1.3.2 Kahuku Training Area (KTA)

Ecosystem Restoration Management Plan

OIP Year 4-8, Oct. 2010 – Sept. 2015

Region: Kahuku Training Area

MU: Kaunala, Pahipahialua, Oio, KTA no MU

**Overall OIP Management Goals:**

- Form a stable, native-dominated matrix of plant communities which support stable populations of IP taxa.
- Control ungulate, rodent, arthropod, slug, fire, rust fungus, and weed threats to support stable populations of IP taxa. Implement control methods by 2013.

**Background Information**

**Location:** Kahuku Training Area (KTA)

**Land Owner:** US Army

**Land Manager:** Oahu Army Natural Resources Program (OANRP)

**Acreage:** 9,400 acres ~10 acres within fenced MUs

**Elevation Range:** 80 ft. - 2,100 ft

**Description:** KTA is located on the northern extent of Oahu, beginning in the lowlands across Kamehameha Highway from the shrimp farms and agricultural fields to the summit of the Koolau Mountains. The Army purchased KTA from The Estate of James Campbell. The Army uses KTA for pyrotechnic training, foot maneuver training, urban combat training and heli training. The terrain consists of rolling hills dissected by broad drainages in lower elevations, and relatively steep and windswept ridges in upper elevations. Habitat within KTA is highly disturbed with some small, predominantly native forest patches in the mid elevation mesic forest leading up to mostly native stretches of summit and wet forest. MU management is primarily focused within 3 small fenced MUs within the mid elevation mesic forest around the populations of endangered Eugenia koolauensis. Management is also implemented to control key incipient weeds throughout KTA. Road and LZ surveys are conducted to assist in detection of invasive taxa and monitoring spread within the training area. There are four IP species found at KTA.

<table>
<thead>
<tr>
<th>Native Vegetation Types</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Koolau Vegetation Types</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mesic mixed forest</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Canopy includes:</strong> Acacia koa, Metrosideros polymorpha, Psydrax odorata, Nestegis sandwicensis, Diospyros spp., Fouteria sandwicensis, Charpentiera spp., Pisonia spp., Psychotria spp., Antidesma platyphylum, Bobea spp. and Santalum freycinetianum, Pleomele halapepe</td>
</tr>
<tr>
<td><strong>Understory includes:</strong> Microlepia strigosa, Sphenomeris chinensis, Scaevola gaudichaudiana, Alyxiastellata</td>
</tr>
</tbody>
</table>

| Mesic-Wet forest |
Canopy includes: *M. polymorpha*, *Chetrodendron trigynum*, *Cibotium* spp., *Melicope* spp., *A. platyphyllum*, and *Ilex anomala*.

Understory includes: *Cibotium chamissoi*, *Broussasia arguta*, *Dianella sandwicensis*, *Dubautia* spp. Less common subcanopy components of this zone include *Clermontia* and *Cyanea* spp.

**Primary Vegetation Type in Kaunala, Pahipahialua, and Oio**

Mesic Gulch

<table>
<thead>
<tr>
<th>Organism Type</th>
<th>Species</th>
<th>Pop. Code</th>
<th>Population Unit</th>
<th>Management Designation</th>
<th>Wild/Reintroduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant</td>
<td><em>Cyanea koolauensis</em></td>
<td>KTA-A</td>
<td>Kamananui-Kawainui Ridge</td>
<td>GSC</td>
<td>Wild</td>
</tr>
<tr>
<td>Plant</td>
<td><em>Eugenia koolauensis</em></td>
<td>KTA-A, B, C, D, E, F, H, I</td>
<td>Pahipahialua, Kaunala, Kaleleiki, Oio, East of Oio, Aimuu, Ohiaai</td>
<td>MFS and GSC</td>
<td>Wild</td>
</tr>
<tr>
<td>Plant</td>
<td><em>Gardenia mannii</em></td>
<td>KTA-A, B</td>
<td>Ihiihi-Kahawainui ridge, Kamananui-Malaekahana Summit Ridge</td>
<td>GSC</td>
<td>Wild</td>
</tr>
<tr>
<td>Plant</td>
<td><em>Hesperomannia arborescens</em></td>
<td>KTA-A</td>
<td>Ohiai Ridge</td>
<td>GSC</td>
<td>Wild</td>
</tr>
</tbody>
</table>

MFS= Manage for Stability  
GSC= Genetic Storage Collection  
*= Population Dead  
†= Reintroduction not yet done
Other Rare Taxa at KTA:

<table>
<thead>
<tr>
<th>Organism Type</th>
<th>Species</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant</td>
<td>Bobea timonioides</td>
<td>SOC</td>
</tr>
<tr>
<td>Plant</td>
<td>Nesoluma polynesicum</td>
<td>SOC</td>
</tr>
<tr>
<td>Plant</td>
<td>Pteralyxia macrocarpa</td>
<td>C</td>
</tr>
<tr>
<td>Plant</td>
<td>Tetraplasandra gymnocarpa</td>
<td>E</td>
</tr>
<tr>
<td>Animal</td>
<td>Lasiurus cinereus semotus</td>
<td>E</td>
</tr>
</tbody>
</table>

SOC: Species of Concern, C: Candidate, E: Endangered

Rare Resources at KTA

Cyanea koolauensis

Eugenia koolauensis

Eugenia koolauensis

Gardenia mannii

Hesperomannia arborescens
**MU Threats to OIP MFS taxa**

<table>
<thead>
<tr>
<th>Threat</th>
<th>Taxa Affected</th>
<th>Localized Control Sufficient?</th>
<th>MU scale Control required?</th>
<th>Control Method Available?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pigs</td>
<td>All</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Rats</td>
<td>All</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Rust fungus</td>
<td>E. koolauensis</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Slugs</td>
<td>C. koolauensis, G. mannii, H. arborescens</td>
<td>Yes</td>
<td>No</td>
<td>Under development</td>
</tr>
<tr>
<td>Ants</td>
<td>Unknown, but may impact rare plants by tending pest insects</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Some available, depends on species</td>
</tr>
<tr>
<td>Weeds</td>
<td>All</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Fire</td>
<td>All</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Management History**

**1996** - Robust *E. koolauensis* population found in Pahipahialua

**1998** - *E. koolauensis* surveys conducted in KTA

**1998** - Weed control initiated around *E. koolauensis* populations

**1999** - ICA’s established in KTA

**2005** - *Casuarina equisetifolia* removal contracted for Oio and Pahipahialua

**2006** - Kaunala, Pahipahialua and Oio MU fences constructed

**2006** - *Puccinia psidii* rust noted on *E. koolauensis* at all sites

**2010** - Thorough census conducted at all *E. koolauensis* MFS sites

Fall **2010** - *P. psidii* rust control research initiated by OANRP in KTA

**Ungulate Control**

**Identified Ungulate Threats:** Pigs

**Threat Level:** High

**Primary Objectives:**

- Maintain all three MU fences (Kaunala, Pahipahialua, and Oio) as ungulate free.

**Monitoring Objectives:**

- Conduct fence checks and read transects quarterly. GPS and mark the fence at ten meter intervals so that the fence will be one large transect.
- Monitor for pig sign while conducting other management actions in the fence.
- Monitor fence integrity of all fences after extreme weather/wind events as soon as possible.
Management Responses:

- If any pig activity is detected within the fenced units, remove pigs through hunting and/or trapping methods.
- Check fence and repair breaches.

Maintenance Issues:

All three fences are prone to possible damage from tree fall and potentially after extreme weather/high wind events. Vandalism to the fences has not been an issue in the past but is always a concern, especially since the Kaunala and Pahipahialua fences are in close proximity to public access trails.

Weed Control

Weed Control actions are divided into 4 subcategories:

  5) Vegetation Monitoring
  6) Surveys
  7) Incipient Taxa Control (Incipient Control Area - ICAs)
  8) Ecosystem Management Weed Control (Weed Control Areas - WCAs)

These designations facilitate different aspects of OIP requirements.

Vegetation Monitoring

Currently there is no plan for MU-scale vegetation monitoring in the Kaunala, Pahipahialua, and Oio MUs. Current OANRP methods of vegetation monitoring are designed for larger scale MUs. These methods would need to be modified, or a different methodology would need to be chosen, in order to accurately detect changes in vegetation composition.

Instead we are considering a small-scale monitoring project to examine the effects and potential benefits of common reintroductions in: 1) increasing native plant cover, and 2) reducing weeding effort required to prevent alien vegetation cover levels from exceeding 25%. This trial will help direct future management efforts in Kaunala, Oio, and Pahipahialua.

Surveys

Army Training?: Yes

Other Potential Sources of Introduction: NRS, pigs, public hikers

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

Management Objective:

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

Monitoring Objectives:

- Survey transects for weeds; begin surveys of fenceline ungulate transect.
- Quarterly surveys of LZs (if used). Annual surveys of Army LZs (required by contract).
• Note unusual, significant or incipient alien taxa during the course of regular field work.
• Road surveys (required by contract).

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, fence lines, and other highly trafficked areas are inventoried regularly; 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.

Survey Locations at KTA

Incipient Taxa Control (ICAs)

Management Objectives:

• Target high priority species identified as incipient in the region by 2015.
• Conduct seed dormancy trials for all high priority incipients by 2015.
Monitoring Objectives:

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

Management Responses:

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

ICAs are drawn around each discrete infestation of an incipient 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 bank, dormancy and life cycle information are important in making management decisions to facilitate eradication. NRS will compile information for each ICA species and conduct research to understand the biology of incipient species.

The table below summarizes incipient invasive taxa at Kahuku Training Area. 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 training range. ICAs are not designated for every species in the table below; however, occurrences of all species in the table should be noted in Kahuku Training Area. All current ICAs are mapped. 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).

### Summary of Potential ICA Target Taxa

<table>
<thead>
<tr>
<th>Taxa</th>
<th>Management Designation</th>
<th>Notes</th>
<th>No. of ICAs</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Acacia mangium</em></td>
<td>Incipient</td>
<td>Planted by ITAM in 2000. Four sites where OANRP is currently still finding individuals.</td>
<td>5</td>
</tr>
<tr>
<td><em>Angiopteris evecta</em></td>
<td>Widespread</td>
<td>Widespread in upper elevation areas in Kahuku. The leaves of this fern can form a canopy up to 5 m tall shading out most other plants in the area. High priority for control in MU fences, if found.</td>
<td></td>
</tr>
<tr>
<td><em>Arthrostemma ciliatum</em></td>
<td>Widespread</td>
<td>Widespread across KTA. Of the KTA MU’s only an issue at Oio. High priority for control in fenced areas. OANRP is currently using a foliar application due to the plants vegetative reproduction abilities. OANRP need to diligently decontaminate their gear to minimize seed dispersal.</td>
<td>0</td>
</tr>
<tr>
<td><em>Casuarina equisetifolia</em></td>
<td>Control locally</td>
<td>Widespread throughout Kahuku. High priority for control in areas near <em>E. koolauensis</em>; do not significantly altering light levels around <em>E. koolauensis</em>.</td>
<td>0</td>
</tr>
<tr>
<td><em>Chrysophyllum oliviforme</em></td>
<td>Control locally</td>
<td>Widespread throughout Kahuku. <em>Chrysophyllum oliviforme</em> is a habitat modifier that creates monotypic stands. It is a high priority for OANRP to do thorough sweeps targeting <em>C. oliviforme</em> inside the MU fences as well as a 5m buffer around the fences.</td>
<td>0</td>
</tr>
<tr>
<td><em>Ficus spp.</em></td>
<td>Control locally</td>
<td>Widespread throughout Kahuku. <em>Ficus spp.</em> is a habitat modifier that can strangle and shade out native species. It is a high priority for OANRP to do thorough sweeps targeting <em>Ficus spp.</em> inside the MU fences as well as a 5m buffer around the fences.</td>
<td>0</td>
</tr>
<tr>
<td><em>Leucaena leucocephala</em></td>
<td>Control locally</td>
<td>Widespread throughout Kahuku. <em>Leucaena leucocephala</em> grows quickly and in dense thickets which crowd out any native vegetation. It is a high priority for OANRP to do thorough sweeps targeting <em>L. leucocephala</em> inside the MU fences as well as a 5m buffer around the fences.</td>
<td>0</td>
</tr>
<tr>
<td>Taxa</td>
<td>Management Designation</td>
<td>Notes</td>
<td>No. of ICAs</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>------------------------</td>
<td>----------------------------------------------------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Leptospermum scoparium</td>
<td>Widespread</td>
<td>Widespread in upper elevation areas in Kauhuku. This small, scrubby tree forms thickets which crowd out other plants. It appears to have allelopathic activity like many other members of the Myrtaceae. Herbicide Ballistic Technology™ with James Leary has been tested on a handful of plants. If aerial control techniques become available, consider targeting this species across landscape.</td>
<td></td>
</tr>
<tr>
<td>Macaranga mappa</td>
<td>Control locally</td>
<td><em>Macaranga mappa</em> is naturalized in Kahuku. This large leaved tree forms dense thickets, crowding out other plants and forming deep shade areas. It is a high priority for OANRP to do thorough sweeps targeting <em>M. mappa</em> inside the MU fences as well as a 5m buffer around the fences.</td>
<td>0</td>
</tr>
<tr>
<td>Melaleuca quinquenervia</td>
<td>Control locally</td>
<td><em>Melaleuca quinquenervia</em> has been planted extensively in reforestation projects throughout Oahu. This is a high priority for OANRP due to the allelopathic activities of this species, as well as the ability to harbor <em>Puccinia psidii</em>,<em>Ohia rust</em>. OANRP staff thoroughly sweep inside MU fences as well as a 5m buffer around the MU fences.</td>
<td>0</td>
</tr>
<tr>
<td>Melochia umbellata</td>
<td>Incipient</td>
<td>First started control in 1999. Highly invasive, particularly on the Big Island. On Oahu, only known from KTA and Punalu. Likely introduced via military training. There are two sites OANRP is still currently finding individuals. Other three site OANRP staff have not found since 2006. One new site found in 2010.</td>
<td>6</td>
</tr>
<tr>
<td>Pennisetum setaceum</td>
<td>Incipient</td>
<td>First discovered in 1998. Highly invasive grass with known tolerance of fire. Likely introduced to KTA via military training. Last plant found in 2004. Site is still monitored by OANRP annually and will continue to monitor until the seed dormancy is known. Preliminary research suggest seeds may only be viable for a year.</td>
<td>1</td>
</tr>
<tr>
<td>Pimenta dioica</td>
<td>Control locally</td>
<td>Widespread throughout Kahuku. High priority for control in all areas near <em>E. kooluaensis</em> without significantly altering light levels. Harbors <em>Puccinia rust</em>. Forms dense thickets. OANRP staff thoroughly sweep inside MU fences as well as a 5m buffer around the MU fences.</td>
<td>1</td>
</tr>
<tr>
<td>Pluchea carolinensis</td>
<td>Control locally</td>
<td>Widespread throughout Kahuku. Tends to colonize open sunny areas. High priority for control in MU fences without significantly altering light levels.</td>
<td>0</td>
</tr>
<tr>
<td>Psidium cattleianum</td>
<td>Widespread</td>
<td>Widespread throughout Kahuku. High priority for control in MU fences without significantly altering light levels. Forms dense monocultures. May harbor <em>Puccinia rust</em>, as it is in the Myrtaceae family.</td>
<td>0</td>
</tr>
<tr>
<td>Pterolepis glomerata</td>
<td>Widespread</td>
<td>This melastome is ubiquitous across the Koolaus. It thrives in disturbed areas, particularly pig wallows. OANRP do not currently target it for control. Strict sanitation measures should be followed to ensure staff do not accidentally track it to the Waianaes.</td>
<td>0</td>
</tr>
<tr>
<td>Rhodomyrtus tomentosa</td>
<td>Incipient</td>
<td>One immature was found in 2005. OANRP continues to monitor site. Plant possibly introduced by motocross users. Taxa widespread in the Kaneohe area, where it forms dense monocultures. Also highly invasive on Kauai.</td>
<td>1</td>
</tr>
<tr>
<td>Sideroxylon persimile</td>
<td>Incipient</td>
<td>One immature was found in 2008. OANRP continues to monitor site. No information on how plant might have established in the area.</td>
<td>1</td>
</tr>
<tr>
<td>Taxa</td>
<td>Management Designation</td>
<td>Notes</td>
<td>No. of ICAs</td>
</tr>
<tr>
<td>-------------------------</td>
<td>------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td><em>Setaria palmifolia</em></td>
<td>Control locally</td>
<td><em>Setaria palmifolia</em> is widespread across Kahuku. It high priority for OANRP staff to do thorough sweeps targeting <em>S. palmifolia</em> throughout the fence as well as a 5m buffer around the fences. OANRP need to diligently decontaminate their gear to minimize seed dispersal.</td>
<td>0</td>
</tr>
<tr>
<td><em>Sphaeropteris cooperi</em></td>
<td>Widespread</td>
<td>Widespread in the upper areas of Kahuku. High priority for control in MU fences. If aerial control techniques become available, consider controlling across the landscape.</td>
<td>0</td>
</tr>
<tr>
<td><em>Spathodea camapnulata</em></td>
<td>Control locally</td>
<td>Widespread throughout Kahuku. High priority for control in MU fences without significantly altering light levels.</td>
<td>0</td>
</tr>
<tr>
<td><em>Syzygium cumini</em></td>
<td>Widespread</td>
<td>Widespread throughout Kahuku. This large tree forms a dense cover, excluding all other species. The large black fruit are dispersed by birds and perhaps occasionally by feral pigs. OANRP staff thoroughly sweep inside MU fences as well as a 5m buffer around the MU fences.</td>
<td>0</td>
</tr>
<tr>
<td><em>Syzigium jambos</em></td>
<td>Widespread</td>
<td>Widespread throughout Kahuku. <em>S. jambos</em> is a major host for the <em>Puccinia</em> rust. Stands of <em>S. jambos</em> have been defoliated by the rust, although the rust does not necessarily appear to kill <em>S. jambos</em>. Dead-looking stands are highly visible from a distance. The proximity of rust reservoirs to <em>E. koolauensis</em> populations is very concerning. All <em>S. jambos</em> inside MU fences, and in a 5m buffer around the fences, are targeted for control. If aerial control options become available, consider controlling <em>S. jambos</em> stands within 1km of known <em>E. koolauensis</em>.</td>
<td>0</td>
</tr>
</tbody>
</table>
Incipient and Weed Control Areas at KTA

Legend
- Roads
- Incipient Control Area
- Taxoncode # = ICA Name
- Weed Control Area
- MUName- # = WCA Name
- Management Unit

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:
- 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.

Management Responses:
Increase/expand weeding efforts if MU vegetation monitoring (conducted every 3 years) indicates that goals are not being met. Weed strategies around *E. kooluaensis* should be executed with extreme caution. When weeding the over story around *E. kooluaensis* light levels should be maintained. Weeding should be primarily focused on understory weeds around *E. kooluaensis*.

**WCA: Oio-01 KTA-F**

**Veg Type:** Mesic / Mid-Slope / Gulch  
**OIP Goal:** 10% native cover  
**Targets:** All weeds, focusing on *P. carolinensis, Ficus sp., C. oliviforme, P. dioica, C. equisetifolia, M. quinquenervia, M. mappa, S. campanulata, A. ciliatum, S. palmifola, L. leucocephala.*  
**Priority:** High  
**Notes:** There is a wild *E. koolauensis* in this WCA. No other rare species found in the WCA. OANRP staff plan to weed around the *E. koolauensis* annually across the entire WCA once every year until OIP goals are achieved. Extreme care must be used when weeding around rare species.

**WCA: East Oio-01 KTA-D**

**Veg Type:** Mesic / Mid-Slope / Gulch  
**OIP Goal:** 10% native cover  
**Targets:** All weeds, focusing on *P. carolinensis, Ficus sp., C. oliviforme, P. dioica, C. equisetifolia, M. quinquenervia, M. mappa, S. campanulata, A. ciliatum, S. palmifola, L. leucocephala.*  
**Priority:** High  
**Notes:** There are wild *E. koolauensis* and reintroductions of common natives in this WCA. No other rare species found in this WCA. This WCA contains two separate areas, east and west of the dividing ridge. OANRP staff plan to work around the *E. koolauensis* twice a year and across the entire WCA once every year until OIP goals are achieved. Extreme care must be used when weeding around rare species.

**WCA: Pahipahialua-01 KTA-A Pahipahialua**

**Veg Type:** Mesic Ridges / Mesic Gulches  
**OIP Goal:** 10% native cover  
**Targets:** All weeds, focusing on *P. carolinensis, Ficus spp., C. oliviforme, P. dioica, C. equisetifolia, M. quinquenervia, M. mappa, S. campanulata, A. ciliatum, S. palmifola, L. leucocephala* and *Grevillia robusta.*  
**Priority:** High  
**Notes:** There are wild *E. koolauensis* and reintroductions of common native species in this WCA. No other rare species found in this WCA. OANRP staff plan to work around the *E. koolauensis* twice a year and across the entire WCA once every year until OIP goals are achieved. Extreme care must be used when weeding around rare species.
WCA: Kaunala-01 KTA B/E Kaunala

Veg Type: Mesic/Mid Slope
OIP Goal: 15% native cover.
Targets: All weeds, focusing on *P. carolinesis*, *Ficus spp.*, *C. oliviforme*, *P. dioica*, *C. equisetifolia*, *M. quinquenervia*, *M. mappa*, *S. campanulata*, *A. ciliatum*, *S. palmifola*, *L. leucocephala*, *G. robusta*, *Passiflora suberosa*.
Priority: High.
Notes: This WCA contain the highest concentration of wild *E. kooluaensis* compared to the other WCA’s in the Kahuku area. No other rare species found in this WCA. OANRP staff plan to work around the *E. kooluaensis* twice a year and across the entire WCA once every year until OIP goals are achieved. Extreme care must be used when weeding around rare species.

WCA: Kaleleiki-01

Veg Type: Mesic Forest
OIP Goal: 50% native cover
Targets: All weeds, focusing on *P. cattleianum*, *C. hirta*, *C. equisetifolia*, *P. edulis*, and *P. suberosa*.
Priority: High.
Notes: There are wild *E. kooluaensis* in fence. No other rare species found in this WCA. Kaleleiki is owned by the State of Hawaii and is in a game management area. NRS needs to collaborate with the state to develop weed control strategies. The WCA is surrounded by *C. equisetifolia* requiring annual sweeps to control any immature individuals.

Rodent Control

Threat level: Unknown
Current control method: None
Seasonality: N/A
Number of control grids: None
Primary Objective:
- To implement rodent control if determined necessary for the protection of rare plants
Monitoring Objective:
- Monitor rare plant populations to determine impacts by rodents.
MU Rodent Control:
- OANRP have observed predated fruits of *Cyanea* sp. within other MUs, however no rat predation has been observed at KTA. Currently no rodent control is conducted by OANRP around the *C. koolauensis*, *E. koolauensis*, *G. Mannii*, and *H. arboescens*. If rare plants are determined to be
impacted adversely by rodents OANRP will evaluate the use of localized rodent control for the protection of rare species.

**Slug Control**

*Species*: Unknown  
*Threat level*: Low  
*Control level*: Localized  
*Seasonality*: Wet season  
*Number of sites*: *Cyanea koolauensis* site (1 site KTA-A)

**Primary Objective:**
- Determine whether slugs are present within the vicinity of *C. koolauensis*
- If present, reduce slug population to levels where germination and survivorship of *C. koolauensis* is unaffected by predation.

**Management Objective:**
- If slugs are present in numbers sufficient to negatively impact *C. koolauensis* seedling survival begin control program using Sluggo (if additional conservation use labeling is approved)
- By 2013, reduce slugs by at least 50% of estimated baseline densities around the *C. koolauensis* population through a pilot control program

**Monitoring Objectives:**
- Annual census monitoring of *C. koolauensis* seedling recruitment following fruiting events.
- Annual census monitoring of slug densities during wet season.

No slugs have been collected within this MU, however, they may be present as no focused surveys have taken place. It is unlikely that slugs are abundant given the dry habitat.

**Rust Control**

*Species*: *Puccinia psidii*  
*Threat level*: High  
*Control level*: Localized  
*Seasonality*: Year round  
*Number of sites*: Six to eight *E. koolauensis* populations  
*Acceptable Level of Activity*: Unknown

**Primary Objective:** Reduce the disease incidence (number of diseased leaves/total number of leaves) and prevent infection of new individuals.

**Management Objective:**
- Remove alien tree species which serve as hosts for *P. psidii* (*P. dioica*, *M. quinquenervia*, *Syzgium jambos*, *S. cumini*), particularly those upwind of *E. koolauensis*. 
- Conduct research to develop fungicide treatments which are both safe and effective against rust in a field setting.

Monitoring Objectives:
- Annual monitoring of disease incidence within *E. koolauensis* population(s).
- Annual sweep of areas surrounding *E. koolauensis* to locate alien tree species which can serve as hosts to the rust.

Three methods are recommended for disease control: disease avoidance, planting resistant genotypes, and fungicide applications. A degree of disease avoidance may be achieved by removing alien trees which serve as rust hosts. OANRP plans to target host trees within 100 m of *E. koolauensis* within the boundaries of the fence line. Aerial application of herbicide is a possibility for monotypic alien tree stands such as the patch of *S. jambos* situated near the Oio population. When taking cuttings for propagation of *E. koolauensis*, it is desirable to take material from individuals with the lowest disease incidence. In practice, however, *E. koolauensis* must be propagated from whichever cuttings successfully root. A few fungicides have been effective in preventing rust infection in *M. polymorpha* but none are labeled for use on *E. koolauensis* in the wild. With permission from the Hawaii Department Agriculture, OANRP hopes to begin field testing a subset of these fungicides. If proven effective and not phytotoxic to *E. koolauensis*, an expansion of the fungicide label may be pursued.

![E. koolauensis showing clusters of rust pustules (groups of urediniospores are yellow-orange in color).](image-url)
Rust is most common on new leaf flush. *E. koolauensis* with rust lesions on the young leaves.

**Ant Control**

**Species:** *Leptogenys falcigera, Pheidole megacephala* confirmed

**Threat level:** Unknown

**Control level:** Only for new incipient species

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

**Number of sites:** Three, trailhead to Oio, Pahipahialua and Kaunala *E. koolauensis* sites

**Acceptable Level of Ant Activity:** Unknown

**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.
- Ant populations will be kept to a determined acceptable level across the MU to facilitate ecosystem health.

**Monitoring Objective:**

- Sample ants at human entry points (trailhead to Oio, Pahipahialua and Kaunala). Use samples to track changes in existing ant densities and to alert NRS to any new introductions.
- Look for evidence of ant tending of aphids or scales on rare plants.
Ants have been documented to pose threats to a variety of resources, including native arthropods, plants (via farming of Hemipterian pests), and birds. It is therefore important to know their distribution and density in areas with conservation value. This can be accomplished using a survey methodology developed by S. Plentovich (UH Manoa). The protocol for sampling ants follows:

Place index cards (3 X 5 inches) containing SPAM, peanut butter and honey throughout the sampling area. Place card so that it is halfway out of a ziplock “sandwich” bag. Deploy a minimum of 10 cards separated by at least 15 meters and label them with the date, location, card # and collector name. Deploy cards no earlier than 8:00 am in the morning and leave them in places where ants were likely to forage (under vegetation) for 1 hour. Collect baits rapidly by slipping the card into its accompanying ziplock and immediately closing the ziplock. Bring samples in for identification.

Standardized surveys have not yet taken place. Opportunistic collection confirms that the following two species are present: *L. falcigera* and *P. megacephala*. The first species occurs in low numbers and is not considered a threat to native resources. The second is present in high numbers at Pahipahialua but does not appear to be damaging *E. koolauensis*. Both species are well established and widespread throughout Oahu, therefore any attempt at control would be temporary. While control is not recommended at this time, future surveys are needed to ensure new species are not becoming established.

**Fire Control**

**Threat Level:** Low

**Available Tools:** Fuelbreaks, Visual Markers, Helicopter Drops, Wildland Fire Crew, Red-Carded Staff.

**Management Objective:**

- To prevent fire from burning any portion of the MUs at any time.

**Preventative Actions:**

There is little infrastructure to reduce the threat of fire. NRS will focus on maintaining good communication with the Army Wildland Fire Working Group to facilitate positive on-the-ground fire response. NRS will maintain red-carded staff to assist with fire response.
Burned area at Pahipahialua, stretching from ridge (point of ignition) to *E. koolauensis* location.

*E. koolauensis* seedling, with burned *C. equisitifolia*.  
Edge of fire behind *E. koolauensis* trunk.
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<td>Vegetation Monitoring</td>
<td>Conduct common reintro trial/monitoring</td>
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<td>General Survey</td>
<td>Survey LZ's actively used by the army once a year</td>
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<td>Conduct road surveys of frequently used army access roads.</td>
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<td>ICA</td>
<td>KTA-AcaMan-01: Monitor/control AcaMan at lower oio road site every 6 months. Pick and remove from field any potentially viable fruit.</td>
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<td>KTA-AcaMan-02: Monitor/control Acaman at upper oio road site every 6 months. Pick and remove from field any potentially viable fruit.</td>
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<td>KTA-AcaMan-03: Survey aerially greater Canes area every 2-3 years to facilitate control efforts.</td>
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<td>KTA-AcaMan-03: Monitor/control AcaMan at Canes complex. Sweep entire ICA every 6 months. Pick and remove from field any potentially viable fruit. Track weedling effort with GIS; large ICA</td>
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<td>KTA-AcaMan-04: Monitor/control AcaMan at Puu 804 every 6 months. Pick and remove from field any potentially viable fruit.</td>
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<td>KTA-Melumb-01: Monitor/control Melumb at roadside core quarterly. Pick and remove from field any potentially viable fruit.</td>
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<td>KTA-Melumb-01: Spray roadside with Garlon/Roundup mix to facilitate survey/detection. Every 6 months or as needed.</td>
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<td>KTA-MelUmb-02:</td>
<td>Monitor/control MelUmb at Kaunala/off-road site. Pick and remove from field any potentially viable fruit. Flag locations of any plants found to facilitate later follow-up. Visit all hot spots and sweep upper portion of ICA quarterly. Track weeded</td>
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<td>KTA-MelUmb-02:</td>
<td>Survey aerially every 2-3 years to facilitate control efforts.</td>
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<td>KTA-MelUmb-02:</td>
<td>Monitor lowest known plant site (in gulch) annually.</td>
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<td>KTA-MelUmb-03:</td>
<td>Monitor/control MelUmb at west outlier site annually. Pick and remove from field any potentially viable fruit.</td>
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<td>KTA-MelUmb-04:</td>
<td>Monitor/control MelUmb at east outlier site annually. Pick and remove from field any potentially viable fruit.</td>
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<td>KTA-MelUmb-05:</td>
<td>Monitor/control MelUmb at delta farmer’s gate site annually. Pick and remove from field any potentially viable fruit.</td>
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<td>KTA-PenSet-01:</td>
<td>Monitor/control Penet at watertank hill road site annually.</td>
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<td>KTA-RhoTom-01:</td>
<td>Monitor/control RhoTom on road below Puu 1010 annually.</td>
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<td>KTA-Sidper-01:</td>
<td>Survey around known ICA to distance of 200m. Verify that SidPer not present elsewhere. Update ICA shape. GPS.</td>
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<td>KTA-Sidper-01:</td>
<td>Monitor/control SidPer at charlie road site annually.</td>
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<td>General WCA</td>
<td>GPS boundaries of all existing WCAs. Use geographical and vegetation data. Use landmarks to mark in field</td>
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<td>GPS trails</td>
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<td>Determine whether Oio will remain a MFS population, or if Kaleleiki will replace it as an MFS population. Revise plan accordingly</td>
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<td>Evaluate <em>E. koolauensis</em> Aimuu site to determine need for weed control. Obtain permission from land owner for access.</td>
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<td>Aimuu No MU</td>
<td>Conduct weed control across (proposed) exclosure annually. This is a genetic storage population. Focus around Eugkoo; exercise extreme care around Eugkoo seedlings. Target understory weeds. Control canopy weeds gradually to prevent major light changes.</td>
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<td>EastOio-01</td>
<td>Conduct weed control across (proposed) exclosure annually. This is a genetic storage population. Focus around Eugkoo; exercise extreme care around Eugkoo seedlings. Target understory weeds. Control canopy weeds gradually to prevent major light changes.</td>
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<td>Kaunala -01</td>
<td>Control weedy grasses across exclosure as needed. Focus around native plants, Eugkoo, but exercise care around Eugkoo seedlings. Target Oplhir, Pascon. Target Casgl-eq., Melqui, Eucrob, Grerob and other very large potentially allelopathic trees for removal.</td>
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<td>Kaleleiki -01</td>
<td>Conduct weed control across exclosure, focusing on areas around Eugkoo first, then around other native species, then on connecting these areas. Target understory, gradually control canopy (minimize light change). Use volunteers whenever possible. Maintain clear LZ as needed. May not need, as road now runs through LZ.</td>
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<td>Conduct weed control across the exclosure every 6 months/year. This is a genetic storage population. All management actions to be cleared with the State. Exercise extreme care around Eugkoo seedlings. Focus on understory weed control. Control grass (Pascon) across the exclosure every 6 months/year. This is a genetic storage population. All management actions to be cleared with the State. Exercise extreme caution around Eugkoo seedlings.</td>
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<td>Control weedy grasses across exclosure as needed. Focus around native plants, Eugkoo, but exercise care around Eugkoo seedlings. Target Oplhir, Pascon.</td>
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<td>Oio -01</td>
<td>Conduct weed control across exclosure, focusing on areas around Eugkoo first, then around other native species and common reintroductions, then on connecting these areas. Target understory, gradually control canopy (minimize light change). Use volunteers whenever possible.</td>
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<td><strong>Pahipahialua - 01</strong></td>
<td>Control weedy grasses across exclosure as needed. Focus around native plants, Eugkoo, but exercise care around Eugkoo seedlings. Target Oplhir, Pascon. Conduct weed control across exclosure, focusing on areas around Eugkoo first (3 subgulches), then around other native species and common reintroductions, then on connecting these areas. Target understory, gradually control canopy (minimize light change).</td>
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| **Ungulate Control** | Kaleleiki- Monitor and maintain fence integrity  
Kaunala- Monitor and maintain fence integrity  
Oio- Monitor and maintain fence integrity  
Pahipahialua- Monitor and maintain fence integrity |
| **Rodent Control** | Monitor rare plants for predation by rodents  
Implement localized rodent control if determined to be necessary for the protection of rare plants. |
| **Slug Control** | Monitor slug activity at *C. koolauensis* site  
Monitor *C. koolauensis* seedling recruitment following fruiting events  
If slugs found to exceed acceptable levels during monitoring, maintain slug bait at sensitive plant population(s) |
| **Rust Control** | Remove alien host trees  
Survey E. koolauensis for rust  
Test fungicides, pursue label expansion if feasible |
| **Ant Control** | Conduct surveys for ants at human entry points annually  
Implement control if deemed necessary |

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