Ecosystem Restoration Management Plan
MU: Palikea Subunit 1 and Palikea NoMU

Overall MIP Management Goals:
- Form a stable, native-dominated matrix of plant communities which support stable populations of IP taxa.
- Control ungulate, rodent, arthropod, slug, snail, fire, and weed threats to support stable populations of IP taxa.

Background Information
Location: Southern Waianae Mountains
Land Owner: State of Hawaii
Land Manager: State of Hawaii/OANRP
Acreage: 24.9 acres
Elevation Range: 1900ft. -3100 ft.
Description: Palikea MU is located at the southern end of the former Honouliuli Preserve. It is now a State of Hawaii Forest Reserve. The managed area includes the summit ridge and windward slopes of the southern parts of Palawai gulch. The western edge of the MU ends abruptly in cliffs which sweep down into Halona and Nanakuli on the leeward side of the mountains. The eastern edge is partially ringed by a series of cliffs. The crestline is the most native of the MU, while the southern corner is predominantly non-native overstory and understory. The MU includes several small ridges, one long major ridge, steep gulches, one large and shallow gulch, and one flat bowls. The MU is named after the Puu Palikea, the tallest peak in the area, located on the eastern edge of the exclosure. Access to Palikea is via Makakilo and Palehua to the south, and is facilitated by an agreement with the Gill and Olsen groups. Staff drive up the gated Palehua road, park at Mauna Kapu, and hike into Palikea along the summit crest trail.

This plan is the first major revision to the original Palikea ERMUP. Please reference the original plan for additional information: available at http://manoa.hawaii.edu/hpicesu/dpw_ermp.htm and also located on the OANRP internal server (V/Ecosystem Restoration MU Plan/Palikea/2009).

<table>
<thead>
<tr>
<th>Native Vegetation Types</th>
<th>Waianae Vegetation Types</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mesic mixed forest</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Canopy includes:</strong></td>
<td>Acacia koa, Metrosideros polymorpha, Nestegis sandwicensis, Diospyros spp., Pouteria sandwicensis, Charpentiera spp., Pisonia spp., Psychotria spp., Antidesma platyphyllum, Bobea spp. and Santalum freycinetianum.</td>
</tr>
<tr>
<td><strong>Understory includes:</strong></td>
<td>Alyxia oliviformis, Bidens torta, Coprosma spp., and Microlepia strigosa</td>
</tr>
<tr>
<td><strong>Mesic-Wet forest</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Canopy includes:</strong></td>
<td>Metrosideros polymorpha . Typical to see Cheirodendron trigynum, Cibotium spp., Melicope spp., Antidesma platyphyllum, and Ilex anomala.</td>
</tr>
<tr>
<td><strong>Understory includes:</strong></td>
<td>Cibotium chamissoni, Broussasia arguta, Dianella sandwicensis, Dubautia spp. Less common subcanopy components of this zone include Clermontia and Cyania spp.</td>
</tr>
</tbody>
</table>

NOTE: For MU monitoring purposes vegetation type is mapped based on theoretical pre-disturbance vegetation. Alien species are not noted.

NOTE: For MU monitoring purposes, vegetation types were subdivided using topography (gulch, mid-slope, ridge). Topography influences vegetation composition to a degree. Combining vegetation type and topography is useful for guiding management in certain instances.
**Primary Vegetation Types at Palikea**

Mesic-Wet Summit Crest

Mesic Gulch
Uluhe dominated flats – not a separate vegetation type, but an anomalous feature in Palikea

Views of Palikea

View to the north, from a gulch towards the summit ridge.
View to the south, from northern fenceline.

**MIP/OIP Rare Resources:**

<table>
<thead>
<tr>
<th>Organism Type</th>
<th>Species</th>
<th>Pop. Ref. Code</th>
<th>Population Unit</th>
<th>Management Designation</th>
<th>Wild/Reintroduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant</td>
<td><em>Cyanea grimesiana</em> subsp. <em>obatae</em></td>
<td>PAK-A, B</td>
<td>Palikea</td>
<td>MFS</td>
<td>Wild and Reintroduction</td>
</tr>
<tr>
<td>Plant</td>
<td><em>Cyanea superba</em> subsp. <em>superba</em></td>
<td>N/A</td>
<td>N/A</td>
<td>None</td>
<td>Reintroduction</td>
</tr>
<tr>
<td>Plant</td>
<td><em>Phyllostegia hirsuta</em></td>
<td>PAK-A</td>
<td>Palikea</td>
<td>MFS</td>
<td>Reintroduction</td>
</tr>
<tr>
<td>Snail</td>
<td><em>Achatinella mustelina</em></td>
<td>PAK-A, B, C, D, E, F, G, H, I, J, K, L, M, N, P</td>
<td>ESU-F</td>
<td>MFS</td>
<td>N/A</td>
</tr>
<tr>
<td>Bird</td>
<td><em>Chasiempis ibidis</em></td>
<td>N/A</td>
<td>N/A</td>
<td>None</td>
<td>N/A</td>
</tr>
<tr>
<td>Fly</td>
<td><em>Drosophila montgomeryi</em></td>
<td>PAK-A</td>
<td>Palikea</td>
<td>MFS</td>
<td>Wild</td>
</tr>
<tr>
<td>Fly</td>
<td><em>Drosophila substenoptera</em></td>
<td>PAK-A</td>
<td>Palikea</td>
<td>MFS</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 Palikea MU:

<table>
<thead>
<tr>
<th>Organism Type</th>
<th>Species</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant</td>
<td>Cyanea calycina</td>
<td>Endangered</td>
</tr>
<tr>
<td>Plant</td>
<td>Exocarpos gaudichaudii</td>
<td>Species of Concern</td>
</tr>
<tr>
<td>Plant</td>
<td>Lobelia yuccoides</td>
<td>Species of Concern</td>
</tr>
<tr>
<td>Plant</td>
<td>Nothocestrum longifolium</td>
<td>Species of Concern</td>
</tr>
<tr>
<td>Plant</td>
<td>Phyllostegia parviflora var. lydgatei (reintroduction)</td>
<td>Endangered</td>
</tr>
<tr>
<td>Plant</td>
<td>Platycosma cornuta var. decurrens</td>
<td>Endangered</td>
</tr>
<tr>
<td>Plant</td>
<td>Pritchardia sp. A (reintroduction)</td>
<td>Species of Concern</td>
</tr>
<tr>
<td>Plant</td>
<td>Silene perlmansii (reintroduction)</td>
<td>Endangered</td>
</tr>
<tr>
<td>Plant</td>
<td>Schiedea hookeri (reintroduction)</td>
<td>Endangered</td>
</tr>
<tr>
<td>Plant</td>
<td>Solanum sandwicense (reintroduction)</td>
<td>Endangered</td>
</tr>
<tr>
<td>Plant</td>
<td>Urena kaalae (reintroduction)</td>
<td>Endangered</td>
</tr>
<tr>
<td>Snail</td>
<td>Achatinella concavospira</td>
<td>Endangered</td>
</tr>
<tr>
<td>Snail</td>
<td>Auriculella ambusta</td>
<td>Species of Concern</td>
</tr>
<tr>
<td>Snail</td>
<td>Laminella sanguinea</td>
<td>Species of Concern</td>
</tr>
<tr>
<td>Fly</td>
<td>Drosophila aglaia</td>
<td>Endangered</td>
</tr>
<tr>
<td>Fly</td>
<td>Drosophila craddockae</td>
<td>Species of Concern</td>
</tr>
<tr>
<td>Fly</td>
<td>Drosophila hemipeza</td>
<td>Endangered</td>
</tr>
<tr>
<td>Fly</td>
<td>Drosophila tarphytrichia</td>
<td>Endangered</td>
</tr>
<tr>
<td>Bird</td>
<td>Asio flammeus sandwichensis</td>
<td>State Endangered</td>
</tr>
<tr>
<td>Bird</td>
<td>Vestriaria coccinea</td>
<td>State Endangered</td>
</tr>
</tbody>
</table>

Rare Resources at Palikea

![Drosophila hemipeza](image1)

![Chasiempis ibidis](image2)
Cyanea grimesiana obatae

Bagging C. grimesiana obatae for fruit collection

Laminella sanguinea

Lobelia yuccoides
### Locations of Rare Resources at Palikea

Map removed to protect rare resources, available upon request

### 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 Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pigs</td>
<td>All</td>
<td>No</td>
<td>Yes</td>
<td>MU fenced</td>
</tr>
<tr>
<td>Rats</td>
<td>All</td>
<td>Unknown</td>
<td>Yes</td>
<td>MU-wide trap out grid installed in 2010</td>
</tr>
<tr>
<td>Predatory snails</td>
<td><em>Achatinella mustelina</em></td>
<td>Unknown</td>
<td>Unknown</td>
<td>Limited to hand-removal and physical barriers</td>
</tr>
<tr>
<td>Slugs</td>
<td><em>Cyanea grimesiana</em> subsp. <em>obatae</em></td>
<td>Yes</td>
<td>No</td>
<td>Sluggo application once per month</td>
</tr>
<tr>
<td>Ants</td>
<td>Potential threat to <em>Drosophila</em> spp.</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Control possible, but non-target impacts to native insects need to be determined</td>
</tr>
<tr>
<td><em>Vespula pensylvanica</em></td>
<td>Potential threat to <em>Drosophila</em> spp.</td>
<td>No</td>
<td>Yes</td>
<td>Experimental toxicants available</td>
</tr>
<tr>
<td>Jackson’s Chameleon</td>
<td><em>Achatinella mustelina, Drosophila</em> spp.</td>
<td>Unknown</td>
<td>No</td>
<td>Hand capture</td>
</tr>
<tr>
<td>Weeds</td>
<td>All</td>
<td>Yes</td>
<td>Yes</td>
<td>See WCA section</td>
</tr>
<tr>
<td>Fire</td>
<td>All</td>
<td>No</td>
<td>Yes</td>
<td>See Fire section</td>
</tr>
</tbody>
</table>

### Management History
The Nature Conservancy of Hawaii (TNC) pioneered management at the Palikea MU during its tenure as steward of the Honouliuli Preserve. Naturally, TNC did not focus only on MIP taxa (as does OANRP), but rather managed all taxa found within Honouliuli. Thus, several plant populations listed in the two Rare Resources tables above include reintroductions which do not fall under the auspices of the MIP; these reintroductions are of *C. superba*, *U. kaalae*, *S. sandwicense*, and *P. parviflora*. TNC also conducted more wide scale elepaio management in Palikea than OANRP currently does.

- 1997: Rare *Drosophila* species found (*D. aglaia*, *D. hemipeza*, *D. montgomeryi*, and *D. tarphytrichia*).
- 1999: Small fence constructed around wild *C. grimesiana* population, PAK-A with assistance from OANRP staff.
- 2003-04: First TNC reintroductions of *C. grimesiana* planted into the small TNC fence.
- 2004: OANRP begins consistent rodent control efforts at Palikea to protect *A. mustelina*. Rat control areas expand over time as more snail populations are found.
- 2008: 25 acre MU fence completed. The MU fence was closed in December 2007, but strategic sections at the summit portion of the fence were found to be insecure and additional fencing was completed in August 2008. Fence skirting in vulnerable (loose) soil was completed in September 2008. NRS was able to eradicate pigs from the fence prior to the completion of fence improvements; all ungulates were removed by May 2008.
- 2000-2006: TNC Snaring outside fence reduces pig population to unknown level.
- 2007: TNC ends most field work in Honouliuli. Some baiting continues at Palikea.
- 2009: OANRP Snaring program re-initiated outside the fence to protect newly discovered snail populations and unfenced MIP plant taxa.
- 2009: TNC ends all management of Honouliuli.
- 2009: State of Hawaii takes over management from Campbell Estate.
- 2009: Arthropod sampling conducted inside and outside a proposed rat control grid by UH researchers.
- 2010: Rat control grid established by OANRP.
- 2011: State of Hawaii takes over land management control as Honouliuli Forest Reserve. OANRP signed MOU with the State of Hawaii for OANRP management of natural resources on State lands related to OIP and MIP.
- 2011: OANRP Snaring outside MU fence is halted due to change in land holding.
- 2012: Snail exclosure fence constructed within northwest corner of MU. Project is funded by U.S. Fish and Wildlife Service with logistics handled by OANRP.
- 2012: OANRP restoration efforts initiated inside snail enclosure.
- MU fence extended approximately 100m below snail exclosure fence and around the campsite LZ.
- 2013: Endangered snails moved from the management unit to inside snail exclosure fence.
- 2013: Outplanting of common native plants begins in management unit and snail exclosure fence.
- 2014: Palikea placed under DOFAW management.
Ungulate Control

Identified Ungulate Threats: Pigs
Threat Level: High

Primary Objective:
- Maintain the entire MU as ungulate-free.

Strategy:
- Maintain the MU fence as pig free by maintaining the fence, retrofitting older fence sections with skirting, and trimming overhanging and fallen trees.

Monitoring Objectives:
- Conduct fence checks Monitor for pig sign while conducting other management actions in the fence.

Management Responses:
- If any pig activity is detected within the fenced unit, implement hunting and/or snaring program.

Maintenance
There are three fences in Palikea Subunit 1: the MU perimeter fence, the *C. grimesiana* subsp. *obatae* PU fence (TNC fence), and the snail enclosure fence. The MU fence is relatively small (25 acres) and takes advantage of cliffs to strategically protect the area. The major threats to the fence include fallen trees and vandalism; there are no major gulch crossings. No incidences of vandalism have been observed, but since the fence is accessible to the public, there is the potential for vandalism to take place. Special emphasis will be placed on checking the fence after extreme weather events. Monitoring for ungulate sign will occur during the course of other field activities. The *C. grimesiana* subsp. *obatae* fence is very small (1.3 acres), and provides additional protection to both wild and reintroduced *C. grimesiana* subsp. *obatae*. The fence is GPS mapped and tagged at ten meter intervals to aid in monitoring fence sections in need of repair. The snail enclosure fence is a predator-proof fence to protect endangered snails from pigs, rats, mice, Jackson’s chameleons and invasive carnivorous snails. The enclosure fence is maintained for electronics and material repair by the OANRP snail specialist.
Weed Control

Weed Control actions are divided into four subcategories:
1) Vegetation monitoring
2) Surveys
3) Incipient Control Areas
4) Weed Control Areas

These designations facilitate different aspects of MIP/OIP requirements.

Vegetation Monitoring

Please see appendix: Palikea MU vegetation monitoring, for a full description of monitoring history and results.

Surveys

Army Training: No
Other Potential Sources of Introduction: NRS, pigs, public hikers
Survey Locations: roads, landing zones, camp sites, fencelines, high potential traffic areas
Management Objective:
- Prevent the establishment of any new invasive alien plant or animal species through regular surveys along roads, landing zones, camp sites, fencelines, trails, and other high traffic areas (as applicable)

Monitoring Objectives:
- Survey roads annually
- Survey transect and camp site for weeds
- Quarterly surveys of LZs (if used)
- Note unusual, significant, or incipient alien taxa during the course of regular field work

Management Responses:
- Any significant alien taxa found will be researched and evaluated for distribution and life history. If found to pose a major threat, control will begin and will be tracked via ICAs.

Sanitation Issues:
Due to the widespread presence of *Ehrharta stipoides*, special care needs to be taken to clean shoes and gear upon departure from the MU. Seeds from *E. stipoides* have long awns and are easily transported via canvas, fabric, and Velcro. Staff should inspect and clean gear upon leaving the MU, sweep out vehicles daily, and ensure that camping gear is clean. Contractors working in Palikea need to follow the same guidelines. If possible, sanitation should be addressed in contract documents. There is anecdotal evidence suggesting *E. stipoides* has been spread from Palikea to Kahanahaiki via personnel in the past, which only emphasizes the importance of this issue.

Surveys are designed to be the first line of defense in locating and identifying potential new weed species. Roads, landing zones, camp sites, fencelines, and other highly trafficked areas are inventoried regularly. At Palikea, LZs, the campsite, one transect, and the access road are currently surveyed. NRS conducted the first road survey in January 2009. Since no Army training takes place at Palikea, NRS will conduct Palehua road surveys biannually.
Survey Locations at Palikea

Incipient Taxa Control (ICAs)

Management Objectives:
- As feasible, eradicate high priority species identified as incipient invasive aliens in the MU by 2019.

Monitoring Objectives:
- Visit ICAs at stated re-visitation intervals. Control all mature plants at ICAs and kill any immature or seedling plants to prevent them from reaching maturity. Survey Palikea trail, from gate around west (ridge) side of exclosure, ending at camp; annually.

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

ICAs are drawn around each discrete infestation of an incipient invasive weed. They 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. NRS will compile this information for each ICA species.
The table below summarizes target weed taxa at Palikea. Appendix 3.1 of the MIP lists significant alien species and ranks their potential invasiveness and distribution. Each species is given a weed management code: 0 = not reported from MU, 1 = incipient (goal: eradicate), 2 = control locally. OANRP supplemented and updated Appendix 3.1 with additional target species identified during field work. In many cases, the weed management code assigned by the MIP has been revised to reflect field observations. If no code is listed in the ‘original’ column, the species was not evaluated by the IP, but was added later by OANRP. While the list is by no means exhaustive, it provides a good starting point for discussing which taxa should be targeted for eradication, immediate control throughout the MU, or control within active WCAs. ICAs are not designated for every species in the table below; however, occurrences of all species in the table should be noted by field staff. All current ICAs are mapped.

### Summary of Potential ICA Target Taxa

<table>
<thead>
<tr>
<th>Taxa</th>
<th>MIP weed man. code</th>
<th>Notes</th>
<th>No. of ICAs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Acacia mearnsii</strong></td>
<td>1</td>
<td>None within MU; large infestation along trail. No control currently planned outside of the MU. Erosion a major potential side effect.</td>
<td>0</td>
</tr>
<tr>
<td><strong>Angiopteris evecta</strong></td>
<td>0</td>
<td>Staff has found three locations with immature plants both within the MU fence and in gulches below the campsite LZ. No mature plants have been found at any of the known sites, or during the course of field work elsewhere in the MU. Therefore, it appears that there must be some source population located outside the MU, and that staff can expect more immature plants to appear across the MU in future. While ICAs were initially created for this taxon, based on the likelihood of plants showing up anywhere, not just at known location, it was decided to control this species as part of WCA management, instead of ICA efforts.</td>
<td>0</td>
</tr>
<tr>
<td><strong>Araucaria columnaris</strong></td>
<td>0</td>
<td>There is a stand of <em>Araucaria</em> both inside and outside the fence in the southern part of the MU exclosure, and another smaller stand above the TNC exclosure. Currently, the population appears stable, although a few immature plants have been seen and removed. <em>Araucaria</em>’s potential for invasiveness has been observed elsewhere. This taxon will eventually be targeted for control in the WCAs in which it occurs, but is not currently a high priority.</td>
<td>0</td>
</tr>
<tr>
<td><strong>Casuarina glauca</strong></td>
<td>2</td>
<td>While there are few to no plants found within MU, there is a large population outside MU along the access trail. This taxon has a low rate of spread. Any plants found within MU will be targeted in WCA sweeps.</td>
<td>0</td>
</tr>
<tr>
<td><strong>Crocosmia x crocosmiiflora</strong></td>
<td>2</td>
<td>Several infestation sites were known prior to fence construction. After the fence was completed, NRS noted plants scattered further along the fence corridor, suggesting that staff activity is a dispersal vector. Four ICAs have been drawn in the MU, and one outside. Control is conducted primarily with volunteer groups, and has been successful at reducing overall numbers of plants. Staff supplement volunteer efforts by working on steep slopes in the ICAs. Control technique: manual removal of bulbs. Herbicide not required. Vegetative reproduction dominant, with seed produced occasionally.</td>
<td>5</td>
</tr>
<tr>
<td><strong>Cryptomeria japonica</strong></td>
<td>0</td>
<td>There is a large population of <em>Cryptomeria</em> in and to the south of the TNC exclosure. While the population appears stable, a few immature plants have been seen. This taxon is well-documented as an ecological pest in other areas of Hawaii, although native species persist beneath it at Palikea. Gradual removal of this weedy tree has begun in WCAs. No aggressive control actions are planned at this time. This taxon is susceptible to IPA and drilling control methods.</td>
<td>0</td>
</tr>
<tr>
<td>Species</td>
<td>Code</td>
<td>Notes</td>
<td></td>
</tr>
<tr>
<td>------------------------</td>
<td>------</td>
<td>-----------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Dicliptera chinensis</td>
<td>1</td>
<td><em>Dicliptera chinensis</em> inside old TNC exclosure is controlled quarterly. This weed is glyphosate resistant. Pick and remove from field any potentially viable fruit or roots.</td>
<td></td>
</tr>
<tr>
<td>Ehrharta stipoides</td>
<td>2</td>
<td>This species is widespread both in and outside of MU, and vegetation monitoring suggests it covers a greater area now than in 2008. Control is needed to check the spread of this species. This grass is a WCA control priority. Focus will be on keeping <em>E. stipoides</em> off the access and rat trails, as well as preventing movement to other MU’s by cleaning gear after each trip to Palikea</td>
<td></td>
</tr>
<tr>
<td>Ficus macrophylla</td>
<td>1</td>
<td>One large tree was known from the northern part of the MU. It was successfully controlled by drilling holes around the base with a gas-powered drill and filling them with glyphosate.</td>
<td></td>
</tr>
<tr>
<td>Fraxinus uhdei</td>
<td>0</td>
<td>One mature tree was found during monitoring. The tree was killed and no new seedlings found.</td>
<td></td>
</tr>
<tr>
<td>Juniperus bermudiana</td>
<td>1</td>
<td>This species is not known from this MU.</td>
<td></td>
</tr>
<tr>
<td>Melaleuca quinquenervia</td>
<td>2</td>
<td>Few to no trees are found within the MU. If any are seen, they will be a priority for control in WCA sweeps. This species is a host for the Puccinia rust. There is a large infestation along access trail.</td>
<td></td>
</tr>
<tr>
<td>Montanoa hibiscifolia</td>
<td>1</td>
<td>None seen within MU. If seen, control is a high priority.</td>
<td></td>
</tr>
<tr>
<td>Schefflera actinophylla</td>
<td>1</td>
<td>One plant was found in the MU during vegetation monitoring. This bird-dispersed species is a high priority for control, and is a target during WCA sweeps.</td>
<td></td>
</tr>
<tr>
<td>Setaria palmifolia</td>
<td>2</td>
<td>There are three locations of this invasive grass within the MU, and a fourth on the access trail. ICAs have been created around each. Control technique: handpull and remove plant material, or spray with glyphosate. Efforts have been effective, with few plants found at any of the sites in the last year.</td>
<td></td>
</tr>
<tr>
<td>Sphaeropteris cooperi</td>
<td>1</td>
<td>During monitoring and other field activities, many plants have been found scattered across the MU. Large infestations are known just outside MU to the west and north. There is zero tolerance for this species, which is a priority during WCA sweeps. The plants are killed when weeding WCA’s</td>
<td></td>
</tr>
<tr>
<td>Toona ciliata</td>
<td>1</td>
<td>None known within Palikea MU. If any are found, they will be a high priority for control in WCA sweeps.</td>
<td></td>
</tr>
<tr>
<td>Trema orientalis</td>
<td>0</td>
<td>Some trees were seen at the eastern edge of the MU fence on the middle ridge, in an area with very steep terrain. There is zero tolerance for this wind-dispersed species inside the MU, and it is a priority target during WCA sweeps.</td>
<td></td>
</tr>
</tbody>
</table>
**Incipient species at Palikea**

*C. crocosmiiflora* flower and corm

**Incipient and Weed Control Areas at Palikea**
**Ecosystem Management Weed Control (WCAs)**

**MIP 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 both the understory and canopy across the MU.
- 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. Please see Appendix: Palikea MU vegetation monitoring for discussion

**Weed Control Summary**

In order to meet management objectives for Palikea MU, a number of general and specific actions are recommended. More aggressive weed control across the MU is necessary. Partial canopy removal/thinning for *Morella faya*, *S. terebinthifolius*, and *Cryptomeria japonica* is recommended, as these are among the more frequently occurring and more easily managed canopy weeds, and have infrequent recruitment. However, caution should be applied to not open too much canopy, as this may promote growth of understory weeds, especially *C. hirta* and *R. rosifolius*. Incision Point Application (IPA) herbicide delivery technique is recommended for *Cryptomeria japonica* and *Araucaria columnaris* across the entire MU, as these weeds occur relatively infrequently in the canopy, and may be a more achievable target for elimination. *Passiflora suberosa* should be targeted during WCA efforts, especially in the canopy. *Sphaeropteris cooperi* has been found sporadically throughout the MU over the years and is a target species to be controlled during weed sweeps through all WCA areas. *Ehrharta stipoides* is a prominent weedy grass that needs more attention as it is spreading along trails and is seen throughout the interior of the MU. Common native outplantings will be conducted in addition to weeding efforts to aid in native understory recovery.

Vegetation monitoring at Palikea indicates that management objectives of having < 50% non-native understory and canopy and > 50% native understory and canopy cover were only met with respect to the non-native understory. This indicates that continued weed control is needed at Palikea. Areas near rare taxa will continue to be prioritized, especially along the southern fenceline near camp, and the H-line around the common outplanting area. Where *A. mustelina* are present, NRS will seek to avoid unintentional negative impact by being cognizant of snail presence and avoiding chemical control of grass in and around of preferred snail trees.

In the central portion of the MU and along the southern fenceline, control strategies will focus on sweeping through the understory for *C. hirta* and *R. rosifolius*, while controlling weedy grasses along trails and fencelines. Gradually removing canopy weeds such as *Morella faya*, and *S. terebinthifolius*, while simultaneously targeting *P. cattleianum* stands for more aggressive, clear-cut style control will be the strategy used throughout the MU. Large numbers of *A. koa*
seedlings have been observed recruiting thickly in the cleared *P. cattleianum* areas. Additionally, common reintroductions will be used to complement weeding efforts.

In the northeastern part of the MU, gulch portion of the MU the gulches are weedier and more varied than the rest of the MU. Work here centers around rare taxa and weeding is prioritized within the *C. grimesiana* fence around wild and reintroduced plants. Control of the canopy tree *Cryptomeria japonica* will be a priority, as well as understory weeds *C. hirta, R. rosifolius*, and weedy grasses.

**WCA: Palikea-01 (Campsite corner)**
Vegetation Type: Mesic-Wet Forest (ridge)
**MIP Goal:** Less than 25% non-native cover given presence of MIP taxa (snails). Monitoring shows that for this vegetation type, native cover is at 50%.
**Targets:** All weeds, focusing on *M. faya, P. cattleianum, C. hirta, R. rosifolius*, and grasses.
**Notes:** This WCA includes a native dominated forest patch home to *A. mustelina, A. concavospira* and *L. sanguinea*, enclosed by a predator-proof snail exclosure. There are few weeds and many common outplantings have been added inside the exclosure. See Appendix 1-6, Snail Exclosure Restoration summaries for further details on this process. The exclosure is slated for continued gradual removal of *S. terebinthifolius*, as it is present in the middle of the exclosure fence. Much of the WCA is bordered by the fenceline, and the more native areas of the WCA are concentrated above and around the snail exclosure fence. NRS will target *E. stipoides*, other grasses, and *S. terebinthifolius* along fencelines and trails. Follow up treatment of *B. appendiculatum, R. rosifolius, C. hirta, P. suberosa*, and other understory weeds will be required. Currently, *R. rosifolius* and *P. suberosa* are present in thick patches above the snail jail towards the fenceline and weeding efforts will be prioritized at this location until the area is cleared of these weeds. The understory adjacent to the fenceline below the campsite LZ is dense with weedy grasses and immature *P. cattleianum*, and should be sprayed regularly.

**WCA: Palikea-02 (Uluhe flats/H line)**
Vegetation Type: Mesic Mixed Forest (uluhe dominated flats)
**MIP Goal:** 50% or less alien cover (no rare taxa in WCA). Monitoring data for this vegetation type is highly variable; however, the 50% alien cover goal has been met for the MU as a whole.
**Targets:** All weeds, focusing on *S. terebinthifolius, P. cattleianum, S. cooperi*, and shrubs.
**Notes:** Much of this WCA is covered with *Dicranopteris linearis*, however, the areas around the flats include high densities of *S. terebinthifolius, C. hirta* and *P. cattleianum*. Targeting these regions would help to improve overall habitat quality while providing connectivity between the surrounding WCAs, most of which are 50% or greater native cover. *S. cooperi* has been found in this region; this taxa should be targeted in particular. In the *S. terebinthifolius* and *P. cattleianum* dominated areas, common native outplantings are underway in order to speed rehabilitation and provide habitat enhancement for populations of endangered *Drosophila*. Native canopy replacement is needed as the *M. polymorpha* will not quickly replace removed non-native trees. Common native species slated for outplanting include: *C. longifolia, C. trigynum, K. affinis, A. platyphllum, M. polymorpha* and *Drosophila* host trees *U. glabra* and *U. kaalae*. *U. glabra* will be planted in the winter of 2014 for habitat improvements for *Drosophila*.

**WCA: Palikea-03 (Crestline)**
Vegetation Type: Mesic-Wet Forest (ridge)
**MIP Goal:** 25% or less alien cover (rare taxa in WCA). Monitoring shows that this vegetation type is already at 50% native cover.
**Targets:** All weeds, focusing on *M. faya, S. terebinthifolius, P. cattleianum, E. stipoides*, other grasses.
**Rare Taxa:** *A. mustelina*
Notes: This region is steep, including much of the summit area in the MU. Some portions of the WCA include cliffs. Fortunately, most of the understory is dominated by native species, however, M. faya forms a significant part of the canopy. Control of this species will be staggered so as to minimize changes in the light regime. Early results from IPA (incision point application) herbicide trials show promise for controlling M. faya. The area along the fenceline will be sprayed regularly for E. stipoides and other grasses; keeping E. stipoides from moving away from the fenceline and into the MU is a priority. There is a large population of A. mustelina on the southern end of the WCA; NRS will seek to avoid negative impacts to the population by exercising caution when working around snail trees. In open areas, NRS will consider using common native species seed sow or plantings to reduce habitat for E. stipoides. Past attempts to transplant Dicranopterus linearis into bare ground areas have been unsuccessful. Appropriate species for future plantings include R. albescens and D. sandwicensis. Melinus minutiflora control will be focused around Puu Palikea and surrounding snail habitat, followed by common native seed sow using Bidens torta and Carex wahuensis, as the weedy grasses are persistent and spreading down gulch.

WCA: Palikea-04 (Mid-Gulch)

Veg Type: Mesic Forest (gulch)/Mesic-Wet Forest (Slope)
MIP Goal: 25% or less alien cover (rare taxa in WCA). This WCA spans two vegetation types. Monitoring shows that the mesic-wet vegetation type is already at 50% native cover, while the mesic gulch forest type is much more variable in cover (80-100% alien).
Targets: All weeds, focusing on S. cooperi, M. faya, S. terebinthifolius, P. cattleianum, E. stipoides, M. minutiflora and other grasses.
Notes: This WCA is large and stretches from the eastern edge of the MU, along the C. grimesiana fence, to the steep, cliff areas on the western edge of the MU. It encompasses a mesic gulch bordered by two ridges. The mesic forest vegetation type is the most degraded type in Palikea. It is dominated by S. terebinthifolius, has low species diversity, low native cover, and very high percent bare ground. The bare ground is due to dense shading by S. terebinthifolius. On the western end of the WCA, P. cattleianum provides most of the canopy, although vegetation is somewhat mixed in the understory with natives and weeds. Despite the weedy character of the WCA, A. mustelina, A. concavospira, L. sanguinea, and C. ibidis are all present. Care needs to be taken to avoid significant negative impacts to these rare taxa and their habitat. Control work will focus on gradual removal of S. terebinthifolius canopy; this will open up light gaps which will need to be monitored for weedy grasses, etc. The ridges bordering the gulch include more native vegetation elements. These ridges will be swept, and M. faya, the primary weed, will be targeted gradually. The mixed P. cattleianum patches on the west of the area will be swept and weeded gradually. Native canopy outplantings (e.g. Pisonia sp., U. glabra) will likely be needed to assist in recovery after any large removals of S. terebinthifolius.

WCA: Palikea-05 (CyaGri Fence)

Veg Type: Mesic Forest (gulch)
MIP Goal: 25% or less alien cover (rare taxa in WCA). Monitoring shows that for this vegetation type, percent native cover is highly variable.
Targets: All weeds, focusing on understory species.
Notes: This WCA encompasses the small TNC fence. Approximately an acre, the fence protects both wild and reintroduced C. grimesiana, as well as other rare species reintroductions planted by TNC. This area has been protected from pigs since 1999; since then, native ferns have thrived. Weed control has been ongoing at this site for many years. Portions of the WCA are still dominated by weeds, and the canopy throughout the WCA is made up of Cryptomeria japonica. C. japonica has not been observed recruiting aggressively in the WCA, however C. grimesiana seedling recruitment beneath this overstory has also been limited. NRS have begun to remove selected trees and will continue to do so in the coming year with the aim of increasing C. grimesiana seedling recruitment, and to eventually promote a native canopy in this area. NRS is hopeful that native fern recruitment seen within the TNC fence will be
echoed elsewhere in Palikea. Planting common native species such as *Pipturus albidus*, *Hedyotis terminalis*, and *D. sandwicensis* may help to jumpstart forest restoration in the weedier portions of this WCA. Continued control of weedy grasses along the perimeter of the TNC fence will be a priority as *M. minutiflora* seems to be spreading lower into the gulch and upslope away from the fence into other WCA’s. Common outplantings in the predominantly grassy areas will help to control the spread of *M. minutiflora*.

**WCA: Palikea-06 (Tsugi Gulch)**

**Veg Type:** Mesic Forest (gulch)/ Wet-Mesic Forest  
**MIP Goal:** 25% or less alien cover (rare taxa in WCA). This WCA spans two vegetation types.  
Monitoring shows that the mesic-wet vegetation type is already at 50% native cover, while the mesic gulch forest type is much more variable in cover (80-100% alien).  
**Targets:** All weeds, focusing on *C. japonica*, *M. faya*, *S. terebinthifolius*, *P. cattleianum*, *C. hirta*, *B. appendiculatum*, *S. cooperi*, *E. stipoides*, and grasses.  
**Rare Taxa:** *A. mustelina* and *Chasiempis ibidis* in WCA.  
**Notes:** Much of this WCA is dominated by *Cryptomeria japonica* and *P. cattleianum* canopy. The area is heavily shaded, with a very open understory and lots of bare ground. This WCA directly abuts the *C. grimesiana* fence. Gradually native ferns should colonize much of the bare ground in the WCA, as they did in the TNC fence. In a novel control method conducted this year, select mature *C. japonica* trees were treated by drilling and injecting herbicide, as well as IPA, and are starting to die. Gradual removal of this dominant overstory trees, as well as *R. rosifolius* in the understory, will be a focus. The large gulch extending from the south portion of the TNC fence up towards the crestline will be a focus of weeding and restoration efforts. Weed control efforts will focus on understory species, grasses, and some *P. cattleianum* canopy control. Gradual removal of *P. cattleianum* will be implemented. Common native species will be outplanted here to help provide native understory replacements for *P. cattleianum* and *C. japonica*.

**WCA: Palikea-07 (Norfolks, South Corner)**

**Veg Type:** Mesic Mixed Forest (slope, ridge)  
**MIP Goal:** 25% or less alien cover (rare taxa in WCA). Monitoring data for this vegetation type is highly variable; however, the 50% alien cover goal has been met for the MU as a whole.  
**Targets:** All weeds, focusing on *Araucaria columnaris*, *M. faya*, *S. terebinthifolius*, *P. cattleianum*, *E. stipoides*, *S. cooperi* and grasses.  
**Notes:** Much of the WCA is dominated by very large *Araucaria columnaris*. These trees originally were planted; while they are not naturalizing quickly, some keiki have been found. Removing the *Araucaria* would drastically alter light and moisture levels and could be quite biologically dangerous. For now, any young *Araucaria* will be controlled. Other portions of the WCA are dominated by a mix of native species. Weeding efforts will focus in these areas. The Palikea trail runs through the WCA; grass control, especially *E. stipoides*, will be a priority along the fence. The northern part of this WCA has native forest patches that are host to *A. mustelina*. These areas will be weeded cautiously to minimize potential impact to the tree snails. Some scattered *P. cattleianum* has been seen amongst the native patches and will be a priority when weeding in this WCA. Volunteers have weeded some *P. cattleianum* in this WCA and while some follow up with grass spraying is needed, much of the area has been grown over by *D. linearis*. *S. cooperi* also continues to periodically recruit in this area.

**WCA: Palikea-08 (Mid-east Gulch/South of F line)**

**Veg Type:** Mesic Mixed Forest (gulch, ridge)  
**MIP Goal:** 25% or less alien cover (rare taxa in WCA). Monitoring data for this vegetation type is highly variable; while the 50% alien cover goal has been met for the MU as a whole, the mesic gulch forest type is highly variable in cover (80-100% alien).
Targets: All weeds, focusing on *M. faya*, *S. terebinthifolius*, *P. cattleianum*, *M. minutiflora*, and grasses.  
Notes: This WCA is very similar to Palikea-04 in terms of vegetation types, topographic features, and resources. Control will focus on gradual removal of *S. terebinthifolius* from the gulch and *M. faya* from the ridges. Common natives may be used in the light gaps resulting from weeding. *A. mustelina* in the WCA are primarily found in a large Freycinetia arborea patch and in high numbers at the top of the WCA on host trees in the *D. linearis* patch. The *F. arborea* patch is nearly entirely surrounded by *S. terebinthifolius*. Controlling this weedy tree around the edges of the *F. arborea* to prevent it from expanding is a focus in this area. Open canopy created from control of *S. terebinthifolius* may be good candidate areas for common outplantings. The perimeters of this patch are easier to weed as they are near well-used trails, and not on steep cliffs like the center of the WCA. *A. concavospira* are also found in this WCA. The bottom of this WCA is along the fenceline and is often covered with *M. minutiflora*, and should be a priority for control to prevent it from spreading uphill into the remainder of the WCA, where the terrain is very steep, weed control difficult. Removing all the *S. terebinthifolius* from this WCA will be a big task and should be considered with other large projects in more native areas of the MU.

WCA: Palikea-09 (East Corner/F line/Clearcut)  
**Veg Type:** Mesic-Wet Forest/ Mesic Mixed Forest  
**MIP Goal:** 25% or less alien cover (rare taxa in WCA). This WCA spans two vegetation types. Monitoring shows that the mesic-wet vegetation type is already at 50% native cover, while the mesic gulch forest type is much more variable in cover (80-100% alien).  
**Targets:** All weeds, focusing on *S. terebinthifolius*, *P. cattleianum*, *R. rosifolius*, and *P. suberosa*.  
**Notes:** This WCA encompasses the long north-facing slope of the main ridge crossing the MU. The western end of the WCA borders on the uluhe flats, while the eastern end wraps around the central ridge in Palikea MU to include a small gulch. It is very diverse, with many native and weedy elements and *A. mustelina*. This WCA contains outplanted *Phyllostegia hirsuta* near the north fenceline. Control efforts will focus on conducting weed control around the native forest patches for both canopy and understory weeds. A large area of *P. cattleianum* was removed by clearcutting a large monotypic stand near the bottom of the WCA on the eastern fenceline. *A. koa* found on the ridge above the site has begun to recruit in the areas, but supplemental plantings of this species as well as other common natives are planned for this site. The fast-growing *Phytolacca octandra* is the predominant weed, replacing the bare ground after clearcutting, however, it is relatively easy to control. Along the fenceline, both *M. minutiflora* and *S. terebinthifolius* will be controlled to facilitate fenceline maintenance. Around *P. hirsuta*, weeding efforts will focus on maintenance of *M. minutiflora*, and removal of *R. rosifolius*, which has dominated the area after removal of *S. terebinthifolius*. Additionally, control of *P. suberosa* should be a focus in this WCA, as it appears to be spreading, especially along the fenceline near the *P. hirsuta* outplanting.

WCA: PalikeaNoMU-01 (Palikea Trail)  
**Veg Type:** Mesic-Wet Forest (ridge)  
**MIP Goal:** This WCA does not fall in the Palikea MU. The MIP does not specify weed control goals outside MUs, except with regards to incipient invasive species. The objective of this WCA is to maintain the access trail to the MU fence and to keep the highly invasive *E. stipoides* off the trail, thus reducing the potential to spread it.  
**Targets:** *E. stipoides* and other grasses, *M. quinquenervia*, *Casuarina* spp., *M. faya*.  
**Notes:** The Palikea trail runs through a variety of plant communities, ranging from separate monocultures of bamboo, *Casuarina* spp., and *M. quinquenervia*, to native dominated mesic-wet forest. *E. stipoides* is also found along much of the access trail and is well established in the region; it is the most invasive understory species in the area. Control of *E. stipoides* is a high priority. The trail will be sprayed regularly to reduce the potential of staff to accidentally spread it to intact areas of Palikea or other MUs. Weedy tree species found in the native-dominated portions of the WCA will be controlled as time permits; this is a low priority. Additionally, *M. minutiflora* has been spreading around the TNC *A. koa*.
outplanting area, and focus on control of this invasive grass will be a priority when spraying the access trail.

**WCA: PalikeaNoMU-02 (East SphCoo Bowl)**

*Vegetation Type:* Mesic mixed forest (gulch)

*MIP Goal:* This WCA does not fall in the Palikea MU. The MIP does not specify weed control goals outside MUs, except with regards to incipient invasive species. The objective of this WCA is to control *S. cooperi* and reduce its ability to disperse into the MU.

*Targets:* *S. cooperi*, *Trema orientalis*, *M. faya* and other significant/ unusual tree weeds.

*Notes:* Just outside the Palikea fence, in a gulch to the northeast, there is an infestation of *S. cooperi*. This species is widely but sparsely scattered, with immature recruits found across the Palikea exclosure. It is a target in all WCAs. *S. cooperi* is highly invasive, and can form dense stands in mesic/wet forest. Eliminating mature plants is a high priority and all known mature plants at this site have been controlled. NRS hope that by targeting large infestations outside of the MU, the number of recruits found inside the MU will be reduced. Other weedy source taxa such as *T. orientalis* will also be controlled in this WCA during weed sweeps.

**Juvenile Sphaeropteris cooperi**

**WCA: PalikeaNoMU-04 (Halona Ridge)**

*Vegetation Type:* Mesic-Wet Forest (ridge)

*MIP Goal:* This WCA does not fall in the Palikea MU. The MIP does not specify weed control goals outside MUs, except with regards to incipient invasive species. The objective of this WCA is to maintain Halona ridge trail toward Nanakuli relatively free of *Crocosmia x crocosmiiflora*, *S. cooperi*, and weedy grasses.

*Targets:* *E. stipoides* and other grasses, *S. cooperi*, and *Crocosmia x crocosmiiflora*.

*Notes:* The Halona Ridge runs from the southwest corner outside the Palikea MU fence down towards Nanakuli, towards the Palikea IV MU. The upper portion of the ridge is native dominated mesic-wet
forest. This ridge area is also where the last *Vestiaria coccinea*, (Iiwi), was observed by OANRP on Oahu, in 2014. *E. stipoides* is also found along much of the ridge and is well established in the region; it is the most invasive understory species in the area. Control of *S. cooperi*, and *Crocosmia x crocosmiiflora* are a high priority and will be the focus of weeding efforts. Weedy tree species found in the native-dominated portions of the WCA will be controlled as time permits; this is a low priority as it falls outside of the Management Unit.

**Rat Control**

**Threat level:** High  
**Current control method:** MU level Kamate trap grid  
**Seasonality:** Year-Round  
**Number of control grids:** 180 Kamate traps

**Primary Objective:**  
- To maintain rat/mouse populations to a level that facilitates stabilized or increasing rare plant and snail populations across the MU by the most effective means possible.

**Management Objective:**  
- Continue to maintain Kamate traps to protect *Achatinella mustelina* populations throughout the MU, and reduce predation of fruit from rare plant taxa.  
- Depending on the success of traps in other MUs, automatic resetting traps may be installed in place of Kamate traps in the future.

**Monitoring Objectives:**  
- Monitor tracking tunnels quarterly to determine rat activity within the trapping grid.  
- Monitor ground shell plots in and outside of snail enclosure for predation of *Achatinella mustelina* by rats.  
- Monitor *Cyanea grimesiana* subsp. *obatae* for predation of fruits by rats.  
- UH researcher continues to monitor arthropod composition and abundance in response to rat control.

**Monitoring Issues:**  
- An acceptable level of rat activity, which promotes stable or increasing *A. mustelina* and *C. grimesiana* subsp. *obatae* populations, has not been clearly identified. In order to determine an acceptable level, more intensive monitoring of rare resources is required. Regardless of rat activity levels, resource response is the ultimate goal of rat control. Snail counts and seedling survival are two variables that will help determine if current rat control is sufficient.  
- Threatened resources are widespread throughout the Palikea MU. The habitat quality is high, and the MU is of sufficient size for an effective trapping grid. Monitoring of rat activity via tracking tunnels, *A. mustelina* populations, and populations of *C. grimesiana* subsp. *obatae* will be vital in determining whether control is having the desired effect.

**Ant Control**

**Species:** *Cardiocondyla venustula, Solenopsis papuana*  
**Threat level:** Low
Control level: Only for new incipient species
Seasonality: Varies by species, but nest expansion observed in late summer, early fall
Number of sites: ~5 (Drosophila substenoptera, D. montgomeryi sites, trails, campsite LZ and fenceline)
Acceptable Level of Ant Activity: Current level acceptable, sampling confirms ants are not abundant

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

Monitoring Objectives:
- Continue to sample ants at human entry points and a minimum of once a year. Use samples to track changes in existing ant densities and to alert OANRP to any new introductions.
- Sample ants at Drosophila substenoptera and D. montgomeryi sites annually, as well as along trails and fencelines, as ants are likely to attack immature larvae.

Ants have been documented to pose threats to a variety of resources, including native arthropods, plants (via farming of hemipteran pests), and birds. The distribution and diversity of ant species in upland areas on Oahu, including Palikea, has only begun to be studied and changes over time. Impacts to the rare species present in Palikea remain unknown, but it is likely they are having some type of effect on the ecosystem at large. OANRP have already conducted some surveys across Palikea to determine which ant species are present and where they are located. Surveys were conducted using a standardized sampling method (see Invasive Ant Monitoring Protocol http://manoa.hawaii.edu/hpicesu/DPW/2010_YER/027.pdf). Solenopsis papuana and Cardiocondyla venustula were found outside forested areas (on ridges) in low densities. These two species were at low numbers, and infrequently found at bait cards, therefore control is not merited at this time.

Slug Control

Species: Limax maximus, L. flavus, Meghimatium striatum, Lehmannia valentiana, Deroceras leave
Threat level: High
Control level: Localized
Seasonality: Present year round, more active in the wet season
Number of sites: 3 (Cyanea grimesiana subsp. obatae and Phyllostegia hirsuta populations)

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

Management Objective:
- Continue to control slugs around the Cyanea grimesiana subsp. obatae populations. If surveys confirm no native snails are present, apply Sluggo at the Phyllostegia hirsuta populations to reduce herbivory and encourage seedling recruitment

Monitoring Objectives:
- Annual census monitoring of Cyanea grimesiana subsp. obatae and Phyllostegia hirsuta seedling recruitment following fruiting events
- Annual census monitoring of slug densities during wet season inside and outside of control areas
Effective molluscicides have been identified (Sluggo) and control programs are ongoing in Palikea. It has been established that in order for Sluggo to be effective, it needs to be applied across an area >100 m² and need to be reapplied at least every month. The rare plants protected via slug control are shown on the map below.

Predatory Snail Control

Species: *Euglandina rosea* (rosy wolf snail)
Threat level: High
Control level: Localized
Seasonality: Year-Round
Number of sites: One, potentially 13 (*A. mustelina* sites)
Acceptable Level of Activity: Unknown

Primary Objective:
- Reduce predatory snail populations to a level optimal for *A. mustelina* survival.

Management Objective:
- Continue to develop better methods to control predatory snails
- Keep sensitive snail populations safe from predatory snails by maintaining snail exclosure.

Monitoring Objectives:
- Annual or every other year census monitoring of *A. mustelina* population(s) to determine population trend.
• Annual searches for predatory snails to confirm their absence or presence in proximity to *A. mustelina*.

No baits have been developed for the control of predatory snails. Little is known regarding their distribution and prey preference. Control is limited to hand removal. Visual searches are time-consuming, difficult, and not feasible over large areas and in steep terrain. It is also unknown whether predatory snail populations are, in fact, reduced by hand removal. *Euglandina rosea* has been found in this MU, but in low numbers.

Section of snail exclosure fence

View from inside of snail exclosure fence before outplantings

Palikea snail exclosure panorama

**Jackson’s Chameleon Control**

**Threat:** *Chameleon jacksonii* subsp. *xantholophus* (Jackson’s Chameleon)

**Threat level:** Unknown, perhaps High

**Control level:** Localized

**Seasonality:** Year-Round

**Number of sites:** One, potentially 13 (*A. mustelina* sites)

**Acceptable Level of *C. jacksonii* Activity:** Zero within snail enclosure, unknown in remainder of MU
Primary Objective:
- Determine the threat level *C. jacksonii* pose in the MU.

Secondary Objectives:
- *C. jacksonii* presence will be mapped along the Palehua road.
- Determine if *C. jacksonii* are having an impact on *A. mustelina* in the MU, and dissecting captured *C. jacksonii* to determine gut content.

Management Objective:
- By end of 2015, conduct a distribution survey for *C. jacksonii* along Palehua Road and through the residential area.
- By end of 2015, survey the Palikea MU and determine whether *C. jacksonii* are present in the MU.
- If needed, develop a control technique and strategy for *C. jacksonii*.

Monitoring Objectives:
- Monitor extent and geographic distribution of resident population of *C. jacksonii* regularly.

Discovery of *A. mustelina* shells in the stomachs of *C. jacksonii* found in the Puu Kumakalii region show that beleaguered tree snails have yet another predator and that *C. jacksonii* pose a serious threat to rare taxa. Palikea is home to a large population of *A. mustelina*. NRS have reported observations of *C. jacksonii* along the Palehua road, the primary access point for Palikea. Additionally, one chameleon was captured in the MU near the campsite LZ. Additional surveys are vital to determining the extent of the chameleon population in the region. Once more information is known about the distribution of and threats posed by *C. jacksonii*, NRS will update the five year plan for Palikea.

**Yellowjacket Control**

**Threat:** *Vespula pensylvanica* (western yellowjacket)
**Threat level:** Unknown, perhaps High
**Control level:** MU level
**Seasonality:** Year-Round, abundance peaking in August–October
**Number of sites:** Bait network of about 30 heptyl butyrate traps
**Acceptable Level of *V. pensylvanica* Activity:** Unknown

Primary Objective:
- Determine the 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 Objectives:
- 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 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. Two of the endangered *Drosophila* species found at Palikea, *D. substenoptera* and *D. hemipeza* (the latter is not managed by OANRP) 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 Palikea, *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 Palikea, 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.

**Fire Control**

**Threat Level:** Low  
**Available Tools:** Fuelbreaks, Visual Markers, Helicopter Drops, and Wildland Fire Crew

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

**Preventative Actions**
There is little infrastructure/construction which would be helpful to reduce fire threat. NRS will focus on maintaining good communication with the Wildland Fire Working Group to facilitate positive on-the-ground fire response in the event of another catastrophic Nanakuli brushfire. In 2014, a fire burned near Palikea MU in the Makakilo area. While the fire did not reach Palikea, similar fires in the area could impact management of the MU by limiting access. This could be an issue for slug and rat control in the future.
Nanakuli Fire

2005 Fire burning up leeward slopes in Nanakuli, towards the Waianae summit and Palikea

Grass control in the MU is discussed in the Weed Control section of the plan.

Fire Mitigation Activities at Palikea

Receiving watertank near Puu Palikea to support fire fighting efforts
Fuel break along the ridge
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<tbody>
<tr>
<td>General Survey</td>
<td>LZ-HON-107: Survey Puu Palikea LZ whenever used, not to exceed once per quarter. If not used, do not need to survey.</td>
<td>4</td>
<td>1</td>
<td>2</td>
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<td>LZ-HON-137: Survey Palikea Camp LZ whenever used, not to exceed once per quarter. If not used, do not need to survey.</td>
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<td></td>
<td>WT-Palikea-01: Survey Palikea trail, from gate around west (ridge) side of exclosure, ending at camp; annually.</td>
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<td>RS-Palikea-01: Survey road from bottom gate to Mauna Kapu, Palikea trailhead. No side roads. Every other year.</td>
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<td>ICA</td>
<td>Palikea-Crocro-01: Monitor/control Crocro at Norfolk pine site annually. Sweep entire ICA each time. Dig out corms, remove from field. Pick and remove from field any potentially viable fruit.</td>
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<td>Palikea-Crocro-02: Monitor/control Crocro at DZ/akolea gulch site 1x year (2x year if needed). Once initial knockdown is complete, sweep entire ICA each time. Dig out corms, remove from field. Pick and remove from field any potentially viable fruit.</td>
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<td>Palikea-Crocro-03: Monitor/control Crocro on very steep slopes at steps site minimum 1x year (2x year if needed). Sweep entire steep portion of ICA each time (Outreach to get gentler slopes/trailside areas). Dig out corms, remove from field. Pick and remove from field any potentially viable fruit.</td>
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<td>Palikea-Crocro-04: Monitor/control Crocro on fence N of lunch puu a minimum 1x year (2x year if needed). Sweep entire ICA each time. Dig out corms, remove from field. Pick and remove from field any potentially viable fruit.</td>
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<tr>
<td>WCA 1: Campsite corner</td>
<td>Palikea-Dicchi-01: Monitor/control Dicchi inside old TNC exclosure quarterly. This weed is roundup resistant. Pick and remove from field any potentially viable fruit or roots.</td>
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| WCA 2: Uluhe flats/H line | Palikea-SetPal-01: Monitor/control Setpal at site east of camp quarterly/every 6 months. Handpull and remove from field all plants/fruit.  
Palikea-SetPal-02: Monitor/control SetPal at steps site quarterly/every 6 months. Handpull and remove from field plant and potentially viable fruit.  
Palikea-SetPal-03: Monitor/control SetPal at camp site quarterly. Handpull and remove from field plant and potentially viable fruit. |
| WCA 3: Crestline | Monitor/control SetPal at camp site quarterly. Handpull and remove from field plant and potentially viable fruit. |
| WCA 4: Midgulch | Spray any grass found along ridgeline and fenceline, check quarterly, spray as needed  
Control weedy grasses 2x year  
Sweep accessible portions of WCA 1 time each year; reduce M. faya cover gradually  
Control understory weeds throughout WCA  
Spray weedy grasses found in WCA 2x year  
Control understory weeds throughout WCA |
<p>| WCA 5: Cyagri Fence | Sweep WCA 2x year for understory and overstory weeds |</p>
<table>
<thead>
<tr>
<th>Location/Description</th>
<th>Management Activities</th>
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<tr>
<td>Gradually remove <em>C. japonica</em> above <em>C. grimesiana</em> outplanting</td>
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<td>Control weedy grasses along fenceline and within WCA twice per year</td>
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<td><strong>WCA 6: Tsugi Gulch</strong></td>
<td>Thin <em>C. japonica</em> using drilling and herbicide method</td>
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<tr>
<td>Control small portions of <em>P. cattleianum</em> 2x year and overstory weeds 2x year</td>
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<td>Control weedy grasses and understory species</td>
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<td><strong>WCA 7: Norfork/South Corner</strong></td>
<td>Sweep entire WCA one time per year. Focus on understory species and gradual removal of overstory weeds.</td>
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<td>Sprays grasses, <em>E. stipoides</em>, along trail two x year</td>
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<td><strong>WCA 8: Mideast Gulch</strong></td>
<td>Spray any grass found in WCA twice per year</td>
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<td>Control understory and canopy weeds in gulch every other year</td>
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<tr>
<td><strong>WCA 9: East Corner/F line/Clearcut</strong></td>
<td>Control understory and canopy weeds across WCA once per year, focus on <em>S. terebinthifolius</em>, <em>P. cattleianum</em>, and <em>R. rosifolius</em></td>
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<tr>
<td>Control weedy grasses along fenceline and within WCA twice per year</td>
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<td><strong>Palikea NoMU-01: Palikea Trail</strong></td>
<td>Spray <em>E. stipoides</em> and other grasses along the trail, from the trailhead to the MU fence; check quarterly, spray as needed</td>
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<tr>
<td><strong>Palikea NoMU-02: Sphcoo Bowl</strong></td>
<td>Sweep entire area for <em>S. cooperi</em>, <em>T. orientalis</em>, etc once, every two years</td>
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<tr>
<td><strong>Palikea NoMU-04:</strong></td>
<td>Sweep entire area for <em>S. cooperi</em></td>
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</table>
Conduct weed control on Halona ridgeline annually. Focus on Eri kar, Sphcoo, grasses, canopy weeds.

| Rat Control | Run tracking tunnels 1x quarter |
| Trapout rat grid every six weeks |
| Slug Control | Apply Sluggo monthly at rare plant populations |
| Monitor slugs with beer traps quarterly |
| Ungulate Control | Check MU fence for breaches and check transects |
| Check *C. grimesiana obatae* fence for breaches |
| Check *C. grimesiana obatae* fence for breaches |
| Predatory Snails/Snail Exclosure | Check snail enclosure for breaches and remove predatory snails under the hood quarterly |
| Ants | Survey for ants annually |
| Rare Insects | Quarterly survey at managed populations |
| Common Outplanting | Outplant and monitor common reintros |