Ecosystem Restoration Management Plan
OIP Year 8-12, Oct. 2014 – Sept. 2019
MUs: Opaeula Lower I

Overall MIP Management 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: Northern Koolau mountain range
Land Owner: Kamehameha Schools, US Army lease and license agreement
Land Managers: Oahu Army Natural Resource Management Program (OANRP)
Acreage: 15.9 acres
Elevation Range: 1920 ft - 2260 ft
Description: Lower Opaeula 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 Opaeula Stream to the north and Helemano Stream to the south. The MU mainly consists of a bowl which surrounds two ponds, the ridge immediately to the south of the bowl, running between Puu Curta and Puu Melicope, and a narrow finger extending south of the ridge into the Helemano drainage. This finger fence was added to protect rare resources. Although the historic Peahinaia trail runs to Lower Opaeula, it is overgrown, and OANRP access is via helicopter at the highest point in the MU, Puu Curta. The plant community is classified as a montane wet forest, and 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. While some early management took place between 2000 and 2003, efforts were halted until the fence was constructed in 2011.

Native Vegetation Types at Opaeula Lower I

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

NOTE: For MU monitoring purposes vegetation type is mapped based on theoretical pre-disturbance vegetation. Alien species are not noted.
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
Right: Gardenia mannii on Puu Melicope
View of north facing slope from Puu Curta facing west, showcasing taller stature *A. koa*

### MIP/OIP Rare Resources at Opaeula Lower I

<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><em>Cyrtandra dentata</em></td>
<td>OPA-F</td>
<td>Opauela</td>
<td>MFS</td>
<td>Wild</td>
</tr>
<tr>
<td>Plant</td>
<td><em>Gardenia mannii</em></td>
<td>OPA-B, OPA-T, PAA-K</td>
<td>Lower Peahinaa</td>
<td>MFS/T1</td>
<td>Wild</td>
</tr>
<tr>
<td>Plant</td>
<td><em>Melicope lydgatei</em></td>
<td>OPA-D*, E*, F, M, PAA-L</td>
<td>Kawaiiki and Opauela</td>
<td><strong>T1</strong></td>
<td>Wild</td>
</tr>
<tr>
<td>Plant</td>
<td><em>Myrsine juddii</em></td>
<td>PAA-H</td>
<td>Kaukonahua to Kamananui-Koloa</td>
<td>T2</td>
<td>Wild</td>
</tr>
<tr>
<td>Plant</td>
<td><em>Phyllostegia hirsuta</em></td>
<td>OPA-G*</td>
<td>Helemano and Opauela</td>
<td>GSC/T1</td>
<td>extirpated</td>
</tr>
<tr>
<td>Animal</td>
<td><em>Achatinella sowerbyana</em></td>
<td>OPA-N*</td>
<td>Opauela</td>
<td>T2</td>
<td>extirpated</td>
</tr>
<tr>
<td>Insect</td>
<td><em>Drosophila substenoptera</em></td>
<td>OPA-A</td>
<td>Opauela</td>
<td></td>
<td>Wild</td>
</tr>
</tbody>
</table>

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

**T1** due to the lack of fire threat for OIP species that occur outside of KTA or SBW, *Melicope lydgatei* will no longer be managed as a MFS/T1

### Other Rare Taxa at Opaeula Lower I

<table>
<thead>
<tr>
<th>Organism Type</th>
<th>Species</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant</td>
<td><em>Cyanea lancelota</em></td>
<td>endangered</td>
</tr>
<tr>
<td>Plant</td>
<td><em>Exocarpos gaudichaudii</em></td>
<td>none</td>
</tr>
<tr>
<td>Plant</td>
<td><em>Joinvillea ascendens</em> subsp. ascendens</td>
<td>candidate</td>
</tr>
<tr>
<td>Plant</td>
<td><em>Stenogyne kaalae</em> subsp. sherfii</td>
<td>Endangered, outplanted in 2013 with OPEP</td>
</tr>
<tr>
<td>Insect</td>
<td><em>Drosophila craddockae</em></td>
<td>none</td>
</tr>
<tr>
<td>Insect</td>
<td><em>Drosophila oahuensis</em></td>
<td>none</td>
</tr>
</tbody>
</table>
Locations of rare resources at Opaeula Lower I

Map removed to protect rare resources, available upon request

Rare Resources at Opaeula Lower I

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>All</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Yes</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>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Fire</td>
<td>N/A</td>
<td>No</td>
<td>No</td>
<td>Yes, but fire unlikely in this MU</td>
</tr>
<tr>
<td>Slugs</td>
<td>Cyrtandra dentata,</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, possibly Drosophila substenoptera</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Some available, depends on species</td>
</tr>
<tr>
<td>Crane flies</td>
<td>Drosophila substenoptera</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unknown, not likely</td>
</tr>
<tr>
<td>Yellowjackets</td>
<td>Drosophila substenoptera</td>
<td>No</td>
<td>Yes</td>
<td>Yes, but probably impractical at site</td>
</tr>
</tbody>
</table>

### 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 was awarded to the Koolau Mountain Watershed Partnership in 2001
- Weed control efforts occurred from 2002 and 2003, however they were discontinued as OANRP staff observed severe pig damage in freshly weeded areas.
- In November 2010 A 20 year license agreement was obtained from Kamehameha Schools to conduct Natural resource management on KS lands leased by the US Army.
- Initial line clearing for fence construction occurred in June 2011. Fence construction completed in December 2011. Ungulate control was resumed and the unit declared ungulate free in early 2012.
- In April 2012, tree fall on fence was observed by staff on a routine fence check and ungulate sign was detected within the fence. Snare groups were promptly set. Seven pigs were removed from the unit and in June the unit was declared ungulate free once more.
- Ecosystem weed control resumes in April 2012.
- In April 2013, a population of Stenogyne kaalae subsp. sherffi was outplanted in the fence with staff members of the Oahu division of the Plant Extinction Prevention Program of Hawaii.
- In May 2013. OANRP staff installed plots to conduct a study of different weed control regimes on Clidemia hirta to determine best control strategy.
- In December 2013, a single D. substenoptera was observed at Lower Opaeula MU, the first record of the species in the Koolau range since 1972
**Ungulate Control**

*Identified Ungulate Threats:* Pigs  
*Threat Level:* High  

**Primary Objective:**
- Maintain fence as ungulate free.

**Monitoring Strategy:**
- Conduct quarterly fence checks.  
- Note any pig sign while conducting day to day actions within fenced MU.  
- Document any pig sign during other management activities.

**Management Strategy:**
- Initiate snaring program if any pig activity is detected within fence.

**Fence Completion:**
- 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 tree has already fallen on the fence. In another area a portion of the ground under the fence sloughed away creating an opening. During 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 would easily be replaced since it is built with panels.

---

**Fence and 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 below the 50% threshold, determine if this value is increased significantly toward that goal based on repeated 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 objectives/questions which will be monitored in the MU.

1. Document effect of weed control in areas dominated by *P. cattleianum*.
   - Install photopoints at various locations through the MU and take photos annually.
2. When climax stands of *Clidemia hirta* are controlled, what is the vegetation response? NRS are interested in the following responses: the recovery of native species eighteen months after weeding, the establishment of other weed species, and the re-establishment of *C. hirta*. NRS want to discover the best interval between weeding events to minimize effort and weedy recruitment and maximize native recovery.
   - To answer these questions, a new monitoring protocol was established and is documented in Appendix 1-2 of the 2013 Year End Report: 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 MU. An overview on the methods is included below.
   - In May 2013, four small ground plots 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:
     - 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 upon installation, six, 12, and 18 months, and vegetation cover data will be taken 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. At the 12 month reading, none of the tagged keiki had matured, the 18 month interval monitoring is due to be conducted after this year's reporting deadline.

**Surveys**

**Army Training:** The army conducts aerial training above Lower Opaeula I.

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

**Survey Locations:** LZ, Camp Site

**Management Objective:**
- Prevent the establishment of any new invasive alien plant or animal species through regular surveys at LZ.

**Monitoring Strategy:**
- Note unusual, significant, or incipient alien taxa during the course of regular field work and quarterly surveys of LZ.

**Management Strategy:**
- Novel alien taxa found will be researched and evaluated for distribution and life history. If taxa are found which 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 drop zone at the campsite. Quarterly monitoring of the Puu Curta LZ and the campsite 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, implement regular control of high priority species identified as incipient invasive aliens in the MU with the goal of eradication within 10 years.
- Conduct seed dormancy trials for all high priority incipients by 2016.

**Management Strategies:**
- Visit ICAs at stated re-visitation intervals. Control all mature plants at ICAs and prevent any immature or seedling plants from reaching maturity.
- If unsuccessful in preventing immature plants from maturing, increase ICA re-visitation interval.

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 described in the original MIP, and therefore is not included in Appendix 3.1 of the MIP, which lists significant alien species and ranks their potential invasiveness and distribution. This table supplements Appendix 3.1 by identifying target species for Opaeula Lower. 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 monitor and consider control on possible incipients when appropriate. While not classified as incipient for this MU, the other taxa described in the table below are targeted during regular weed control.
sweeps. OANRP will continue to control *R. caduca* in order to remove all matures within WCAs. Return visits will be scheduled in order to prevent immature individuals from reaching maturity.

### 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</td>
<td>Scattered immature individuals along streamlets in the middle of the MU, mostly in OpauelaLower-03</td>
<td>0</td>
</tr>
<tr>
<td><em>Citharexylum caudatum</em></td>
<td>Widespread</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 OpauelaLower-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 OpauelaLower-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. The flat bowls in the center of the MU contain some particularly dense stands of <em>P. cattleianum</em>. Control must be conducted carefully, to ensure that cleared areas aren’t taken over by grass, but are managed for native taxa regeneration.</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 OpauelaLower-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.</td>
<td>1</td>
</tr>
<tr>
<td><em>Setaria palmifolia</em></td>
<td>Control</td>
<td>One population treated at campsite in OpauelaLower-04. It is unclear if this is widespread in nearby drainages, but within the exclosure, this is the only known site. It is a priority for control.</td>
<td>0</td>
</tr>
<tr>
<td><em>Sphaeropteris cooperii</em></td>
<td>Control</td>
<td>Scattered individuals in the middle of the MU, especially in OpauelaLower-03. Lower Opauela 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</td>
<td>One population treated at campsite in OpauelaLower-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>Unknown Palm</td>
<td>Control</td>
<td>At least two palm trees are known from the eastern slopes of the MU. They are non-native, but have yet to be identified. If possible, they should be identified, and removed.</td>
<td>0</td>
</tr>
</tbody>
</table>

**Weed Control Areas (WCAs) & Incipient Control Areas (ICAs) at Opauela Lower I**
Incipient and Weed Control Areas

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:
- Focus weeding around Gardenia manii, Cyrtandra dentata, and Drosophila substenoptera populations to enlarge and improve habitat.
- 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 Strategy:
- Modify weeding efforts if population monitoring indicates weed control efforts are not contributing to stable population growth of IP taxa.

Early OANRP weed control efforts at Lower Opaeula were focused on reducing alien vegetation encroachment around C. dentata, G. manii, and M. lydgatei rare plant populations. These efforts were not effective at removing woody weeds, as ungulates were not excluded from the MU at the time and the weeded areas provided open space for the pigs to till.

The major weed threats in the MU are P. cattleianum and C. hirta. Both of these species 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 staff resources. The WCAs that are most accessible, have the gentlest terrain, the most rare resources, and the fewest weeds will be prioritized for control.

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 more weed-dense areas, control involves working in a smaller designated area, removing all weeds, and in the case of dense C. hirta stands, stacking the slash into piles in or out of the fence. In areas with steep terrain or dense native understories, 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: Opaeula-Lower-01 (Melicope Finger Fence)

<table>
<thead>
<tr>
<th>Veg Type</th>
<th>Wet Montane</th>
</tr>
</thead>
<tbody>
<tr>
<td>OIP Goal</td>
<td>50% or less alien cover.</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 Dicranopteris linearis, with a Metrosideros polymorpha and Acacia koa overstory. Most of the weeds (C. hirta and C. caudatum) are concentrated at the southern end of the WCA near the stream bottom and low lying areas. Weed sweeps will concentrate on C. hirta removal around rare taxa locations and native forest patches. Eventually, efforts may be expanded across the WCA as time allows.</td>
</tr>
</tbody>
</table>
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 taxa in this WCA include *M. lydgatei* and *E. gaudichaudii*. This WCA encompasses northern slopes of Puu Curta and the vegetation is predominantly native, with a thick *D. linearis* understory. Weed sweeps will focus on *P. cattleianum* and *C. hirta*, which are concentrated in a bowl around the Blue Curta Trail 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. Weed sweeps will utilize spotters with binoculars to direct targeted weed control to minimize damage to *D. linearis*.

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. hatheayui*, and *Cibotium* species in the understory. Rare plants in this WCA include *C. dentata*, *G. mannii*, and a *S. kaalae 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. Common native tree and understory outplanting may occur in these cleared areas depending on whether or not native recruitment occurs.

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. spinosum*, 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 focus on *P. cattleianum* and *C. hirta*. Other weeds including *P. conjugatum*, *S. palmifolia*, *U. maxima*, and *L. camara* will be targeted at the camp site. The open areas directly adjacent to the pond that are subject to a cycle of ebb and flood will not be prioritized as they are easily invaded by grasses, however grass control will be a priority at the forested edges of the pond. The western half of the WCA contains high amounts of native vegetation, including *W. oahuensis*, *A. stellata*, *F. arborea*, and *Antidesma* sp, and a *G. mannii* rare plant population. 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 and populations of *G. mannii* and *Drosophila substenoptera* at the far East corner of the WCA.. Weed control will be concentrated around the rare taxa and native forest patches. This WCA may be extended eastward beyond the fence in order to improve habitat for *D. substenoptera* as the management actions for the species are still being determined. Spotters with binoculars will be utilized to direct
targeted weed control to minimize damage to *D. linearis* on slopes. 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:** Threaten *G. manii*, and *C. dentata*, threat level unknown to other rare plant taxa. High threat in regards to *Achatinella sowerbyana* (extirpated).

**Current control method:** Many available, No active control method currently employed.

**Seasonality:** A population spike occurs in the fall within other MUs were rat populations are tracked. It is not known if this population spike occurs in Opaeula Lower I.

**Number of control grids:** None

**Acceptable Level of Activity:** Currently there are no known populations of *Achatinella sowerbyana* or any other *Achatinella* spp. in the MU. Rats have predated airlayers on *G. manii* and *C. dentata*, but this predation can be avoided with the use of cages around the air layers. No control program has been planned as the threat level to rare plants has not been fully assessed. If rats are shown to be preying upon IP plant taxa besides airlayers (ie *G. manii* fruit or outplantings), localized control will be conducted to achieve the desired resource response.

**Monitoring Objective:**

- Monitor IP taxa to determine impacts by rodents.

**Monitoring Strategies:**

- Use direct observation and game cameras to determine rodent impacts.
- Use tracking tunnel data, trap data, and rare plant monitoring to guide further rodent control.

**Management Objective:**

- Reduce rodent impacts on rare taxa (as determined by monitoring).

**Management Strategy:**

- Implement rodent control around rare plant populations during two periods: when out planting occurs and when outplants mature and are producing fruit.

**Ant Control**

**Species:** No collections to date, however *Solenopsis papuana* has been observed.

**Threat level:** Low, may be higher for *D. substenoptera*.

**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 surveys for ants have been conducted at Opaeula Lower I. However, *Solenopsis papuana* has been observed on sponges used in surveying for *Drosophila*. Suggested sites to survey in the future are the Landing Zone and the campsite.

**Acceptable Level of Activity:** Unknown

**Primary Objectives:**

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

**Monitoring Strategy:**

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

**Management Strategy:**

- 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. If *S. papuana* is found to be impacting *Drosophila*, control methods will be determined and implemented.

**Yellowjacket Control**
**Threat:** *Vespula pensylvanica* (western yellowjacket)

**Threat level:** Unknown, perhaps High for *D.substenoptera*.

**Control level:** MU level.

**Seasonality:** Year-Round, abundance peaking in August–October.

**Number of sites:** None yet, proposed bait network of about 30 heptyl butyrate traps.

**Acceptable Level of *V. pensylvanica* Activity:** Unknown

**Primary Objective:**
- Determine the population and threat level *V. pensylvanica* poses in the MU.

**Secondary Objectives:**
- Map spatial distribution and seasonal abundance changes of *V. pensylvanica* in the MU.
- Determine if *V. pensylvanica* is having an impact on *Drosophila* spp. in the MU.

**Management Strategies:**
- By end of 2015, conduct a distribution and abundance survey for *V. pensylvanica* in areas of the MU where *Drosophila* are known to be or potentially present.
- If needed, develop a control technique and strategy for *V. pensylvanica*.

**Monitoring Objectives:**
- Monitor for unusually high summer/fall outbreaks and apply control if necessary.

The arrival of *Vespula pensylvanica*, a generalist predator on other invertebrates and scavenger, was followed shortly by major declines of many of the large sized endemic picture-wing *Drosophila* species. They are also known to have serious impacts on native *Hylaeus* bees, both through direct predation and by excluding bees from flowers. The endangered *Drosophila* species found at Lower Opaeula, *D. substenoptera*, may be particularly vulnerable to predation because they often stand conspicuously with their wings held to the side even when not actively displaying. In relatively dense forests such as Opaeula, *V. pensylvanica* may occur in high abundance but still be inconspicuous by keeping primarily to the canopy. Wasps are strongly attracted to the non-toxic chemical lure heptyl butyrate, which can be used to quantitatively monitor populations over time. If they turn out to be highly abundant at the MU, particularly in the late summer and fall when populations typically undergo booms, then control may be warranted. Work at Hawaii Volcanoes National Park has demonstrated successful control using poisoned meat baits.

**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 MFS species affected:** *Cyrtandra dentata*.

**Acceptable Level of Activity:** No control program planned currently and threshold not determined for threats.

**Primary Objective:**
- Reduce slug population to levels where germination and survivorship of rare plant taxa are impeded.

**Monitoring Objective:**
- Determine presence and species composition of slugs
- Determine monitoring methods for *C. dentata*

**Monitoring Strategies:**
• 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.
• Annual census monitoring of slug densities during wet season.
• If Sluggo is deployed, monitor efficacy via beer traps.
Management Strategy:
  • 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 at the label rate.

Fire Control
Threat Level: Low
Management Objective:
  • To prevent fire from burning any portion of the MU at any time.
Preventative Actions: None needed

Old military helmet found in a draw not far from the Peahinaia trail
### Action Table

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General Monitoring</strong></td>
<td>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</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>General Survey</strong></td>
<td>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.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ICA</strong></td>
<td>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.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>OpaeulaLower-01</strong></td>
<td>Sweep entire subunit for canopy weeds and sparse understory weeds, working slowly towards removing all Clihir, once every 3-5 years. Prioritize rare taxa locations and native forest patches.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>--------------------------------------------------------------------------</td>
<td>--------------------------------</td>
<td>--------------------------------</td>
<td>--------------------------------</td>
<td>--------------------------------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td><strong>OpaeulaLower-02</strong></td>
<td>Control weeds along fencelines and trails, as needed.</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Conduct control in weedy gulch to east of Blue Curta Saddle trail. Target understory control, and gradual removal of canopy.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>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.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>OpaeulaLower-03</strong></td>
<td>Control weeds around reintroductions (SteKaaShe) every 6 months. Target all weedy taxa; always control SphCoo, AngEve, CitCau if seen.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Control grasses (mostly PasCon) in forested areas, every 6 months or as needed.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>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.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>OpaeulaLower-04</strong></td>
<td>Control weeds along fencelines and trails, as needed.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Control grasses (mostly PasCon) in forested areas, every 6 months or as needed. Ignore areas directly around Frog Pond and Little Pond</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Control SetPal and UroMax around Frog Pond and camp quarterly.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------</td>
<td>---------------------------------------------------------------------------------------------------</td>
<td>---------------------------------</td>
<td>---------------------------------</td>
<td>---------------------------------</td>
<td>---------------------------------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>OpauelaLower-05</td>
<td>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.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Control weeds along fencelines and trails, as needed.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Conduct control in weedy gulch to east of Blue Curta Saddle trail. Target understory control, and gradual removal of canopy.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>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.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ungulate Control</td>
<td>Monitor fence integrity quarterly</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rodent Control</td>
<td>Monitor rare plant taxa for signs of rodent damage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Implement localized rodent control if determined to be necessary for the protection of rare plants</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ant Control</td>
<td>Conduct surveys for ants at 2 human entry points (Puu Curta LZ, campsite)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellowjacket Control</td>
<td>Survey yellowjacket population levels (continue if determined to be a threat)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slug Control</td>
<td>Monitor rare plants for signs of slug damage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Deploy slug bait around susceptible plant population(s) at TBD interval</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Hatching = Quarter Scheduled