Appendix 2
MIP/OIP NATURAL RESOURCES MONITORING PROGRAM

Monitoring Protocol 1.2.1
Belt Plot Sampling for Understory, Weeds, and Canopy

22 September 2008

INTRODUCTION

The U.S. Army is currently involved in a major conservation effort to stabilize populations of endangered plant and animal species within lands they manage on the island of O‘ahu. These actions are conducted by the Army’s Environmental Division (AED) following strategies described in the Makua Implementation Plan (MIP) (Gon et al. 2001, Makua Implementation Team et al. 2003) and the O‘ahu Implementation Plan (OIP) (In Prep.). Both of these plans specify that monitoring will be conducted as part of the species stabilization efforts to evaluate the response of both the target species and their habitats to conservation management actions.

To meet this requirement, monitoring protocols are developed for each management unit (MU) and target species population unit (PU) to assess changes in distribution and abundance of populations of native and alien plant species, as well as changes in distribution, structure, and composition of the dominant plant communities. The monitoring protocol described in this document focuses on monitoring both overstory and understory components of the plant communities within the U.S. Army’s Makua and O`ahu natural resource management units. This protocol includes collecting data on vegetation structure, species composition, and species cover for both native and alien plant species, which can be used to track changes in these parameters relative to ongoing and future management actions in this area.

Monitoring Objectives

Primary Objectives

1. Assess the cover of alien plant species within a specific MU to determine if it is less than 50% across the sampled unit or continuing to decrease to ultimately meet that threshold requirement (Makua Implementation Team et al. 2003).

2. If alien species cover is not below the 50% threshold, determine if this value is decreasing significantly toward that goal based on repeat monitoring of the MU.

Secondary Objectives

1. Monitor the status of native plant species within the MU and determine if their cover changes relative to management actions conducted within the unit.

2. Assess the status and changes in bare ground (not vegetated areas) within the MU relative to management actions conducted within the unit.

3. Determine if any ungulates (feral pigs or goats) are detected within the fenced portion of a MU.

Statistical Thresholds

All of the sampling and analysis methods addressed in this protocol are based on the following assumptions:

- The probability of making a Type I error (detecting change or difference when none exists) is <10% (Alpha = .10)
- The probability of making a Type II error (missing change or difference that does exist) is <20%.
- Minimum detected change or difference between two samples being compared is 20% over the sampling period. This threshold may be revised in cases where the resulting needed sample size is too large to be practical.

Sample Size Considerations

An optimal sample size will be calculated following the collection of the initial set of data at a particular MU. Sampling effort will be stratified by the major plant communities within the unit, but may be pooled for analysis. For the first sampling effort within each MU, at least 100 sample plots will be established with no less than 10 plots per each plant community stratum. The results of this baseline survey will be used to assess the total sample size needed to monitor changes in species cover for the unit.

FIELD SAMPLING

Sampling Framework

Vegetation sampling within the MUs is conducted using both transects and rectangular plots that are established throughout the area using a systematic sampling scheme with a random start for the initial point. Since several different vegetation units may be found within each MU, the sample plots will be post-stratified into the different communities for analysis. It was decided that pre-stratification was not practical since the plant communities are closely interdigitated within the MU,(e.g., transects crossing both ridges and gulches), and some of the units may change significantly in plant species distribution, composition, or vegetation structure as a result of management actions within the unit, particularly following removal of ungulates and weeding.

Transect and Plot Layout

Using ArcMap a base line is selected running across the long axis of the MU. Along this base a series of points at 10 m intervals are plotted to serve as potential starting points for the first transect. One of these points is selected using a random numbers table and used to establish the

first transect in the MU, running perpendicular to the base line. Additional transects are then placed at a set intervals parallel to the initial transect, extending to encompass the entire MU with care to ensure that the interval does not favor a particular vegetation zone over another. Transects within a MU are numbered from north to south, with the zero point established at the end with highest elevation on the initial reference transect. All other transects within the MU then follow this numbering orientation. Initial location coordinates and for the start points for each transect are obtained from the GIS and used to locate the sampling points in the field. Compass bearings for transects are also generated using the GIS. When transects and plots are sampled for the first time, location coordinates are taken using a field GPS unit. Both the GIS and GPS should be setup using UTM Zone 4 projection and NAD 83 datum base.

Sampling plots are located along each transect. Each plot is 5 m wide (extending 2.5 m to each side of the transect line), and 10 m long. The distance between the end of a plot and the start of the next plot will be determined based on vegetation strata. The spacing will be set in order to ensure an adequate number of plots in each . However, for small MUs, this distance may be reduced (even down to zero) to allow for the establishment of at least 100 plots within the unit.

The start point for the first plot on each transect within a MU is located using the GIS-generated coordinates. From this point a meter tape or pull-line marked with 5 m intervals is fixed and extended along the GIS-generated azimuth for the transect. The start and end points for each plot are marked using yellow and blue colored flagging tape tied to a woody stem within 30 cm of the actual point. If there is not a suitable place to tie the flagging within this distance, it is tied to a PVC pipe that is pounded into the ground. An aluminum tag with the transect number and distance is also tied to this point.

If it is impossible (due to terrain) or inappropriate (due to sensitivity of the area) to continue the transect along the specified bearing, the compass heading should be changed by 45 degrees away from the impediment. As soon as the terrain permits, complete the sampling plot, then return to the original compass heading prior to delineating a new plot. (NEEDS FIGURE).

Data Collection

Within each plot, data are recorded on cover in several pre-defined plant species associations, as well as the presence and cover of each species by specified vegetation layers, using the Belt Plot Sampling Field Form (Appendix 2.1) or this form loaded onto a field PDA unit or data logger. In addition to recording plant data, information is recorded on when the plot was sampled and observer names, data on the plot location (GPS coordinates), plant community type, if photographs were taken, and other comments on the site or conditions.

Understory vegetation is considered to be all live foliage up to 2 m from the surface of the ground; canopy vegetation is foliage that is greater than 2 m above the ground. Dead foliage on the ground is considered to be litter and is not recorded. Bare ground is defined as areas from 0 – 10 cm above the ground surface that are not directly covered by live foliage. Cover values for both species and species associations are estimated in 10% cover classes, except for values less than 10% cover which are estimated at finer resolution (Table 1). When estimating cover values it is best to have two people independently come up with a value, then discuss the results to arrive at the consensus value that is recorded on the data form.

Species are recorded on the form using the standard 3x3 species field code. For any species that cannot be determined in the field, enter the three letter code for the genus followed by "sp" (e.g., Melicope sp. is recorded as MelSp). Indicate in the comments section if a specimen was collected to help with identification. If this is the case, make sure that the determined name is added to the field form as soon as possible. For plants that cannot be determined to genus, enter UNKSP1 (for unknown species 1), and indicate that a collection was made for final determination.

DATA MANAGEMENT

Database Description

A relational database has been designed in MS Access to allow for data entry and management prior to analysis. This database consists of a set of linked tables, queries that are used to join fields together, a data entry form and related subforms, as well as several data report forms. This database is described in Appendix 2.3.

Data Entry and QA/QC

If data were collected using a paper field form, all of the information is entered into the monitoring database using the main data entry form (Belt_Plot_Main) (see Appendix 3). This form allows for several functions including initial data entry and update, creation of new entries for the Observers and Plant Communities fields, as well as running reports used to check the data. If data are entered into the database manually, it is important that a subset (at least 10%) of the entered records is randomly selected and all entries checked for accuracy against the data on the original field sheets. If >10% of these records contain errors in fields other than the Comments field, all records will need to be verified and corrected prior to doing another quality check.

DATA ANALYSIS

Data will be analyzed utilizing both parametric and non-parametric methods, depending on how well they meet the assumptions needed for the various tests. Data analysis for each MU will consist of two steps: baseline analyses following collection of the initial set of data, and analyzing changes in variables over time after the completion of each new sampling effort at the MU.

Baseline Data Analysis

Descriptive statistics will be calculated for all variables following collection of the initial baseline data for each MU and this information will be used to assess current conditions of the variables relative to the monitoring objectives and to help decide what analysis strategies will be appropriate. Additionally, the baseline data will be used to assess the adequacy of sample sizes for the most important variables.

Trend Analysis

After data are collected, following the completion of a new monitoring cycle, analyses will be performed to assess trends of selected variables relative to the thresholds identified in the monitoring objectives for this protocol. These analyses will include paired tests (to compare changes in variables between two specific points in time), trend analysis (e.g., regression analysis), and repeat measures ANOVA.

LITERATURE CITED

Gon, S. M., III, J. D. Jacobi, K. Kawelo, S. Kim, and J. Rohrer. 2001. The Makua Implementation Plan: a comprehensive species and habitat conservation program. Annual Meeting of the Society for Conservation Biology, Hilo, Hawaii.

Makua Implementation Team, Will Chee Planning Inc., and Hawaii Natural Heritage Program. 2003. Implementation Plan: Makua Military Reservation, Island of O‘ahu. Report, U.S. Army, Honolulu, HI.

APPENDIX 2.1

Field Data Form

MIP/OIP NATURAL RESOURCES MONITORING PROGRAM

Protocol 1.2.1 - Belt Plot Sampling for Understory, Weeds, and Canopy

Area or MU: _____ **Date:** _____ **Obs1:** _____

Obs2: _____

Transect: _____ **Plot Start:** _____ **Bearing:** _____ **Others:** _____

UTM Coordinates X: _____ **Y:** _____ **Err:** _____ **Datum:** _____

Ungulate Sign? Y N **Describe:** _____ **Photos:** _____

Veg Type: Alien Gulch Gulch Zone Wet Crest Uluhe Dom Other _____

Comments: _____

SP. ASSOCIATIONS						**COVER VALUES**	
		NS:		**XS:**			
		NF:		**XF:**		**<1 %**	**>40 - 50 %**
		NG:		**XG:**		**1 - 5 %**	**>50 - 60 %**
	Other	**:**		**:**		**>5 - 10 %**	**>60 - 70 %**
		Bryophytes:		**Not Veg:**		**>10 - 20 %**	**>70 - 80 %**
						>20 - 30 %	**>80 - 90 %**
	UNDERSTORY	**∑ Native:**		**∑ Alien:**		**>30 - 40 %**	**>90 - 100 %**

Sp Assn. or Layer	Species Code	% Cover	Notes	Sp Assn. or Layer	Species Code	% Cover	Notes

Native Canopy _____

LAYERS: Native Understory; Alien Understory; Tree Canopy **Alien Canopy** _____

Total Canopy _____

DATA ENTRY Entered by: Date:

DATA CHECK Checked by: Date:

APPENDIX 2.2

Data Entry Form for Database