Appendix 5

OAHU ARMY NATURAL RESOURCES MONITORING PROGRAM

Monitoring Protocol 1.2.1

PLANT COMMUNITY HEALTH MONITORING
FOR OHIKILOLO MU (UPPER SECTION)

Introduction

Oahu Army Natural Resources Program’s (OANRP) primary management objective is to stabilize federally endangered species impacted by military training on the island of Oahu. Recognizing the importance of providing appropriate habitat for rare species stabilization, Management Units (MUs) were designated for rare species recovery actions to occur in and monitoring objectives were. A team of expert biologists representing multiple organizations including the Army, U.S. Fish and Wildlife Service State of Hawaii, Honolulu Board of Water Supply, and The Nature Conservancy of Hawaii created designations of these MUs. The guidelines used for selection of these areas were based on the following criteria: 1) relatively high densities of in situ Population Units (PUs) of target taxa, 2) large areas of relatively intact native-dominated vegetation which would provide habitat for in situ PUs as well as for reintroduction sites, and 3) insofar as possible, locations in areas accessible for management (Makua Implementation Team et al. 2003). To achieve long-term protection of these MUs, a list of priority management actions were outlined in detail in the Makua Implementation Plan (MIP).

The required MIP ecosystem level plant community monitoring goal was to reach and maintain 50% or less non-native percent cover in the canopy and understory. Two additional MU plant community goals, recommended in the MIP, were to reach and maintain 50% or more native percent cover in the canopy and understory strata and track the geographical movement of dominant native and non-native species over time.
MU Background Information

The Ohikilolo MU is one of the larger MIP MUs, encompassing a mix of native and non-native dominated habitat. For management purposes OANRP staff has informally divided the MU into two areas. Plant community health monitoring was conducted separately for the two areas because they are managed by different field teams and have relatively different ecosystem restoration strategies. For details on the management strategy for these two areas refer to the 2009 and 2012 OANRP Status Reports for, respectfully, the Ohikilolo (Upper) and Ohikilolo (Makua) Five Year Plans.

Ohikilolo Upper Plant Community Health Monitoring

In 2010, plant community health baseline data were collected for Ohikilolo Upper (refer to figure 1). In order to monitor for changes in plant community composition over time and to assess whether or not the trend indicates a positive trajectory towards reaching MIP long-term ecosystem restoration goals. These data will be collected every six years.

Priority Area Plant Community Health Monitoring

The 2010 Ecosystem Restoration Plan for Ohikilolo Upper outlined a priority list of short-term five year threat control management actions and associated benchmark goals. The priority management action for non-native vegetation was to conduct Weed Control Area (WCA) level weed sweeps across native forest patches and implement localized weed control around managed taxa (OANRP, 2012 Status Report). In order to help guide the short-term weed control strategy for these priority WCAs, the vegetation monitoring plots that were within priority WCAs, were re-monitored in 2013.

The following analysis serves as a plant community health assessment for priority areas of Ohikilolo Upper from 2010 to 2013 (Figure 2). Since the plant community monitoring protocol was designed to address multiple MU level management goals, the following results were separated into sections. The goals, monitoring objectives, and statistical thresholds used for analysis came from the MIP.
Appendix 1-5 Ohikilolo Upper Plant Community Health Monitoring Results

Figure 1: Ohikilolo Upper

Figure 2: Priority Vegetation Monitoring Plots
Section 1:

MIP Plant Community Health Percent Cover Goals

*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 (MIT 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 (MIT 2003).
  - If native species percent cover is not met, determine if this value is increased significantly toward that goal based on repeated monitoring of the MU.

*Sampling Objective:*
  - Be 90% confident of detecting a 10% change in both non-native and native understory vegetation in the understory and canopy.
  - The acceptable level of making a Type I error (detecting a change that did not occur) is 10% and a Type II error (not detecting a change that did occur) is 20%.
  - Minimum detected change between two samples being compared is 10% over the sampling period.

*Vegetation Monitoring Protocol:*
  - Refer to the monitoring section of the OANRP 2008 Year End Report.

Data Analysis and Results

To determine if non-native and native vegetation met the primary MU level management goal for the priority weed control area in 2010 and 2013, native and non-native total percent cover values were calculated. Since the distributions were non-normal, the median value provided the most accurate description of percent cover values. To assess percent cover change over time, the 2010 baseline percent cover values for native and non-native vegetation was subtracted from the 2013 percent cover values. As the sampled plots were permanent, a matched pairs design was used for analysis. A negative value indicated a decrease in percent cover, a positive value indicated an increase, and zero indicated no significant trend. The percent cover data were collected in 10% interval ranges but for reporting purposes the average was calculated (e.g. 20-30% cover interval was reported as 25%).

*Non-Native Percent Cover: Understory*

The vegetation monitoring percent cover goal was met in 2010 and 2013 for the non-native understory strata, with a median percent cover of 45% in both years. Over the three year-period, no significant difference in percent cover was detected between years (Wilcoxon = 434.0, p = 0.969).

*Non-Native Percent Cover: Canopy*

The non-native percent cover goal was met for the canopy strata, with a median percent canopy cover of 15% in both years. Over the three year-period, no significant difference in percent cover was detected between years (Wilcoxon = 137.0, p=0.334).
The results for the non-native percent cover goals for the understory and canopy strata suggest that the non-native weed control strategy was sufficient to maintain the MIP management goal for the Ohikilolo Upper priority areas. It also indicated that the overall ecosystem level habitat restoration strategy was effective at maintaining the required MIP level of ecosystem protection for rare species restoration actions to occur in those priority areas.

Native Percent Cover: Understory

The native percent cover goal was met for the understory strata in both years, with a median percent cover of native vegetation in the understory of 65% in 2010 and 55% in 2013. Though the median percent cover was higher in 2010, no significant difference was detected between years (W=209.5, p = 0.891), indicating the percent cover did not change more than the minimum detectable change threshold over the three year period.

Carex meyenii was one of the most dominant understory species established across Ohikilolo Upper, occurring in 91% percent of the monitoring plots in 2013. During field monitoring data collection, it was noticed that C. meyenii was relatively persistent, occurring in both native forest patches and highly disturbed sections of the MU. There was concern that C. meyneii might have influenced total native understory percent cover, causing changes in other native vegetation in the understory to be missed. For this reason, the total percent cover of native vegetation was separated into three different growth form categories - woody shrubs, ferns, grasses and sedges.

Both ferns and woody shrubs had the same percent cover, with a median of 25% both years. For the fern category, no significant difference was detected (Wilcoxon = 242.0, p=0.372), indicating the percent cover had not changed over time. For woody shrubs, a marginally significant increase was detected (Wilcoxon = 327.5, p=0.052), which may indicate that there was a slight increase in percent cover for this category over the three year period. Results should be interpreted with caution, given the marginally significant p value.

The growth form category trends for the understory strata suggested that the percent cover of Carex meyenii did not cause total percent cover values to misrepresent overall native percent cover trends. It also indicated that the three categories of native vegetation in the understory where stable and that woody shrubs may have slightly increased over the monitoring period. These results were encouraging signs of ecosystem recovery.

Native Percent Cover: Canopy

The native canopy percent cover goal was not met for the canopy strata, with a median percent canopy cover of 25% in both years. In addition, no significant change in native percent canopy cover was detected (Wilcoxon = 460.0, p = 0.103) over the three-year period.

OANRP managers have questioned if the recommended > 50% goal for the native canopy percent cover was appropriate for Ohikilolo Upper, given it is unknown if the canopy cover was more than 50% prior to the introduction of ungulates and non-native vegetation. For this reason, to assess if ecosystem level protection had been achieved more emphasis was placed on native percent canopy cover trends over time. A stable or increase in percent cover over time would indicate a positive trend and a decrease would indicate a negative trend. The fact that a significant difference was not detected for native percent canopy cover suggested that the priority area of Ohikilolo Upper was stable over the three-year period.
Native and non-native dominated sections of Kahanahai, another MU, had changed in opposite directions over a three-year period, with a positive plant community health trend for native dominated sections of the MU and a negative trend for non-native dominated sections. For this reason within MU trends were analyzed for Ohikilolo Upper priority area. The 2013 dataset was split into two groups, 50% native vegetation canopy cover was used as the threshold for stratification purposes. More than 50% native canopy cover considered ‘native dominated’.

Following stratification, analysis was conducted in the same way as described in the beginning of this section (Data Analysis). The sample size for the native dominated strata was 17 plots and for the <50% native canopy cover strata it was 34 plots.
**Native Dominated Habitat:**
Between 2010 and 2013, no significant difference was detected for the percent cover of native or non-native vegetation in either the canopy or understory for the native dominated section of Ohikilolo Upper priority area (refer to figure 5). The results indicated that the weed control strategy was sufficient at maintaining the native canopy percent cover goal over the monitoring period.

<table>
<thead>
<tr>
<th>Vegetation Classification</th>
<th>Sample Size</th>
<th>Wilcoxon Statistic</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Native Understory</td>
<td>34</td>
<td>158.5</td>
<td>0.306</td>
</tr>
<tr>
<td>Non-Native Understory</td>
<td>34</td>
<td>161</td>
<td>0.345</td>
</tr>
<tr>
<td>Native Canopy</td>
<td>34</td>
<td>120</td>
<td>0.595</td>
</tr>
<tr>
<td>Non-Native Canopy</td>
<td>34</td>
<td>120</td>
<td>0.595</td>
</tr>
</tbody>
</table>

Figure 5: Native Dominated Habitat

**Percent Cover Change 2010 - 2013**

<table>
<thead>
<tr>
<th>Vegetation Classification</th>
<th>Sample Size</th>
<th>Wilcoxon Statistic</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Native Understory</td>
<td>34</td>
<td>158.5</td>
<td>0.306</td>
</tr>
<tr>
<td>Non-Native Understory</td>
<td>34</td>
<td>161</td>
<td>0.345</td>
</tr>
<tr>
<td>Native Canopy</td>
<td>34</td>
<td>120</td>
<td>0.595</td>
</tr>
<tr>
<td>Non-Native Canopy</td>
<td>34</td>
<td>120</td>
<td>0.595</td>
</tr>
</tbody>
</table>

Figure 6: <50% Native Percent Cover Stratum
The squares represent the median and the circles represent the mean. N = Native and X = Non-Native. Percent cover change over time (at p<0.10) are represented by an asterisks.

>50% Native Dominated Habitat:
For the native dominated stratum, the only significant difference detected was an increase in native vegetation in the canopy (Wilcoxon = 96.0, p = 0.007). For all other vegetation classifications, which included the native understory and non-native understory and canopy, no significant difference was detected. These results indicate that the weed control strategy for the native dominated section of the priority area of the Ohikilolo Upper MU was sufficient to prevent further invasion of non-native species. The increase in native vegetation may also be an additional indication of ecosystem recovery for the priority area of Ohikilolo Upper.
**Percent Cover Change**

<table>
<thead>
<tr>
<th>Vegetation Classification</th>
<th>Sample Size</th>
<th>Wilcoxon Statistic</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Native Understory</td>
<td>17</td>
<td>4</td>
<td>0.208</td>
</tr>
<tr>
<td>Non-Native Understory</td>
<td>17</td>
<td>71</td>
<td>0.081</td>
</tr>
<tr>
<td>Native Canopy</td>
<td>17</td>
<td>96</td>
<td>0.007</td>
</tr>
<tr>
<td>Non-Native Canopy</td>
<td>17</td>
<td>13.5</td>
<td>0.314</td>
</tr>
</tbody>
</table>

Figure 7: >50% Native Canopy Cover

Figure 8: >50% Native Percent Cover Stratum

The square represents the median and the circles represent the mean. N = Native and X = Non-Native. Significant percent cover change over time (at p<0.10) are represented by an asterisk.

**Conclusions to Date**

Overall, the percent cover trends indicated that canopy cover weed control efforts were sufficient to maintain MIP non-native percent cover goals for the Ohikilolo Upper priority area. The marginally significant increase in the percent cover of native woody shrubs in the understory was also a positive trend, indicating ecosystem recovery.

Post stratification analysis indicated that the native dominated sections of the MU recovered faster than non-native dominated sections of the MU, with a significant increase in native vegetation in the canopy. For the priority area with <50% native canopy cover, no significant difference in percent cover was detected. As this point, it is unclear if this section will remain stable or increase in native percent cover without augmentation of common natives or if more intensive ecosystem management will be required.

As additional years of data are collected, trends will allow management to assess if the current ecosystem level strategy will continue to be sufficient to maintain or decrease non-native canopy cover and maintain or increase native percent cover. If percent cover trends suggest a stable or positive trend, the ecosystem management strategy will remain the same. If trends indicate a negative trend, the results will trigger a review by OANRP management to evaluate the current strategy and adapt management if necessary.
Section 2:

Frequency of Occurrence Goals

Management Objective:
- Assess the spatial distribution and frequency of occurrence for both native and non-native species.
- Provide an updated priority weed species list for the Upper Ohikilolo MU.
- Identify any non-native vegetation that was not previously considered to be a threat on an MU scale.

Sampling Objective:
- Detect expansion or contraction in geographical distribution of native and non-native species on an MU scale.

Vegetation Monitoring Protocol:
- Refer to the monitoring section in the 2008 annual status report.

Data Analysis and Results

Geographical Distribution of Native and Non-Native Species:
To determine if a significant change in the geographical distribution of all species found in Ohikilolo Upper over time had occurred, frequency of occurrence data was analyzed. To assess if any of the documented species, within Ohikilolo Upper, had expanded or contracted in geographical range from 2010 to 2013, the percentage of plots that each taxon occurred in, was calculated for both years. To assess if a significant difference between years exists; the frequency of occurrence data was analyzed using a Chi-square test.

For the non-native canopy strata, a total of three species were documented, *Schinus terebinthifolius*, *Grevillea robusta*, and *Psidium cattleianum*. The most common non-native taxon was *S. terebinthifolius*, occurred in 65% of the plots in 2010 and 59% in 2013. *S. terebinthifolius* has been extremely successful at invading Ohikilolo and tends to create monotypic stands over time (qualitative field observation) if left uncontrolled. To prevent an increase in percent cover and expansion in the geographical range from 2010 to 2013, this taxon was designated as a primary target during WCA level weed sweeps.

From 2010 to 2013, no significant change in the geographical range of *S. terebinthifolius* was detected (Chi-Square value = 0.373, P = 0.541). However, the numerical decrease in the frequency of occurrence may suggest there was a decrease in the geographical range of *S. terebinthifolius* over the three-year period.

*Grevillea robusta* and *Psidium cattleianum* were the only other non-native species that were documented to occur in the canopy during the 2013 plant community health monitoring field data collection. The distribution for each taxon was relatively low and the long-term weed control goal, set in the Ohikilolo Upper Five Year Plan, was zero tolerance. From 2010 to 2013 there was no significant difference in the geographical distribution of *Grevillea robusta*, indicating the weed control strategy was sufficient to control range expansion of this taxon. Since *Psidium cattleianum* was controlled by the monitoring crew during the 2010 field data collection period, plant community monitoring data was not used to analyze trends, given the results were not representative of the weed control effort for this taxon across the priority area of Ohikilolo Upper. Given this, OANRP managers documented six immature *Psidium*
cattleianum that had established off the transect lines while conducting the 2013 field monitoring. If a noticeable increase in immature plants is observed the program staff should carefully examine the current control strategy for this taxon and adapt management if needed.

<table>
<thead>
<tr>
<th>Occurrence of Non-Native Canopy Taxa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schinus terebinthifolius</td>
</tr>
<tr>
<td>Grevillea robusta</td>
</tr>
</tbody>
</table>

Figure 8: The sample size was 51 plots.
Occurrence refers to the number of plots the species were present in.

Several other species that were controlled in the canopy and understory during the 2010 monitoring period were Psidium guajava, Passiflora suberosa, Leucaena leucocephala, Casuarina glauca, Toona ciliata, and Syzygium cumini. Like Psidium cattleianum, plant community monitoring data was not used to analyze trends. It was, however, an encouraging sign that none of these species were detected in the monitoring plots during the 2013 monitoring period.

For native taxa that occurred within the priority section of Ohikilolo Upper, no significant changes in the geographical movement were detected. Though these results indicated there was not a significant expansion in the distribution of native species, it was an encouraging sign that the distribution was stable over the three year period.

Species Richness Analysis and Vegetation Monitoring Checklist:
The 2010 baseline vascular plant list documented from Ohikilolo Upper priority areas was updated using the 2013 monitoring datasets (refer to the Species List and Frequency tables below). Within the canopy, a total of 30 plant species were recorded. Of all the species that were documented in the canopy, 27 (90%) were native and 3 (10%) were non-native. In the understory a total of 115 species were recorded; 70 (61%) were native and 45 (39%) were non-native. For a complete list, refer to the vegetation monitoring checklist at the end of this document. In addition to updating the species list, analysis was conducted to determine if there had been a change in species richness between 2010 and 2013. For the canopy, the non-native species richness decreased by 1 taxon and the native species richness increased by 1 taxon. For the understory, non-native species richness remained the same both years and the native species richness decreased by 4 taxa. These differences were not significant, indicating species diversity did not change over the three-year interval.

Conclusions to Date

No significant changes for the geographical distribution of any of the native or non-native species were detected over the three-year period. In addition, no significant change in species richness was detected form 2010 to 2013. These results were encouraging signs that the weed control strategy, over the three-year period, was sufficient in preventing further invasion of non-native species.
References:


## Checklist of Non-Native Species in the Canopy Stratum

<table>
<thead>
<tr>
<th>Species Name</th>
<th>Percent Occurrence (out of 51 plots)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schinus terebinthifolius</td>
<td>58.82%</td>
</tr>
<tr>
<td>Grevillea robusta</td>
<td>5.88%</td>
</tr>
<tr>
<td>Psidium cattleianum</td>
<td>1.96%</td>
</tr>
</tbody>
</table>

## Checklist of Non-Native Species in the Understory Stratum

<table>
<thead>
<tr>
<th>Species Name</th>
<th>Percent Occurrence (out of 51 plots)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melinis minutiflora</td>
<td>70.59%</td>
</tr>
<tr>
<td>Stachytarpheta dichotoma</td>
<td>70.59%</td>
</tr>
<tr>
<td>Schinus terebinthifolius</td>
<td>62.75%</td>
</tr>
<tr>
<td>Ageratina riparia</td>
<td>56.86%</td>
</tr>
<tr>
<td>Ageratina adenophora</td>
<td>49.02%</td>
</tr>
<tr>
<td>Setaria gracilis</td>
<td>43.14%</td>
</tr>
<tr>
<td>Erigeron karvinskianus</td>
<td>39.22%</td>
</tr>
<tr>
<td>Kalanchea pinnata</td>
<td>37.25%</td>
</tr>
<tr>
<td>Rubus roxifolius</td>
<td>31.37%</td>
</tr>
<tr>
<td>Conyza bonariensis</td>
<td>25.49%</td>
</tr>
<tr>
<td>Lantana camara</td>
<td>25.49%</td>
</tr>
<tr>
<td>Christella parasitica</td>
<td>19.61%</td>
</tr>
<tr>
<td>Paspalum conjugatum</td>
<td>15.69%</td>
</tr>
<tr>
<td>Triumfetta semitriloba</td>
<td>15.69%</td>
</tr>
<tr>
<td>Andropogon virginicus</td>
<td>13.73%</td>
</tr>
<tr>
<td>Grevillea robusta</td>
<td>9.80%</td>
</tr>
<tr>
<td>Melinis repens</td>
<td>9.80%</td>
</tr>
<tr>
<td>Verbena litoralis</td>
<td>7.84%</td>
</tr>
<tr>
<td>Cheilanthes viridis</td>
<td>5.88%</td>
</tr>
<tr>
<td>Christella dentata</td>
<td>5.88%</td>
</tr>
<tr>
<td>Gamochaeta purpurea</td>
<td>5.88%</td>
</tr>
<tr>
<td>Araucaria columnaris</td>
<td>3.92%</td>
</tr>
<tr>
<td>Opismsenus hirtellus</td>
<td>3.92%</td>
</tr>
<tr>
<td>Oxalis corniculata</td>
<td>3.92%</td>
</tr>
<tr>
<td>Sporobolus indicus</td>
<td>3.92%</td>
</tr>
<tr>
<td>Adiatum hispidulum</td>
<td>1.96%</td>
</tr>
<tr>
<td>Ageratam conyzoides</td>
<td>1.96%</td>
</tr>
<tr>
<td>Asclepias physocarpa</td>
<td>1.96%</td>
</tr>
<tr>
<td>Bidens pilosa</td>
<td>1.96%</td>
</tr>
<tr>
<td>Buddleia asiatica</td>
<td>1.96%</td>
</tr>
<tr>
<td>Centaurium erythraea</td>
<td>1.96%</td>
</tr>
<tr>
<td>Species Name</td>
<td>Percent Occurrence (out of 51 plots)</td>
</tr>
<tr>
<td>-------------------</td>
<td>-------------------------------------</td>
</tr>
<tr>
<td>Clidemia hirta</td>
<td>1.96%</td>
</tr>
<tr>
<td>Cuphea carthagenes</td>
<td>1.96%</td>
</tr>
<tr>
<td>Emilia fosbergii</td>
<td>1.96%</td>
</tr>
<tr>
<td>Erichites valerianifolia</td>
<td>1.96%</td>
</tr>
<tr>
<td>Opuntia cochenillifera</td>
<td>1.96%</td>
</tr>
<tr>
<td>Panicum repens</td>
<td>1.96%</td>
</tr>
<tr>
<td>Phaius tankervilleae</td>
<td>1.96%</td>
</tr>
<tr>
<td>Psidium cattleianum</td>
<td>1.96%</td>
</tr>
<tr>
<td>Rhyncospora sp.</td>
<td>1.96%</td>
</tr>
<tr>
<td>Schefflera actinophylla</td>
<td>1.96%</td>
</tr>
<tr>
<td>Sonchus oleraceus</td>
<td>1.96%</td>
</tr>
<tr>
<td>Toona ciliata</td>
<td>1.96%</td>
</tr>
<tr>
<td>Youngia japonica</td>
<td>1.96%</td>
</tr>
</tbody>
</table>

**Checklist of Native Species in the Canopy Stratum**

<table>
<thead>
<tr>
<th>Species Name</th>
<th>Percent Occurrence (out of 51 plots)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metrosideros polymorpha</td>
<td>47.06%</td>
</tr>
<tr>
<td>Metrosideros tremuloides</td>
<td>37.25%</td>
</tr>
<tr>
<td>Dodonaea viscosa</td>
<td>35.29%</td>
</tr>
<tr>
<td>Freycinetia arborea</td>
<td>27.45%</td>
</tr>
<tr>
<td>Elaeocarpus bifidus</td>
<td>19.61%</td>
</tr>
<tr>
<td>Myrsine lessertiana</td>
<td>19.61%</td>
</tr>
<tr>
<td>Alyxia oliviformis</td>
<td>17.65%</td>
</tr>
<tr>
<td>Cibotium chamissoi</td>
<td>17.65%</td>
</tr>
<tr>
<td>Acacia koa</td>
<td>15.69%</td>
</tr>
<tr>
<td>Psychotria maritiana</td>
<td>13.73%</td>
</tr>
<tr>
<td>Coprosma foliosa</td>
<td>11.76%</td>
</tr>
<tr>
<td>Psychotria hathewayi</td>
<td>5.88%</td>
</tr>
<tr>
<td>Syzygium sandwicensis</td>
<td>5.88%</td>
</tr>
<tr>
<td>Antidesma platyphyllum</td>
<td>3.92%</td>
</tr>
<tr>
<td>Cocculus orbiculatus</td>
<td>3.92%</td>
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<tr>
<td>Melicope oahuensis</td>
<td>3.92%</td>
</tr>
<tr>
<td>Nestegis sandwicensis</td>
<td>3.92%</td>
</tr>
<tr>
<td>Pritchardia kaalae</td>
<td>3.92%</td>
</tr>
<tr>
<td>Bobea elatior</td>
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<tr>
<td>Dicranopteris linearis</td>
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</tr>
<tr>
<td>Diospyros sandwicensis</td>
<td>1.96%</td>
</tr>
<tr>
<td>Korthalsella complanata</td>
<td>1.96%</td>
</tr>
<tr>
<td>Melicope kaalanensis</td>
<td>1.96%</td>
</tr>
<tr>
<td>Scaevola gaudichaudiana</td>
<td>1.96%</td>
</tr>
<tr>
<td>Species Name</td>
<td>Percent Occurrence (out of 51 plots)</td>
</tr>
<tr>
<td>--------------------------------------------------</td>
<td>---------------------------------------</td>
</tr>
<tr>
<td>Wikstroemia oahuensis var. oahuensis</td>
<td>1.96%</td>
</tr>
<tr>
<td>Xylosma hawaiiense</td>
<td>1.96%</td>
</tr>
<tr>
<td><strong>Checklist of Native Species in the Understory Stratum</strong></td>
<td></td>
</tr>
<tr>
<td>Carex meyenii</td>
<td>90.20%</td>
</tr>
<tr>
<td>Metrosideros polymorpha</td>
<td>66.67%</td>
</tr>
<tr>
<td>Doodia kunthiana</td>
<td>64.71%</td>
</tr>
<tr>
<td>Myrsine lessertiana</td>
<td>62.75%</td>
</tr>
<tr>
<td>Dodonaea viscosa</td>
<td>56.86%</td>
</tr>
<tr>
<td>Alyxia stellata</td>
<td>54.90%</td>
</tr>
<tr>
<td>Cocculus orbiculatus</td>
<td>54.90%</td>
</tr>
<tr>
<td>Coprosma foliosa</td>
<td>45.10%</td>
</tr>
<tr>
<td>Sphenomeris chinensis</td>
<td>45.10%</td>
</tr>
<tr>
<td>Metrosideros tremuloides</td>
<td>43.14%</td>
</tr>
<tr>
<td>Freycinetia arborea</td>
<td>41.18%</td>
</tr>
<tr>
<td>Pteridium aquilinum</td>
<td>41.18%</td>
</tr>
<tr>
<td>Nephrolepis exaltata subsp. hawaiiensis</td>
<td>33.33%</td>
</tr>
<tr>
<td>Psychotria mariniana</td>
<td>29.41%</td>
</tr>
<tr>
<td>Elaeocarpus bifidus</td>
<td>27.45%</td>
</tr>
<tr>
<td>Pritchardia kaalae</td>
<td>27.45%</td>
</tr>
<tr>
<td>Cibotium chamissoni</td>
<td>25.49%</td>
</tr>
<tr>
<td>Dryopteris fusco-atra</td>
<td>25.49%</td>
</tr>
<tr>
<td>Dryopteris sandwicensis</td>
<td>25.49%</td>
</tr>
<tr>
<td>Microlepia strigosa</td>
<td>23.53%</td>
</tr>
<tr>
<td>Antidesma platyphyllum</td>
<td>21.57%</td>
</tr>
<tr>
<td>Dryopteris glabra</td>
<td>21.57%</td>
</tr>
<tr>
<td>Lythrum maritimum</td>
<td>19.61%</td>
</tr>
<tr>
<td>Acacia koa</td>
<td>15.69%</td>
</tr>
<tr>
<td>Carex wahuensis</td>
<td>15.69%</td>
</tr>
<tr>
<td>Psychotria hathewayi</td>
<td>15.69%</td>
</tr>
<tr>
<td>Gahnia beecheyi</td>
<td>13.73%</td>
</tr>
<tr>
<td>Selaginella arbuscula</td>
<td>13.73%</td>
</tr>
<tr>
<td>Athyrium microphyllum</td>
<td>9.80%</td>
</tr>
<tr>
<td>Eragrostis grandis</td>
<td>9.80%</td>
</tr>
<tr>
<td>Lepisorus thungbergianus</td>
<td>9.80%</td>
</tr>
<tr>
<td>Melicope oahuensis</td>
<td>9.80%</td>
</tr>
<tr>
<td>Viola chamissoniana</td>
<td>9.80%</td>
</tr>
<tr>
<td>Bidens torta</td>
<td>7.84%</td>
</tr>
<tr>
<td>Deparia proliferata</td>
<td>7.84%</td>
</tr>
<tr>
<td>Elaphoglossum pallaceum</td>
<td>7.84%</td>
</tr>
<tr>
<td>Kadua acuminata</td>
<td>7.84%</td>
</tr>
<tr>
<td>Species Name</td>
<td>Percent Occurrence (out of 51 plots)</td>
</tr>
<tr>
<td>-------------------------------------------------</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td>Kadua terminalis</td>
<td>5.88%</td>
</tr>
<tr>
<td>Lysimachia hillebrandii</td>
<td>5.88%</td>
</tr>
<tr>
<td>Scaevola gaudichaudiana</td>
<td>5.88%</td>
</tr>
<tr>
<td>Asplenium horridum var. horridum</td>
<td>3.92%</td>
</tr>
<tr>
<td>Christella cyathooides</td>
<td>3.92%</td>
</tr>
<tr>
<td>Dicranopteris linearis</td>
<td>3.92%</td>
</tr>
<tr>
<td>Diospyros sandwicensis</td>
<td>3.92%</td>
</tr>
<tr>
<td>Doryopteris decora</td>
<td>3.92%</td>
</tr>
<tr>
<td>Melicope kaalanensis</td>
<td>3.92%</td>
</tr>
<tr>
<td>Nestegis sandwicensis</td>
<td>3.92%</td>
</tr>
<tr>
<td>Pouteria sandwicensis</td>
<td>3.92%</td>
</tr>
<tr>
<td>Syzygium sandwicensis</td>
<td>3.92%</td>
</tr>
<tr>
<td>Artemisia australis</td>
<td>1.96%</td>
</tr>
<tr>
<td>Bobea elatior</td>
<td>1.96%</td>
</tr>
<tr>
<td>Cryptocarya manii (this must be a different species)</td>
<td>1.96%</td>
</tr>
<tr>
<td>Cyrtandrae waiolani</td>
<td>1.96%</td>
</tr>
<tr>
<td>Korthalsella complanata</td>
<td>1.96%</td>
</tr>
<tr>
<td>Luzula hawaiiensis</td>
<td>1.96%</td>
</tr>
<tr>
<td>Myrsine lanaiensis</td>
<td>1.96%</td>
</tr>
<tr>
<td>Nephrolepis cordifolia</td>
<td>1.96%</td>
</tr>
<tr>
<td>Osteomeles anthyllidifolia</td>
<td>1.96%</td>
</tr>
<tr>
<td>Panicum nephephophilum</td>
<td>1.96%</td>
</tr>
<tr>
<td>Phyllanthus distichus</td>
<td>1.96%</td>
</tr>
<tr>
<td>Pipturus albidus</td>
<td>1.96%</td>
</tr>
<tr>
<td>Platydesma cornuta var. decurrens</td>
<td>1.96%</td>
</tr>
<tr>
<td>Polypodium pellucidum var. pellucidum</td>
<td>1.96%</td>
</tr>
<tr>
<td>Psilotum nudum</td>
<td>1.96%</td>
</tr>
<tr>
<td>Sadleria pallida</td>
<td>1.96%</td>
</tr>
<tr>
<td>Tectaria gaudichaudi</td>
<td>1.96%</td>
</tr>
<tr>
<td>Vaccinium reticulatum</td>
<td>1.96%</td>
</tr>
<tr>
<td>Wikstroemia oahuensis var. oahuensis</td>
<td>1.96%</td>
</tr>
</tbody>
</table>