Ecosystem Restoration Management Plan


MUs: Opaea Lower I

*Overall MIP Management Goals:*

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

**Background Information**

**Location:** Northern Koolau mountain range

**Land Owner:** Kamehameha Schools, US Army lease

**Land Managers:** Oahu Army Natural Resource Management Program (OANRP)

**Acreage:** 15.9 acres

**Elevation Range:** 1920 ft - 2260 ft

**Description:** Opaea Lower I Management Unit (MU) is located in the northern Koolau Mountain Range, on the island of Oahu. Encompassing 15.9 acres of predominantly native habitat, the MU is bounded by Opaea Stream to the north and Helemano Stream to the south. The MU mainly consists of a forested bowl which surrounds two ponds. The ridge immediately to the south of the bowl runs between two hilltops, named Puu Curta and Puu Melicope, from which a narrow finger extends south into Helemano drainage. A fence around this finger ridge was added to the proposed fence to protect additional rare resources. Although the historical Peahinaia trail runs from the summit to Lower Opaea, it is overgrown, and OANRP access is via helicopter that lands at the highest point in the MU, Puu Curta. The plant community is classified as a montane wet forest, and is comprised of a mixture of native and introduced species. This MU contains rare taxa included in both the Makua and Oahu Implementation Plans. It is somewhat unique in the mid-elevation, uluhe-dominated Koolaus, as it includes stands of tall native trees with a fairly diverse native understory. While some early management took place between 2000 and 2003, efforts were halted until the fence was constructed in 2011.

**Native Vegetation Types**

<table>
<thead>
<tr>
<th>Koolau Vegetation Types</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wet forest</strong></td>
</tr>
<tr>
<td><strong>Canopy includes:</strong> <em>Acacia koa</em>, <em>Metrosideros</em> spp., <em>Syzygium sandwicense</em>, <em>Cheirodendron</em> spp., <em>Cibotium</em> spp, <em>Ilex anomala</em>, <em>Psychotria</em> spp., and <em>Melicope</em> spp.</td>
</tr>
<tr>
<td><strong>Understory includes:</strong> <em>Dicranopteris linearis</em>, <em>Freyzcetia arborea</em>, <em>Alyxia stellata</em>, <em>Dianella sandwicense</em>, <em>Melicope</em> spp., <em>Psychotria</em> spp., <em>Cibotium chamissoi</em>, <em>Machaerina angustifolia</em>, and <em>Broussaisia arguta</em>.</td>
</tr>
</tbody>
</table>

**NOTE:** For MU monitoring purposes vegetation type is mapped based on theoretical pre-disturbance vegetation. Alien species are not included.
Wet Forest Vegetation Type at Lower Opaeula I

Typical vegetation in the forested bowl

Left: ‘Frogpond’, the larger of the two ponds in Lower Opaeula I
Right: Gardenia mannii on Puu Melicope
View from Puu Curta LZ looking West towards Mauna Kaala

Old military helmet found in a draw not far from the Peahinaia trail
### MIP/OIP Rare Resources

<table>
<thead>
<tr>
<th>Organism Type</th>
<th>Species</th>
<th>Pop. Ref. Code</th>
<th>Population Units</th>
<th>Management Designation</th>
<th>Wild/Reintroduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant</td>
<td>Cyrtandra dentata</td>
<td>OPA-F</td>
<td>Opaeula</td>
<td>MFS</td>
<td>Wild</td>
</tr>
<tr>
<td>Plant</td>
<td>Gardenia mannii</td>
<td>OPA-B, OPA-T, PAA-K</td>
<td>Lower Peahinaia</td>
<td>MFS/T1 GSC/T1</td>
<td>Wild/Reintroduction</td>
</tr>
<tr>
<td>Plant</td>
<td>Melicope lydgatei</td>
<td>OPA-D*, E*, F, M, PAA-L</td>
<td>Kawaiiki and Opaeula</td>
<td>MFS/T2</td>
<td>Wild</td>
</tr>
<tr>
<td>Plant</td>
<td>Myrsine juddii</td>
<td>PAA-H</td>
<td>Kaukonahua to Kamananui-Koloa</td>
<td>T2/No Management</td>
<td></td>
</tr>
<tr>
<td>Plant</td>
<td>Phyllostegia hirsuta</td>
<td>OPA-G*</td>
<td>Helemano and Opaeula</td>
<td>GSC/T1</td>
<td>extirpated</td>
</tr>
<tr>
<td>Animal</td>
<td>Achatinella sowerbyana</td>
<td>Listed in OIP, none currently known</td>
<td></td>
<td>MFS/T3</td>
<td>extirpated</td>
</tr>
<tr>
<td>Mineral</td>
<td>Achatinella curta</td>
<td>Listed in OIP, none currently known</td>
<td></td>
<td>MFS/T3</td>
<td>extirpated</td>
</tr>
</tbody>
</table>

MFS= Manage for Stability  
GSC= Genetic Storage Collection  
*= Population Dead  
T1 = Tier 1  
T2=Tier 2

### Other Rare Taxa at Lower Opaeula I MU

<table>
<thead>
<tr>
<th>Organism Type</th>
<th>Species</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant</td>
<td>Cyanea lanceolata</td>
<td>Endangered</td>
</tr>
<tr>
<td>Plant</td>
<td>Exocarpos gaudichaudii</td>
<td>none</td>
</tr>
<tr>
<td>Plant</td>
<td>Lindsaea repens var. macraeana</td>
<td>none</td>
</tr>
<tr>
<td>Plant</td>
<td>Joinvillea ascendens subsp. ascendens</td>
<td>candidate</td>
</tr>
</tbody>
</table>
| Plant         | Stenogyne kaalae subsp. sherffii       | None, outplanted in 2013 with Oahu Plant Extinction Prevention Program (OPEP)  
Any management of this species will occur in conjunction with OPEP staff. |
Locations of rare resources at Opaeula Lower I

Map removed to protect location of rare species. Available upon request.

Rare Resources at Lower Opaeula

Gardenia mannii
Melicope lydgatei

Stenogyne kaalae subsp. sherffii

Cyrtandra dentata
MU Threats to MIP/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>Rats</td>
<td>Myrsine juddii, Achatinella sowerbyana*, Achatinella curta*</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Yes, but cost of access to site makes current techniques cost prohibitive</td>
</tr>
<tr>
<td>Pigs</td>
<td>All</td>
<td>No</td>
<td>Yes</td>
<td>Yes, majority of MU fenced</td>
</tr>
<tr>
<td>Weeds</td>
<td>All</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes. Localized control prioritized around rare taxa, but MU-scale weed control required to meet vegetation cover goals.</td>
</tr>
<tr>
<td>Fire</td>
<td>None</td>
<td>No</td>
<td>No</td>
<td>Yes, but fire unlikely in this MU</td>
</tr>
<tr>
<td>Black Twig Borer (BTB)</td>
<td>Melicope lydgatei</td>
<td>Yes</td>
<td>No</td>
<td>No practical method available. Heavy watering and fertilizing of targeted plants sometimes successful.</td>
</tr>
<tr>
<td>Slugs</td>
<td>Cyrtandra dentata, Phyllostegia hirsuta, Myrsine juddii, Cyanea lanceolata, Stenogyne kaalae subsp. sherffii</td>
<td>Yes</td>
<td>No</td>
<td>Yes, Sluggo is available for local control if area has been surveyed by an experienced malacologist to determine whether rare snails are present</td>
</tr>
<tr>
<td>Ants</td>
<td>Unknown</td>
<td>Yes</td>
<td>No</td>
<td>Some available, depends on species</td>
</tr>
</tbody>
</table>

* Listed in OIP, none currently known in MU

Management History

- Initial management began with the use of snares in the area in 1999. OANRP ran the snare groups until May 2001, but removed them due to the area being accessed by hunters.
- Funding for a portion of the MU fence from DLNR is awarded through the Koolau Mountain Watershed Partnership in 2001, However, construction was delayed until issues with obtaining the 20 year licensing agreement with Kamehameha Schools were resolved.
- Documented weed control occurred in 2002 and 2003 although it was discontinued as OANRP staff observed severe pig damage in freshly weeded areas.
- In 2006 a survey discovers 21 Melicope lydgatei and 7 Gardenia manii on the Paalaa gulch side of Puu Curta. Proposed fence line is altered to include the Melicope and two of the Gardenia.
- Night surveys in July of 2011 did not yield any Achatinella spp. or other rare snail observations.
- In April 2012, tree fall on fence is observed by staff on a routine fence check and ungulate sign is detected within the fence. Snare groups are promptly set. Seven pigs were removed from the unit and in June the unit is declared pig free.
- Ecosystem weed control resumes in April 2012.
- In April 2013, a population of Stenogyne kaalae subsp. sherffii is outplanted in the fence by staff members of the Oahu Plant Extinction Prevention Program.
Ungulate Control

Identified Ungulate Threats: Pigs

Threat Level: High

Primary Objective:
- Maintain fence as ungulate free.

Strategy:
- Maintain fence and monitoring established trails for sign.

Monitoring Objectives:
- Conduct quarterly fence checks.
- Note any pig sign while conducting day to day actions within fenced MU.
- Document pig sign during vegetation monitoring transects.

Management Responses:
- If any pig activity is detected within fence initiate hunting or snaring program.

Fence Completions:
- Fence was completed in December 2011.

Maintenance Issues:
- Tree falls are the biggest maintenance issue for the MU. There are many, very large old trees in the area. Since completion of the fence one has already fallen on the fence and in another area a portion of the ground under the fence sloughed away and created openings under the fence. This damage was corrected by the OANRP fence crew. In periods following heavy rains, a portion of the fence bordering the smaller pond is sometimes under water, and this may promote corrosion. However, the section is short (approximately 10m) and easily replaced since it is built with livestock panels.
Fenceline and Established Trails at Opaeula Lower I
**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 (Weed Control Areas - WCAs)

These designations facilitate different aspects of MIP/OIP requirements.

**Vegetation Monitoring**

**MU Vegetation Monitoring**

As defined by the MIP, the major vegetation cover goals are as follows:

*Primary Management Objective:*
- Assess if the percent cover for both the non-native understory and canopy is 50% or less across the entire management unit (Makua Implementation Team et al. 2003).
- If non-native species cover is not below the 50% threshold, determine if this value is decreasing significantly toward that goal based on repeated monitoring of the MU.

*Secondary Management Objective:*
- Assess if the percent cover for both the native understory and canopy is 50% or more across the entire management unit (Makua Implementation Team et al. 2003).
- If native species cover is not above the 50% threshold, determine if this value is increasing significantly toward that goal based on repeated weed control and monitoring of the MU.

Current vegetation monitoring techniques used by OANRP are designed for MUs larger than Opaeula Lower I. NRS are therefore developing a methodology that will accurately detect changes in vegetation composition for an MU of this size. Methodology is expected to be developed within the next two years.

**Weed Control Monitoring**

The following are weed control related questions/objectives which will be monitored in the MU.

1. Document effect of weed control in areas dominated by *P. cattleianum*.
   - Propose installing photopoints at various locations through the MU and taking them at least annually.
2. When climax stands of *Clidemia hirta* are controlled, what is the vegetation response? NRS are specifically interested in the recovery of native species one year after weeding, the establishment of other weed species, and the re-establishment of *C. hirta*. Also, what is the best interval between weeding events, to minimize effort and weedy recruitment and maximize native recovery?
   - To answer these questions, a new monitoring protocol has been established and is documented in Appendix 1-2: Monitoring Protocol 1.4 – Evaluate Non-Native Vegetation Control Methods – Pilot study to identify the most effective weed control re-treatment interval for *Clidemia hirta* for Opaeula Lower I MU. An overview on the methods is included below.
   - In May 2013, four small ground plots to examine these questions were installed. This informal trial will compare the efficacy of different treatment schedules on *Clidemia*, specifically, how *Clidemia* vegetation cover and native species richness compare between 4 plots with different weeding regimes. The different weeding regimes or treatments are:
 plotting plans:

- Plot 1 - no control
- Plot 2 - weeded at time = 0 months
- Plot 3 - weeded at times = 0 months and 6 months
- Plot 4 - weeded at times = 0 months and 12 months.

- The plots will have photo points taken at six, 12, and 18 months, and vegetation cover data will be taken at 18 months. The results of this study will guide future weeding efforts in the MU and may alter the proposed weeding intervals set forth in this plan.
- In addition to the four plots, 50 small (less than six inches) individual *Clidemia hirta* were located and tagged. These 50 keiki will be monitored quarterly to determine how long individuals take to reach maturity.

**Surveys**

**Army Training:** The army conducts aerial training above Lower Opaeula I, with the possibility of smaller Army helicopters using LZs

**Other Potential Sources of Introduction:** OANRP staff, rats, birds, stream rafting, frogs, and wind.

**Survey Locations:** LZs, campsites

**Management Objective:**

- Prevent the establishment of any new invasive alien plant or animal species through regular surveys at LZs and campsites.

**Monitoring Objectives:**

- Note unusual, significant, or incipient alien taxa during the course of regular field work and quarterly surveys of LZs.

**Management Responses:**

- 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.

Surveys are designed to be the first line of defense in locating and identifying potential new weed species. Currently the only avenues for human introduced incipient species are the landing zone at Puu Curta and the LZ/DZ next to the camp at the pond. Quarterly monitoring of the Puu Curta LZ and pond LZ/DZ will be conducted and the aforementioned protocols will be adhered to in the event of a discovery of a novel species.

**Incipient Taxa Control (ICAs)**

**Management Objective:**

- As feasible, eradicate high priority species identified as incipient invasive aliens in the MU by 2018.
- Conduct soil seed bank trials for all high priority incipients by 2014.

**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 new mature plants are found, the ICA re-visitation interval will be shortened.
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 invasive taxa at Opaeula Lower. Note that this MU was 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 Opaeula Lower I. 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).

Only one incipient, *Rhynchospora caduca*, has been identified by OANRP in the MU. OANRP will continue to control *R. caduca* in order to remove all matures. Return visits will be scheduled in order to prevent immature individuals from reaching maturity. OANRP will continue to monitor and consider control on possible new incipients when appropriate. Although not incipient, the other taxa described in the table below are targeted within the WCAs.

### Summary of 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>Angiopteris evecta</em></td>
<td>Control Locally</td>
<td>Scattered immature individuals along streamlets in the middle of the MU, mostly in OpaeulaLower-03</td>
<td>0</td>
</tr>
<tr>
<td><em>Citharexylum caudatum</em></td>
<td>Control Locally</td>
<td>Scattered throughout the MU. Widespread along the Poamoho road, this taxa has bird-dispersed fruit. It can form dense stands, and has flexible habitat requirements. It is a priority for control whenever found.</td>
<td>0</td>
</tr>
<tr>
<td><em>Clidemia hirta</em></td>
<td>Widespread</td>
<td>Widespread and often forming dense patches throughout the MU.</td>
<td>0</td>
</tr>
<tr>
<td><em>Lantana camara</em></td>
<td>Widespread</td>
<td>One large patch at campsite in OpaeulaLower-04; also scattered throughout the MU.</td>
<td>0</td>
</tr>
<tr>
<td><em>Paspalum conjugatum</em></td>
<td>Widespread</td>
<td>Concentrated around the campsite and ponds in OpaeulaLower-04, but also scattered throughout the MU.</td>
<td>0</td>
</tr>
<tr>
<td><em>Psidium cattleianum</em></td>
<td>Widespread</td>
<td>Widespread and often forming dense patches throughout the MU.</td>
<td>0</td>
</tr>
<tr>
<td><em>Psidium guajava</em></td>
<td>Widespread</td>
<td>Widespread throughout the MU.</td>
<td>0</td>
</tr>
<tr>
<td><em>Rhynchospora caduca</em></td>
<td>Incipient</td>
<td>One population has been found along the southern fenceline in OpaeulaLower-03. It is widespread along the Poamoho road and Mid LZ, making it very likely that this species was introduced via management, and will show up elsewhere in the MU. Soil seed bank trials should be conducted for this taxon.</td>
<td>1</td>
</tr>
<tr>
<td><em>Setaria palmifolia</em></td>
<td>Control Locally</td>
<td>One population treated at campsite in OpaeulaLower-04. It is unclear if this is widespread in nearby drainages, but</td>
<td>0</td>
</tr>
</tbody>
</table>
Within the exclosure, this is the only known site. It is a priority for control.

<table>
<thead>
<tr>
<th>Species</th>
<th>Control Locality</th>
<th>Description</th>
<th>Control Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Sphaeropteris cooperii</em></td>
<td>Control Locally</td>
<td>Scattered individuals in the middle of the MU, especially in OpaeulaLower-03. Lower Opaeula is perfect habitat for <em>S. cooperii</em>, and many immature plants have already been removed from the MU. Few large, mature individuals have been found. Due to its documented invasive capability, it is a priority for control.</td>
<td>0</td>
</tr>
<tr>
<td><em>Urochloa maxima</em></td>
<td>Control Locally</td>
<td>One population treated at campsite in OpaeulaLower-04. While the habitat here is a little wet for this grass, its habitat-altering characteristics make it a control priority.</td>
<td>0</td>
</tr>
<tr>
<td>Unidentified Palm</td>
<td>Unknown</td>
<td>Two large individuals are located within WCA-05. Pictures and frond samples will be taken in order to identify and determine control strategy.</td>
<td>0</td>
</tr>
</tbody>
</table>

### Incipient and Weed Control Areas at Opaeula Lower I

![Incipient and Weed Control Areas at Opaeula Lower I](image)

**Legend**
- Natural Resource LZ
- Existing Fence
- Trail
- ICA
- WCA
- Wetland/Pond
- Management Unit

**Ecosystem Management Weed Control (WCAs)**

**MIP Goals:**
- Within 2m of rare taxa: 0% alien vegetation cover except where 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:
Note, current vegetation cover levels are unknown, as vegetation monitoring methodologies have not yet been implemented to determine this. Staff observations suggest alien canopy and understory cover may be greater than 50%.

- Focus weeding around Gardenia mannii, and Cyrtandra dentata populations to enlarge and improve habitat. Weeding around Melicope lydgatei, a Tier 2 species, is a secondary priority.
- Reach 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:
- Modify weeding efforts if vegetation monitoring indicates weed control efforts are not making progress towards non-native and native vegetation cover goals.

Early weed control at Lower Opaeula was focused on reducing alien vegetation encroachment on the populations of C. dentata, G. mannii, and M. lydgatei, However, unglulates were not excluded from the MU at the time and the weeded areas provided open space for the pigs to till and further degrade the habitat around the rare plant populations. Weeding efforts were postponed until ungulates could be excluded in 2011/2012.

The major weed threats in the MU are P. cattleianum and C. hirta, which have the potential to form dense monotypic stands, and are a dominant presence in other areas of the Koolau Mountains. Weed control in Lower Opaeula will focus on conducting ground sweeps across all portions of the MU, targeting P. cattleianum and other weeds (listed in the Summary Target Taxa table above). 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. WCAs are prioritized by those that have the most accessible terrain, the most rare resources, and the highest levels of native cover.

In general, weed sweeps involve all staff lining up and walking in a phalanx across a WCA, treating every target weed seen. The goal of a sweep is to survey and achieve complete coverage of a WCA. In areas with steep terrain or dense native understory, methods will be modified to use “spotters” with binoculars that will direct other staff to target weeds seen. This will ensure more effective weed sweeps that minimize disturbance to native vegetation.

WCAs: OpaeulaLower-01 (Melicope Finger Fence)

<table>
<thead>
<tr>
<th>Veg Type</th>
<th>Wet Montane</th>
</tr>
</thead>
<tbody>
<tr>
<td>OIP Goal</td>
<td>25% or less alien cover around rare plants. 50% or less alien cover elsewhere.</td>
</tr>
<tr>
<td>Targets</td>
<td>All woody species, particularly P. cattleianum, C. hirta, and C. caudatum.</td>
</tr>
<tr>
<td>Notes</td>
<td>This is the southernmost WCA and encloses a M. lydgatei rare plant population. The majority of this WCA is dominated by D. linearis, with a M. polymorpha and A. koa overstory. Most of the weeds (C. hirta and C. caudatum) are concentrated at the southern end of the WCA near the stream</td>
</tr>
</tbody>
</table>
bottom and low lying areas. Weed sweeps will concentrate on *C. hirita* removal and be focused around rare taxa locations and native forest patches.

**WCA: OpaeulaLower-02 (Puu Curta Slopes)**

**Veg Type:** Wet Montane  
**OIP Goal:** 50% or less alien cover.  
**Targets:** All woody species, particularly *P. cattleianum* and *C. hirta*.  
**Notes:** Rare plants in this WCA include *M. lydgatei*, *E. gaudichaudii*, and *C. dentata*. This WCA encompasses northern slopes of Puu Curta and the vegetation is predominantly native, with a heavy *D. linearis* understory. Weed sweeps will focus on *P. cattleianum* and *C. hirta*, which are concentrated in the lower part of the WCA. This WCA also contains the main landing zone for the MU, as well as a *R. caduca* ICA along the southwest fenceline. In order to minimize damage to *D. linearis*, weed sweeps will utilize spotters with binoculars to direct targeted weed control.

**WCA: OpaeulaLower-03 (West Side)**

**Veg Type:** Wet Montane  
**OIP Goal:** 25% or less alien cover around rare plants. 50% or less alien cover elsewhere.  
**Targets:** *S. cooperi*, *A. evecta*. All woody species, particularly *P. cattleianum*, *C. caudatum*, and *C. hirta*.  
**Notes:** The flatter areas of this WCA contain large stands of nearly monotypic *P. cattleianum* and *C. hirta* which are targeted for removal. Immature *S. cooperi* and *A. evecta* have also been observed in the WCA and will be controlled during weed sweeps. This WCA has an abundance of native species in some areas, including *M. polymorpha*, *A. platyphyllum*, and *C. platyphyllum* in the canopy, and *W. oahuensis*, *P. hathewayi*, and *Cibotium* species in the understory. Rare plants in this WCA include *C. dentata*, *G. marnii*, and a *S. kaalae* subsp. *sherffii* reintroduction. Photopoints to document changes in vegetation after weeding have been set throughout the WCA, especially where large patches of *P. cattleianum* and *C. hirta* are being removed. In addition to removal of *P. cattleianum* stands, weed control will be concentrated around the rare taxa and native forest patches.

**WCA: OpaeulaLower-04 (North-West Corner and Ponds)**

**Veg Type:** Wet Montane  
**OIP Goal:** 50% or less alien cover.  
**Targets:** All woody species, particularly *P. cattleianum*, *P. guajava*, *C. caudatum*, and *C. hirta*. *P. conjugatum*, *U. maxima*, and *L. camara* will be targeted at the camp site and around the ponds.  
**Notes:** This WCA is easy to access and weed sweeps can be conducted over the entire area to target *P. cattleianum* and *C. hirta*. Other weeds including *P. conjugatum*, *S. palmifolia*, *U. maxima*, and *L. camara* will be targeted at the camp site and around the ponds. The western half of the WCA contains high amounts of native vegetation, including *W. oahuensis*, *A. stellata*, *F. arborea*, and *Antidesma* sp. A rare plant population of *G. marnii* is present and the WCA is the site of an extirpated *M. lydgatei* population as well. A photopoint to document changes in vegetation after weeding has been established near the main pond.
WCA: OpaeulaLower-05 (Puu Melicope Slopes)

**Veg Type:** Wet Montane

**OIP Goal:** 25% or less alien cover around rare plants. 50% or less alien cover elsewhere.

**Targets:** All woody species, particularly *P. cattleianum, P. guajava, C. caudatum,* and *C. hirta.*

**Notes:** This WCA contains a high percentage of native vegetation, including *D. linearis, M. polymorpha, A. koa,* and *F. arborea.* There is a *M. lydgatei* rare plant population on the southern fenceline. Weed control will be concentrated around the rare taxa and native forest patches. Spotters with binoculars will be utilized to direct targeted weed control to minimize damage to *D. linearis.* There are two large non-native palms in this WCA that need to be identified and controlled.

**Rodent Control**

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

**Threat level:** High in regards to *Achatinella sowerbyana* (extirpated), *A. curta* (extirpated). Otherwise unknown to listed IP plant taxa (Rodents are a threat to *M. judii,* however given it’s T2/No Management designation, there is no threat abatement planned for *M. judii*).

**Current control method:** None

**Seasonality:** N/A

**Number of control grids:** None

**Acceptable Level of Activity:** Currently there are no known populations of *Achatinella sowerbyana, A. curta,* or any other *Achatinella spp.* in the MU. No control program has been planned as threat level to rare plants (besides *M. judii,* see above) has not been fully assessed. If rats are shown to be preying upon IP plant taxa (ie *Gardenia mannii* fruit), localized control may be conducted to achieve the desired resource response (collection of mature fruit).

**Primary Objective:**
- Determine if rats are impacting IP plant taxa.
- Implement rodent control if program managers indicate rodents are a threat to T1 rare plant populations.

**Monitoring Objective:**
- Monitor rare plant populations to determine impacts by rodents.
- If rodent control is implemented, use trap data and tracking tunnels to guide management decisions.

**Management Objective:**
- Implement rodent control if determined necessary for protection of plant populations. Monitor susceptible species for evidence of rodent impacts.

**Black Twig Borer Control**

**Species:** *Xylosandrus compactus*

**Threat level:** Unknown
Control level: Localized
Seasonality: Peaks elsewhere have been observed from October to January
Number of sites: Melicope lydgatei sites
Acceptable Level of Activity: Unknown

Primary Objectives:
- Reduce BTB populations to a level optimal for Melicope lydgatei survival.

Monitoring Objective:
- Annual or every other year census monitoring of Melicope lydgatei populations to determine BTB damage.

Management Objective:
- There are no effective methods available. Heavy watering and fertilization of targeted plants has been successful at reducing BTB damage in agricultural settings, but is not practical here.

**Ant Control**

Species: Only a low-risk species, Paratrechina vega, ever detected (in 2008)

Threat level: Low

Control level: Only for new incipient species

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

Number of sites: No ants have been observed at Lower Opaeula. Suggested sites to survey in the future are the Landing Zone at Puu Curta and the LZ/DZ adjacent to the Camp site.

Acceptable Level of Activity: Unknown

Primary Objectives:
- Determine what ant species are present and monitor these sites over time.

Monitoring Objective:
- Sample ants at human entry points at the LZ and campsite. Use samples to track changes in existing ant densities and to alert OANRP to any new introductions. Ants are unlikely to be a problem here due to wet conditions.

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 with AMDRO.

**Slug Control**

Species: Slugs (multiple species assumed present but no collections to date)

Threat level: High

Current control method: Localized

Seasonality: Wet season (September-May)
Number of species affected: *Cyrtandra dentata*, *Phyllostegia hirsuta*, *Cyanea lanceolata*, *Stenogyne kaalae* subsp. *sherffii*, possibly *Myrsine juddii*

Acceptable Level of Activity: Currently the breadth of slug impacts is not known at this MU. Within the next three years OANRP will monitor slug populations and impacts on rare plants and determine whether or not slug populations are above a threshold that warrants a control program.

**Primary Objective:**
- Monitor rare plant populations and discern slug impacts
- If deemed necessary, reduce slug population to levels where germination and survivorship of impacted rare plant taxa are unimpeded.

**Monitoring Objective:**
- During annual plant monitoring, record whether slug damage is present (chewed leaf margins, slime trails on vegetation).
- Determine slug species present and estimate baseline densities using traps baited with beer.
- Determine monitoring methods for *C. dentata* and *Stenogyne kaalae* subsp. *sherffii* (in cooperation with OPEP staff for the later).
- If Sluggo is deployed, monitor efficacy via beer traps.
- Annual census monitoring of slug densities during wet season.

**Management Objectives:**
- If slug numbers are deemed 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 at the label rate.

**Fire Control**

**Threat Level:** Low

**Available Tools:** Visual Markers, Helicopter Drops, Wildland Fire Crew.

**Management Objective:**
- To prevent fire from burning any portion of the MU at any time.

**Preventative Actions:** Maintain landing and drop zones.
### Action Table

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<th>Action Type</th>
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| General Monitoring   | Develop monitoring protocols for smaller MU’s in the next two years. From then on, monitor vegetation at determined interval.  
                        | Install photopoints, take 1x year.                                                                 |
|                      | Conduct trial on Clihir to determine optimal interval for weeding climax stands at this MU. Trial includes 4 plots: 1 control, 3 others to be weeded at varying intervals.  
                        | Trial to run for 1-2 years. At 3 months after installation, need to determine whether to weed one plot then, or wait till 6 months. Trial installed May 2013 |
| General Survey       | OS-KLOA-02: Survey Frogpond Campsite (by fence) whenever used, not to exceed once per quarter.  
                        | If not used, do not need to survey.                                                                |
|                      | LZ-KLOA-033: Survey Puu Curta LZ whenever used, not to exceed once per quarter. If not used, do not need to survey. |
|                      | LZ-KLOA-022: Survey Frogpond LZ whenever used, not to exceed once per quarter. If not used, do not need to survey. |
| ICA                  | LowerOpaeula-RhyCad-01: Monitor/control RhyCad at fenceline site quarterly/every 6 months. Dig out plants and remove from field, along with any potentially viable fruit. |
|------------------|--------------------------------------------------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|
| **OpaeulaLower-01** | Sweep entire subunit for canopy weeds and sparse understory weeds, working slowly towards removing all Clihir, once every 3-5 years. Prioritize sweeps around rare taxa locations and native forest patches. | 4                             | 2                             | 3                             | 4                             | 1                             | 2                             | 3                             | 4                             | 1                             | 2                             | 3                             |
| **OpaeulaLower-02** | Control weeds along fencelines and trails, as needed.                  |                               |                               |                               |                               |                               |                               |                               |                               |                               |                               |                               |
|                  | Conduct control in weedy gulch to east of Blue Curta Saddle trail. Target understory control, and gradual removal of canopy. |                               |                               |                               |                               |                               |                               |                               |                               |                               |                               |                               |
|                  | Sweep entire WCA for canopy weeds and sparse understory weeds, once every 5 years. Use spotters with binoculars to guide control and minimize damage to uluhe. |                               |                               |                               |                               |                               |                               |                               |                               |                               |                               |                               |
| **OpaeulaLower-03** | Control weeds around reintroductions in cooperation with OPEP (SteKaaShe) every 6 months. Target all weedy taxa; always control SphCoo, AngEve, CitCau if seen. |                               |                               |                               |                               |                               |                               |                               |                               |                               |                               |                               |
| **OpaeulaLower-04** | Control grasses (mostly PasCon) in forested areas, every 6 months or as needed. |                               |                               |                               |                               |                               |                               |                               |                               |                               |                               |                               |
|                  | Sweep WCA once a year, targeting AngEve, SphCoo, CitCau in particular, and focusing on controlling Clihir and sparse canopy weeds in native forest patches and around rare taxa. |                               |                               |                               |                               |                               |                               |                               |                               |                               |                               |                               |
| **OpaeulaLower-04** | Control weeds along fencelines and trails, as needed.                  |                               |                               |                               |                               |                               |                               |                               |                               |                               |                               |                               |
|-----------------|--------------------------------------------------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| **OpaeulaLower-05** | Control grasses (mostly PasCon) in forested areas, every 6 months or as needed. Ignore areas directly around Frog Pond and Little Pond | 4 1 2 3                        | 4 1 2 3                        | 4 1 2 3                        | 4 1 2 3                        | 4 1 2 3                        |
|                 | Control SetPal and UroMax around Frog Pond and camp quarterly.           |                                 |                                 |                                 |                                 |                                 |
|                 | Sweep WCA once a year, targeting AngEve, SphCoo, CitCau in particular, and focusing on controlling Clihir and sparse canopy weeds in native forest patches and around rare taxa. |                                 |                                 |                                 |                                 |                                 |
|                 | Control weeds along fencelines and trails, as needed.                    |                                 |                                 |                                 |                                 |                                 |
|                 | Conduct control in weedy gulch to east of Blue Curta Saddle trail. Target understory control, and gradual removal of canopy. |                                 |                                 |                                 |                                 |                                 |
|                 | Sweep entire WCA for canopy weeds and sparse understory weeds, once every 3-5 years. Use spotters with binoculars to guide control and minimize damage to uluhe. |                                 |                                 |                                 |                                 |                                 |
| Ungulate Control | Monitor fence integrity quarterly                                       |                                 |                                 |                                 |                                 |                                 |
| Rodent Control  | Monitor rare plant taxa for signs of rodent damage                       |                                 |                                 |                                 |                                 |                                 |
|                 | Implement localized rodent control if determined to be necessary for the protection of rare plants |                                 |                                 |                                 |                                 |                                 |
| Ant Control     | Conduct surveys for ants at 2 human entry points once a year (Puu Curta LZ, Frog Pond Camp) |                                 |                                 |                                 |                                 |                                 |
| Slug Control    | Monitor rare plants for signs of slug damage                             |                                 |                                 |                                 |                                 |                                 |
### Action Type

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<tbody>
<tr>
<td>Deploy slug bait around susceptible plant population(s) at TBD interval</td>
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Hatching=Quarter Scheduled