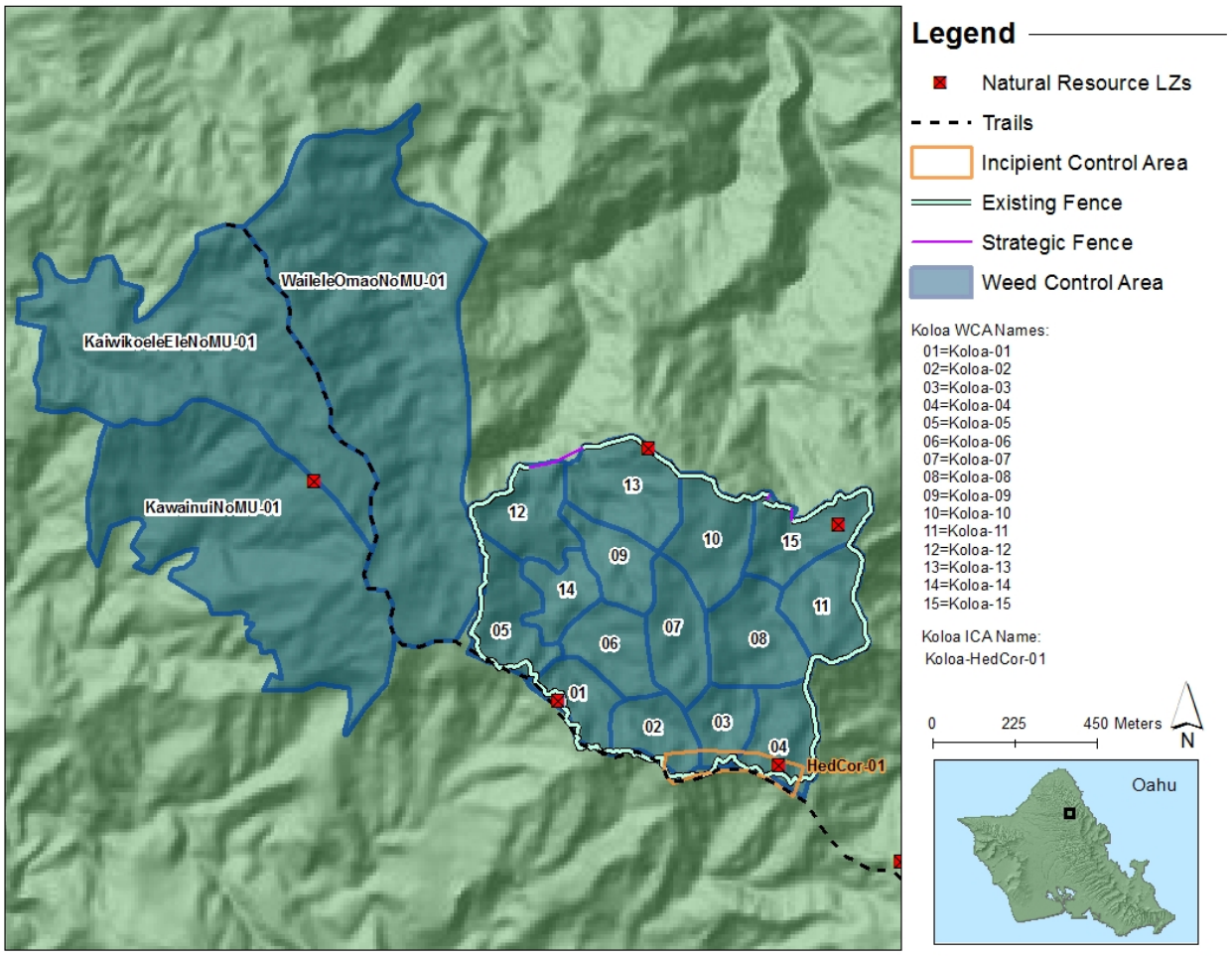
Veg Type: Wet Montane

OIP Goal: 25% or less alien cover (rare taxa in WCA).

Target: *P. cattleianum,* tree weeds

Notes: Low priority for control due to large area, difficult terrain, and more weeds. This WCA is in the northeast corner of the exclosure and is very steep. To minimize the impact to the area, and for safety concerns of our staff, sweeps will be done via the spot-and-treat method. The area has not been well surveyed yet.

KoloaNO MU Weed Control Areas



Discussion: In previous years, NRS conducted sweeps targeting *L. scoparium* to the northwest of Koloa . This is not a current priority as it is outside the MU, possible collaborative project with KMWP will be discussed. Utilizing new technologies and methodologies, such as Herbicide Ballistic Technology (HBT), to develop control methods for *L. scoparium* will be examined in the future.

WCA: KawainuiNoMU-01

Veg Type: Wet Montane

OIP Goal: None (not in MU)

Target: *L. scoparium, A. evecta*

Notes: This WCA is steep and comprised of many small ridges and gulches. To minimize the impact to the area, and for safety concerns of our staff, sweeps will be done via spot-and-treat method.

WCA: KaiwikoeleEleNoMU-01

Veg Type: Wet Montane

OIP Goal: None (not in MU)

Target: *L. scoparium, A. evecta*

Notes: This WCA once held a large population of *L. scoparium.* Remnant seedlings and immature plants continue to sprout and will require additional visits to maintain the low numbers left in this area. This WCA is relatively easy to work in as it is generally flat and not as heavily vegetated as the surrounding area.

WCA: WaileleOmaoNoMU-01

Veg Type: Wet Montane

OIP Goal: None (not in MU)

Target: *L. scoparium, A. evecta*

Notes: This WCA has been swept in the past, but continues to produce *L. scoparium* plants. This WCA has extremely steep walls as well as a relatively flat gulch bottom with a stream running through the center. To minimize the impact to the area, and for safety concerns of our staff, sweeps will be done via Spot-and-treat method: spotting from open ridges with binoculars and directing other staff to the plants for treatment

Small Vertebrate Control

Species: *Rattus rattus* (Black rat), *Rattus exulans* (Polynesian rat), *Mus musculus* (House mouse)

Threat level: Low

Management Objectives:

- To maintain rodent populations to a level that facilitates stabilized or increasing plant populations across the MU by the most effective means possible.
- Implement rodent control if determined necessary for protection of plant populations. Monitor susceptible species for evidence of rodent impacts.

Strategy and Control Methods:

- OANRP currently does not control rodents at Koloa.

Discussion: Currently, no rodent control is conducted by OANRP at Koloa, since *Achatinella livida* is listed as a Tier 2 taxa. Rodent control round these *A. livida* populations has been appointed to SEPP. However, rodent control may be implemented if there is observed damage to any managed plant species. *Labordia cyrtandrae* is susceptible to rodents as damage has been reported in the *L. cyrtandrae* populations located in the Kaala MU.

Slug Control

Species: *Deroceras laeve*, *Limax maximus*

Threat level: High

Seasonality/Relevant Species Biology: Likely abundant year round since area is wet.

Management Objectives:

- Reduce slug population to levels where germination and survivorship of rare plant taxa are unimpeded.
- Determine slug species present and estimate baseline densities using traps baited with beer.
- Determine slug damage monitoring methods for *Cyanea koolauensis*, *Labordia cyrtandrae* and *Phyllostegia hirsuta*.
- If Sluggo or FerroxxAQ is deployed, monitor efficacy via beer traps.
- Annual census monitoring of slug densities during wet season.
- If slug numbers are high enough to damage native plants, survey areas for the presence of rare snails. If no rare snails are present begin slug control using Sluggo or FerroxxAQ at the label rate.
- Additional threats will be assessed and control options weighed.

Strategy and Control Methods:

- Define Slug Control Areas (SLCAs) around rare taxa locations.
- Prior to any control, day and nighttime surveys must be conducted in the proposed control area to ensure there are no rare snails are in the area. Apply Sluggo monthly at each site or apply FerroxxAQ every 6 weeks. A buffer of at least 5 meters from vulnerable plants is recommended. 10 meters is optimal.

Discussion: During annual rare plant monitoring, we will inspect plants for herbivory. If present, this will be noted and may trigger a management response. Indication that slugs are responsible includes the following: lower leaves closer to the ground are more damaged, slime is present, leaf margins are consumed before the interior of the leaf (unless the midrib is resting on the ground while the margins are curled).

If slug herbivory is suspected, check for rare native snails within 20 meters of the rare plants before proceeding with a slug control program.

Sample slugs in the vicinity using baited beer traps. If the number of slugs captured per trap over two weeks exceeds one slug per trap, and if no rare native snails are present, apply Sluggo monthly or apply FerroxxAQ every 6 weeks until slug numbers are reduced.

Although slug control may be necessary around the managed plant taxa, using Sluggo or FerroxxAQ may not be feasible due to the access constraints (only via helicopter) and the usually wet habitat.

Ant Control

Species: None detected in 2016

Threat level: Unknown

Seasonality/Relevant Species Biology: Area may prove to be too wet for ant establishment

Management Objectives:

- Determine what ant species are preset and monitor these sites over time.

Strategy and Control Methods:

- Continue to sample ants Koloa cabin annually in the summer. Use samples to track changes in existing ant densities and to alert OANRP to any new introductions.
- If incipient species are found and deemed to be a high threat and/or easily eradicated locally (<0.5 acre infestation), begin control with AMDRO.

Discussion: Ants were sampled around the cabin in March 2016 using bait cards with vials baited with SPAM, peanut butter and honey. While baits were out, staff looked for ants visually for one hour. No ants were found.

The cabin site is the most likely place for accidental human introduction to take place, since both gear and people are flown to that site. We sample ants according to the following protocol: 10 vials baited with SPAM, peanut butter and honey are left out for ants for at least 1 hour. We remove open the vials and space them 5 meters from each other around the cabin. Ant baiting takes place no earlier than 8:00 am in the morning no sampling occurs on rainy, blustery or cold days as both rain and low temperatures reduce ant activity. Any ants visiting baits are collected and returned to the office for later identification.

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 code, 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 'CenSet' instead of *Cenchrus setaceus*, for brevity.

Action Type	Actions	OIP Year 10 Oct 2017-Sept 2018				OIP Year 11 Oct 2018-Sept 2019				OIP Year 12 Oct 2019-Sept 2020				OIP Year 13 Oct 2020-Sept 2021				OIP Year 14 Oct 2021-Sept 2022			
		4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3
General Survey	LZ-KLOA-025: Survey Koloa Cabin LZ whenever used, no more than once per quarter. If not used, do not need to survey.																				
	LZ-Koloa-163: Survey Koloa/Kaiapapau LZ whenever used, no more than once per quarter. If not used, do not need to survey.																				
	LZ-Koloa-169: Survey Koloa Midridge LZ whenever used, no more than once per quarter. If not used, do not need to survey.																				
	LZ-KLOA-034: Survey LZ Norton/Kainapuaa annually. [NOT CURRENTLY LEASED BY ARMY, WILL SCHEDULE IF TRAINING RESUMES]																				
	OS-KLOA-01: Survey Koloa Cabin campsite whenever used, not to exceed once per quarter. If not used, do not need to survey.																				

Action Type	Actions	OIP Year 10 Oct 2017-Sept 2018				OIP Year 11 Oct 2018-Sept 2019				OIP Year 12 Oct 2019-Sept 2020				OIP Year 13 Oct 2020-Sept 2021				OIP Year 14 Oct 2021-Sept 2022			
		4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3
	WT-Koloa-01: Survey from LZ to Cabin, then along Koolau Summit trail/Koloa fenceline to W side of fence, where fence turns off KST and cuts N; annually. Note, this is expansion over earlier years (<2017), which ran only from Cabin to LZ Northern.																				
	Survey aerially for AngEve and PsiCat, to assist in guiding control efforts.																				
ICA HedCor	KLOA-HedCor-01: Monitor/control Hedcor in Koloa cabin vicinity annually.																				
	KLOA-HedCor-01: Survey area around known locations; check out mini gulches. Easiest to do with 4 people. Define ICA. GPS.																				
WCA: Koloa-01 (Northern LZ)	Conduct canopy weed control across WCA. Focus effort around rare plant sites. Re-sweep every 3-5 years.																				
WCA: Koloa-02 (Hupnut site and LabCyr reintro)	Conduct canopy weed control across WCA. Focus effort around rare plant sites. Re-sweep every 3-5 years.																				
	Control weeds around rare taxa reintro (LabCyr) 2x/year, or as needed. Minimize disturbance to protect rare plants and reduce invasion by PteGlo, CliHir, etc.																				
WCA: Koloa-03	Conduct canopy weed control across WCA. Focus effort around rare plant sites. Re-sweep every 3-5 years.																				

Action Type	Actions	OIP Year 10 Oct 2017- Sept 2018				OIP Year 11 Oct 2018- Sept 2019				OIP Year 12 Oct 2019- Sept 2020				OIP Year 13 Oct 2020- Sept 2021				OIP Year 14 Oct 2021- Sept 2022			
		4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3
(Between Hupnut WCA and Camp WCA)	Control weeds around rare taxa reintro (PhyHir) 2x/year, or as needed. Exercise care when working around sprawling PhyHir. Minimize disturbance to protect rare plants and reduce invasion by PteGlo, CliHir, etc.																				
WCA: Koloa-04 (Cabin WCA)	Conduct canopy weed control across WCA. Focus effort around rare plant sites. Re-sweep every 3-5 years.																				
WCA: Koloa-05 (South West WCA, West of Northern LZ WCA)	Conduct canopy weed control across WCA. Focus effort around rare plant sites. Re-sweep every 3-5 years.																				
WCA: Koloa-06 (Mid ridge to bottom of West gulch)	Conduct canopy weed control across WCA. Focus effort around rare plant sites. Re-sweep every 3-5 years.																				
WCA: Koloa-07 (Mid ridge to Puu 2361)	Conduct canopy weed control across WCA. Focus effort around rare plant sites. Re-sweep every 3-5 years.																				
WCA: Koloa-08 (Puu 2361 across East gulch)	Conduct canopy weed control across WCA. Focus effort around rare plant sites. Re-sweep every 3-5 years.																				
WCA: Koloa-09 (Mid ridge to bottom of West gulch, North of 6)	Conduct canopy weed control across WCA. Focus effort around rare plant sites. Re-sweep every 3-5 years.																				
WCA: Koloa-10 (Midridge to 2361 ridge)	Conduct canopy weed control across WCA. Focus effort around rare plant sites. Re-sweep every 3-5 years.																				

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		4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3
WCA: Koloa-11 (Kaipapau side)	Conduct canopy weed control across WCA. Focus effort around rare plant sites. Re-sweep every 3-5 years.																				
WCA: Koloa-12 (North West corner with huge waterfall)	Conduct canopy weed control across WCA. Focus effort around rare plant sites. Re-sweep every 3-5 years.																				
	Control weeds around rare taxa reintro (LabCyr) 1x/year, or as needed. Minimize disturbance to protect rare plants and reduce invasion by PteGlo, CliHir, etc.																				
WCA: Koloa-13 (Mid ridge to WCA 12)	Conduct canopy weed control across WCA. Focus effort around rare plant sites. Re-sweep every 3-5 years.																				
	Control weeds around rare taxa reintro (LabCyr) 1x/year, or as needed. Minimize disturbance to protect rare plants and reduce invasion by PteGlo, CliHir, etc.																				
WCA: Koloa-14 (West river towards Mid ridge)	Conduct canopy weed control across WCA. Focus effort around rare plant sites. Re-sweep every 3-5 years.																				
WCA: Koloa-15 (North East Corner)	Conduct canopy weed control across WCA. Focus effort around rare plant sites. Re-sweep every 3-5 years. [NO ACTIONS SCHEDULED FOR NEXT 5 YEARS]																				
Ungulate Control	All fence monitoring and maintenance actions. Maintenance is defined as any minor repair work or that is LESS THAN 100m.																				
Ant Control	Conduct surveys for ants at annually at Koloa cabin																				

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		4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3
	Implement control if deemed necessary.																				
Slug Control	Determine slug species are a threat to any managed species.																				
General Maintenance	All camp maintenance including cabin construction, repairs etc.																				