Chapter 1 Ecosystem Management

Introduced species threaten endangered species and native ecosystems by altering habitat and disrupting community structure. Invasive vertebrates alter plant community structure and directly impact endangered plants, birds, snails and arthropods. Weedy plant species out-compete native plants for light, space and nutrients. NRS has been conducting ecosystem management on Army land for twelve years. The level of management has increased dramatically over the years, especially with the execution of the MIP and parts of the OIP. In general, this year NRS expanded the scope of weed control projects across all Management Units (MUs) and increased overall acreage protected from ungulates by fencing.

1.1 Introduction

Chapter Organization
Reporting format was revised to better reflect IP requirements and to present ecosystem management actions in a more unified manner. In previous years, ungulate control efforts and weed control efforts were discussed in separate chapters. This year, all ecosystem-level management is grouped together. Chapter 1 is divided into several sections. First, MIP/OIP requirements are discussed for ungulates, then weeds. Following this is the Weed Survey Report, which details results from LZ and road surveys. Next is the Incipient Weed Report, which discusses the results of incipient invasive species control. Lastly, the Ecosystem Management Report discusses ungulate control, ecosystem-level weed control (organized by Weed Control Areas, or WCAs), and any other issues affecting a particular region. The Ecosystem Management Report is organized into twelve geographical Regions, with each Region divided again into IP Management Units. Issues pertaining to all MUs in a Region are discussed within the Region introduction. Information specific to an MU is presented in the MU section. MU sections include an introduction, ungulate discussion, and weed control discussion. Only results from the past reporting year, Sept. 1, 2006 to Aug. 31, 2007 are discussed.

NRS Partnerships
The scope of the IPs necessitates NRS coordination with other agencies. Weed and ungulate control efforts on land not controlled by the Army are made possible only by the support of the various offsite land owners. Primary partner agencies include The Nature Conservancy of Hawaii (TNCH), Plant Extinction Prevention (PEP) staff, Kamehameha Schools (KS), the Board of Water Supply (BWS), Bishop Museum, Oahu Invasive Species Committee (OISC), and various State of Hawaii agencies, including the Natural Area Reserves System (NARS), State Forest Reserves, and State Parks. NRS rely on partner agencies for guidance on the location and prioritization of weed control areas, as well as types of weed control projects. Many ungulate control projects are joint efforts between NRS and a variety of partners, particularly fence construction, hunting, and snaring. NRS participates in the Feral Goat Working Group, which looks at goat issues island-wide. In particular, NRS works closely with the NARS Specialist to direct actions in the NARS, and with TNC to supplement on-going efforts in Honouliuli.

MIP and OIP Ungulate Management Requirements
There are two species of feral ungulates that inhabit O‘ahu, pigs (*Sus scrofa*) and goats (*Capra hircus*). The goal of the Army’s ungulate program is to eliminate impacts from these feral

animals on endangered species and native habitats by excluding them from the MIP and OIP MUs. This is primarily accomplished by constructing large-scale fences. Prior to the construction of the fences, NRS try to reduce ungulate pressure in the MUs using a multitude of techniques. These techniques include neck snares, hunting, aerial shooting using helicopters, and small PU fences. NRS use transects to help ascertain ungulate presence within the MUs. Most of the MIP and OIP MUs require a fence, but there are a few that do not. The need for a fence is indicated via shading per specific MU in Table 1.1. The status of ungulate control and fences is also included in this table. See the corresponding section in this chapter for maps of the units and more detailed discussion about the on-going ungulate management projects related to the MIP in the specific MUs. Only MUs with ungulate related issues significant to this reporting year will be discussed in detail.

Table 1.1.1 MIP Management Unit Status

Management Unit	Fenced	Ungulate Control	Threats
ARMY MANAGED LANDS			
Kahanahāiki	Partial	The 90 acre Subunit I has been ungulate free since 1998. Subunit II is proposed for construction in Year 3. Snaring is performed in this unit to keep pig pressure off of the Subunit I fence line and to protect the native resources in Subunit II.	Pigs
Kaluakauila	Yes	This MU is fenced and ungulate free.	None
Lower ʻŌhikilolo	Yes	The ʻŌhikilolo ridge fence and the strategic fence are both complete. In July 2006 four small goats breached the fence through a small hole. NRS have removed them from inside the fence.	Pigs Possibly
Lower ʻŌpaeʻula	No	The Koʻolau Mountains Watershed Partnership has acquired partial funding for fence construction. A Final EA has been approved with a Finding of No Significant Impact. A 10-15 year license agreement still has to be obtained prior to construction of the fence.	Pigs
ʻŌhikilolo	Partial	ʻŌhikilolo ridge fence is complete along with six smaller PU fences and all are ungulate free. The Lower Mākua fence is slated for construction in Year 7.	Pigs
Puʻu Kumakaliʻi	No	None needed	None
STATE OF HAWAII DEPARTMENT OF LAND AND NATURAL RESOURCES			
East Makaleha	No	A 230 acre fence is proposed for construction in Year 4. Limited goat control is currently underway in Central and East branches of Makaleha and Lower Kaʻala NAR under the direction of the NARS Specialist.	Pigs Goats
Haili to Keālia	No	None	None
Kaʻena	No	None	None
Keaʻau and Mākaha	No	Small PU fence slated for construction in year 5 awaiting approval.	Pigs Goats
Manuwai	No	MU fence is slated for construction in Year 8. An urgent action fence for *Neraudia angulata* is awaiting approval. Nearby goat populations are currently managed via hunting.	Pigs Goats

Management Unit	Fenced	Ungulate Control	Threats
Pahole	Yes	MU perimeter fence is complete and had been ungulate free. Four pigs breached the fence and a sow had a litter this past season. Four adults and five piglets have been eliminated so far. At this time, it appears that all of the pigs have been removed but NRS and NARS will continue to monitor the MU for confirmation	Pigs
Upper Kapuna	Partial		Pigs
Wai‘anae Kai	Partial	One PU fence has been completed and three others are proposed.	Pigs Goats
West Makaleha	Partial	Two PU fences are completed. A large fence has been proposed for this MU and is awaiting approval from the State. NRS and NARS staff controls a small herd of goats that reside on the boundary between this and the Pahole NAR.	Pigs Goats
THE NATURE CONSERVANCY OF HAWAII			
‘Ēkahanui	Partial	Subunit I was completed by TNCH and is ungulate free. Subunit II is partially completed but there has been some vandalism to this portion of the fence. NRS are awaiting the arrival of more materials to complete the fence. Several PU fences were constructed in 2004 to protect at risk species.	Pigs
Kalua‘a and Wai‘eli	Partial/ Pending	Subunit III was completed by TNCH and has been ungulate free. Unfortunately, there was a breach in the fence and twelve pigs were removed from within. NRS assisted TNCH to complete subunits II A and C as one combined subunit. Subunit II B is slated for construction in Year 10.	Pigs
Palikea	Partial	Small PU fences have been constructed in both Subunits IA and IB. Construction of the larger fence around Subunit IA has begun. NRS are awaiting the arrival of more materials to complete the fence.	Pigs
BOARD OF WATER SUPPLY			
Kamaile‘unu	Partial	One of the PU fences encompassing two populations of *Sanicula mariversa* has been completed. NRS is awaiting the arrival of more fencing materials to complete the second.	Pigs Goats
Mākaha	Partial	Subunit I has been completed. Several community/staff hunts have been completed and one pig has been taken. Subunits II and III are slated for construction in Year 5. NRS has completed a small PU fence around a population of *Cyanea longiflora* located with Subunit II.	Pigs Goats
DOLE FOOD COMPANY, INC.			
Kaimuhole	No	Dole is willing to give permission for construction of this MU fence if the State can come up with a conservation easement. The Army will not purchase the land for conservation purposes but would work there if the State owns an easement for 10 or 20 years	Goats Pigs
KAMEHAMEHA SCHOOLS, DLNR, HIRAM FONG TRUST			
Waiawā	No	MU perimeter fence is slated for construction in Year 9 but may be built earlier due to the overlap with OIP species. A 10-15 year license agreement must be obtained prior to construction of the fence.	Pigs

Shading in the table above indicates that ungulate management is needed for the MU.

Table 1.1.2 OIP Management Unit Status

Management Unit	Fenced	Ungulate Control	Threat
ARMY MANAGED LANDS			
East of Oio	Yes	There is a small 1 acre fence proposed to be constructed around a population of *Eugenia koolauensis*.	Pigs
Ka‘ala	Yes	The Army controlled side of the MU is fenced. It is unclear as to whether all of the pigs have been eradicated from the fence and whether any animals can get up into the the MU from the Waianae/ Mākaha side. Five pigs have been removed this year.	Pigs
Kaunala	Yes	A small 4.9 acre fence has been constructed around a population of *Eugenia koolauensis*.	Pigs
Oio	Yes	A small 3.3 acre fence has been constructed around a population of *Eugenia koolauensis*.	Pigs
‘Ōpae‘ula / Helemano	Yes	The Helemano portion of this combined fence unit was completed in May 2007 and is about 150 acres. This makes the combined size about 300 acres. Twelve pigs have been removed so far and NRS will continue to monitor until no more remain.	Pigs
Pahipahialua	Yes	A small 1.5 acre fence has been constructed around a population of *Eugenia koolauensis*.	None
STATE OF HAWAII DEPARTMENT OF LAND AND NATURAL RESOURCES			
Kaleleiki	Yes	A small 1.9 acre fence has been constructed by the State around a population of *Eugenia koolauensis*.	Pigs
THE NATURE CONSERVANCY OF HAWAII			
Puali‘i	Yes		
HAWAII RESERVES INC.			
Koloa	No		Goats

Shading in the table above indicates that ungulate management is needed for the MU.

Feral Ungulate Monitoring

Monitoring for ungulate sign takes place along ungulate monitoring transects, through incidental observations of ungulate activity, and scouting expeditions. Placement of transects is dictated by management needs, terrain, and manageability. Monitoring transects do not provide information on ungulate population dynamics or densities. They do help detect major changes in ungulate presence and provide managers with a general idea of changes in ungulate activity for a given area over time. This is especially important along fences where ingress can be immediately detected. It is often difficult to draw clear conclusions from transect data because there are many factors affecting field observations and ungulate activity. These factors may include: inclement weather, observer bias, transect placement, and/or topography. To offset these factors NRS do not read transects immediately after inclement weather, use experienced staff members to read transects, and place transects in habitats favored by the different ungulates.

Transects are 500 meters long by five meters wide. If the terrain is too rough or steep, transect lengths may be shorter. Monitoring stations are tagged and labeled every 10 meters along each transect. Observers record all fresh/old ungulate sign, including feeding, scat, rubbings, wallows, and trails for both pigs and goats within each of the 10 by 5 meter transect sections.

Scouting expeditions are used to scope for fresh sign and to look at movements of goat herds in the selected areas. Careful notes are taken on the size of the herd and the sex, age and color of individual members of each herd. This is primarily done prior to hunting operations in order to better direct the hunts and catalogue herd reduction.

Feral Ungulate Control Methods

Snaring

NRS utilize snares to control ungulates in areas that are remote and difficult to access. To increase effectiveness, snares are generally placed in narrow sections of well-used game trails and in areas with steep terrain. They have proven to be very successful in drastically reducing ungulate numbers especially when used in conjunction with other types of control methods. In 2006-2007, a total of 170 staff hours were spent checking and resetting snares which resulted in the removal of 31 pigs. This equals about three pigs per trip.

Shooting/Hunting

Shooting operations are mainly used to control goats although; under certain circumstances they have been used to control pigs as well. All operations are preceded by scouting expeditions which have proven to be a very successful method of increasing the effectiveness of control hunts. In 2006-2007, a total of 5 hunts were conducted, resulting in the removal of 33 goats. This equaled roughly 306 staff hours and 6.6 goats removed per hunt. These areas cover over 3,000 acres which are not currently fenced.

Aerial Shooting

Aerial shooting has only occurred at MMR. Aerial shooting has proven to be very effective at removing a significant portion of the goat population in remote portions of Mākua Valley in the past. Due to the huge decline in animal numbers in MMR, the cost effectiveness of this tool has severely decreased. NRS do not plan to conduct aerial hunts in MMR in the near future but will continue to keep it as an option should the need for aerial shooting arise again in the future. A lengthy approval process is required to obtain permission for using this control technique.

Radio-tracking

Radio and satellite tracking has only been used at MMR, see previous year end reports for specific information. NRS would like to explore the option of using these tools in Lower Ka‘ala NAR and Makaleha Gulch in the future. NRS is seeking to work with the NARS Specialist in this effort as it could greatly improve ungulate control efforts in this area.

Hunting with Dogs

The use of hunting dogs has been implemented in Kaluakauila, Ka‘ala, Mākaha and West Makaleha MUs. The use of hunting dogs as an ungulate management tool has proven to be a highly successful method of removing feral pigs from certain areas. This technique can be used as a means of eradicating animals within a fenced area or lowering pressure along a fence line. Seven hunts have been conducted in Mākaha since May with local community hunters and seven pigs were caught.

Fencing

Fencing is the most effective management tool to keep ungulates out of biologically sensitive areas. There are generally two ways that NRS constructs its fences. Enclosure type fences totally enclose an area by way of an unbroken line of fencing. Strategic type fences use a combination of topography and fencing to stop ingress/egress of feral ungulates into the protected area. NRS use a combination of galvanized hog wire fencing and panels when constructing enclosures. Hog wire fencing is an economical and practical product that can be easily erected over a broad range of terrain types. Hog panels are an expensive but very heavy-duty and durable product that performs well in steep terrain. Due to the additional cost of panels, they are only used in very steep or uneven terrain and when there is a very real threat of erosion compromising the fence.

MIP and OIP Weed Management Requirements

In preparation of this section, NRS reviewed existing documents related to Mākua Section 7 consultations including the Makua Biological Assessment (BA), the Makua Mitigation/Stabilization Plan, the Makua Biological Opinion, the MIP and Addendum, the Oahu BA, and the Oahu BO. None of these documents specify in a detailed manner the Army's weed control requirements but rather outline important areas related to weeds. These areas are: (1) Prevention of Weed Spread, (2) Surveys to detect new weeds before they become established, (3) Prioritization of weed control areas and projects, (4) Monitoring of MIP related weed control, and (5) Research.

1. Prevention of Weed Spread

One of the two main threats from military training at Mākua as outlined in the Army's BA was the introduction of weed species. This threat was not only related to inadvertent weed transport between Hawaiian Islands but also from locations beyond Hawai'i. The BA emphasized troop education as an important tool in reducing the number of introductions each year. NRS have prepared educational brochures and have briefed troops upon request regarding this issue. NRS also worked with Garrison support staff, in particular the Range Division road crews, Integrated Training Area Management (ITAM) crew, and contracted road improvement crews, in order to minimize weed spread due to road construction and maintenance. Figure 1.1.2 is an example of media used in briefings for military units. NRS hope to build on these past efforts. This year, two Public Outreach Specialists were hired. These staff will seek to reestablish reliable connections to the Garrison, continue educational briefings for road crews, improve training media, and seek out other educational avenues for troops. In November 2007, the Public Outreach Specialists will conduct trainings with the Environmental Compliance Officers (ECO) associated with each unit. These ECO trainings, held once a month by the Garrison, are an ideal opportunity to educate soldiers about natural resource threats posed by training.

Mākua related section 7 documents also emphasized gear cleaning infrastructure and procedures for military personnel. This area of the program needs improvement. NRS identified a number of weed species at Army training areas on O'ahu which may have originated at Pohakuloa Training Area (PTA) on Hawai'i Island. Many of these introductions may have been prevented if proper cleaning procedures were implemented at PTA. There is a wash rack at PTA for cleaning vehicles, and it is mandated for use prior to shipping vehicles back to O'ahu. However, clean vehicles leaving PTA must drive miles through land infested with highly invasive species

such as *Pennisetum setaceum* and *Senecio madagascariensis* to reach Kawaihae Harbor, negating the efficacy of the PTA wash rack. There is no similar wash rack at Kawiahae Harbor. NRS support finding solutions to this discrepancy in the coming year. There is a Standard Operating Procedure (SOP) dictating sanitation protocols that the troops are required to follow. Last year, the PTA Colonel reissued this SOP at NRS request. A wash rack was recently completed at Schofield Barracks East Range (SBE). It is used primarily by Stryker units training in SBE. The wash rack is well-used, and NRS will seek to ensure that this continues into the future. NRS are pursuing the addition of a settling basin, and in the meantime monitor the site for invasive species. With NRS help, ITAM updated their soldier cards (Figure 1.1.1) and created posters for the wash racks outlining incipient weed concerns. This past year, due to high turnover at ITAM, the environmental awareness component of their program was inactive. NRS will seek to reestablish communication with ITAM and continue to improve media products in the coming year.

Figure 1.1.1 ITAM training card cover

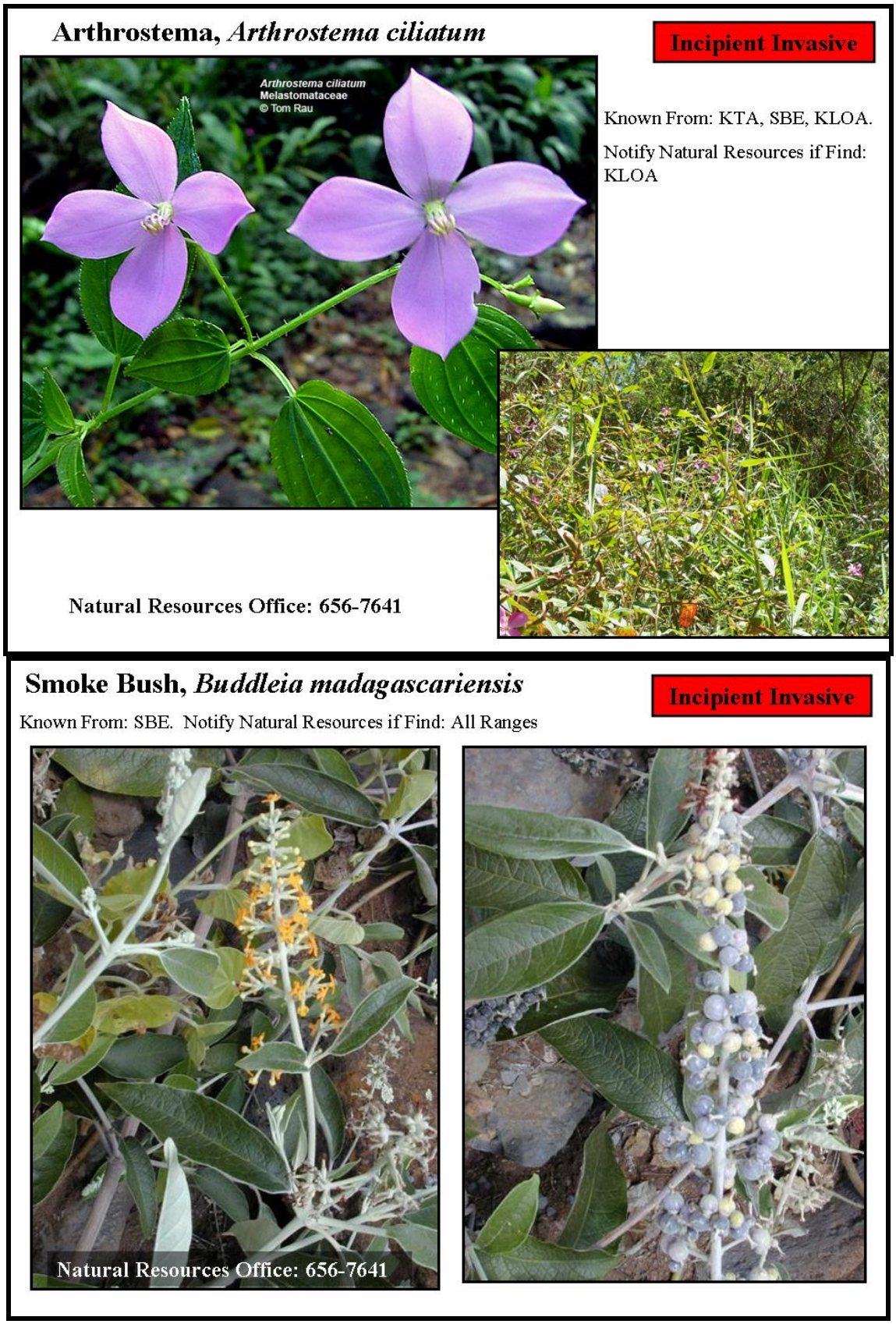

Figure 1.1.2 Invasive species identification cards

In order to reduce weed spread by NRS personnel, NRS have instituted several sanitation policies, described below. Awareness of possible weed problems is the best defense. NRS thinks critically about all field activities and their consequences.

- *Growing and planting.* All plants grown and planted are done so in accordance with MIP sanitization protocols. Sterile media is used to grow all plants and one inch of top soil is removed from plants before outplanting to prevent weed transport.
- *Vehicles.* All vehicles are washed and vacuumed at the end of the week. If a vehicle goes to a site known to have particularly invasive weeds, it is washed at the end of the day. An example of such a site is KTA, which receives heavy military use and is home to a number of habitat-altering invasive weeds.
- *Footwear.* NRS footwear is washed at the end of each work day. Each NRS has two sets of tabis, one dedicated for Wai‘anae and one for Ko‘olau Mountain work.
- *Fencing.* Fencing gear, including panels, posts, and fence rolls, are stored in a weed free storage area until needed. Fencing material is not recycled between management areas.
- *Helicopter operation materials.* Sling nets, straps and swivels are washed whenever they appear dirty. NRS evaluate each Landing Zone (LZ) based on the LZ weed list, and have identified LZs with weeds of concern. They include ‘Ōhikilolo, Ka`ala, and Palikea. After use at these sites, sling nets are washed.
- *Rat bait.* NRS use Ramik, a brand of rat bait that is not formulated with seeds, but rather with cracked corn, milled grain, and wax. None of these components are a potential source of weeds.
- *Personal gear.* NRS frequently wash backpacks, and other personal gear vectors to prevent spreading weeds. NRS avoid setting gear on incipient invasive taxa.

2. Surveys to detect new weeds before they become established

Regular surveys along potential military introduction corridors were identified as important in all Mākua Section 7 related documents. One of the greatest potentials for weed spread by the military is via vehicles along roads. The large vehicles and machinery used for training, and training support, such as road maintenance, are vectors for weed dispersal within and between ranges. Surveys are conducted yearly. NRS survey roads used most frequently by the military and also by NRS, to observe the distribution of weeds within training ranges. This allows NRS to detect and eradicate new weeds, therefore preventing them from becoming established in those ranges. NRS have been conducting road surveys on Army installations for more than six years, and occasionally add new roads to ensure that areas with military use are well surveyed. Offsite roads near MUs are also surveyed. These roads may be used primarily by NRS or by other users, including agricultural lessees. When Transformation occurs, road survey frequency will be re-evaluated.

Weed surveys are conducted on LZs for the same reason that they are conducted on roads: military and NRS helicopters serve as vectors for weed spread. NRS conduct surveys on LZs used heavily by military helicopters yearly and at all small NRS LZs whenever they are used.

Weed surveys are also conducted along ungulate transects. These transects are generally located along fence lines or major ridges. Pigs and goats are a dispersal vector, and fences are corridors along which vectors like pigs and humans can move. NRS track weed presence along these

transects to have a basic understanding of weed distribution. Since ungulate transects are generally monitored quarterly, it is convenient to monitor weeds at the same time along these heavily trafficked corridors.

To combat high-priority invasive species, NRS perform helicopter surveys to identify the extent of infestations that cannot be mapped from the ground. While performing aerial surveys, a GPS is used to map individual plants. These maps direct plant removal on the ground and greatly facilitate navigation to outlying targets. Detailed information about specific aerial surveys can be found in the MU discussions where these weeds are found.

Unidentifiable taxa are sent to Bishop Museum for identification. The staff of the Oahu Early Detection (OED) program, located at Bishop, assisted NRS greatly with timely identification of many samples this year. Upon identification, survey lists are updated to include these plants, and NRS research the significance of the presence and/or spread of this weed. If the weed is incipient, or considered problematic, NRS will work to control it in the same manner as all incipient weeds occurring in MUs. Otherwise, weeds that are new to the survey and are not considered problematic are added to the list, thus tracking the spread of less concerning taxa into new areas.

All survey data is entered into the Weed Database. The database can detect and search for new taxa on a particular survey, and can generate lists of the first observation date for any taxon at any survey location. All data from previous years is in the process of being entered into the database, creating a huge dataset.

3. Prioritization of weed control areas and projects

All the IP documents reviewed simply emphasize that weed control projects should be prioritized and plans developed in order to ensure that the projects with the most conservation value begin first. NRS prioritize incipient projects and WCAs containing 'Manage for Stability' PUs.

Incipient Weeds

Priorities for incipient weeds are determined based on the extent of the infestation, severity of the weed's potential impact if established, and control possibilities in terms of staff time required and control techniques. Weed Risk Assessments (WRA) conducted by the Pacific Islands Ecosystem at Risk (PIER) program are consulted to determine threats posed by weedy species. These risk assessments are available online at www.hear.org/PIER/index.html, along with a full explanation of how the assessments are conducted, and what each WRA score means. Table 1.1.3 outlines the recommendations associated with WRA scores. In general, the higher the score, the more invasive the species, and the greater the threat it poses to Hawaii's ecosystems.

Table 1.1.3 Weed Risk Assessment Score Interpretation

WRA Score, X	Score Interpretation
X<1	Low risk, low potential of becoming an invasive weed.
1<X<6	More study required, must pass through a second screening process.
X>6	High risk, great potential of becoming an invasive weed.

The IP goal for incipient weed control is "total removal". All incipient weeds controlled by NRS are discussed in the Incipient Weed Report. This year, NRS discuss the results of control by species, rather than area. Each site for each species is defined as an Incipient Control Area, or ICA. ICAs were intentionally drawn to encompass small geographic areas, to better track control efforts, declining plant counts, and eradication potential. Maps of target weed taxa and ICAs are included in the Incipient Weed Report. Achieving eradication can take many years and specific management objectives are needed for each ICA to guide control efforts. In general, preventing any individuals from maturing, setting seed, dispersing, and contributing to the seed bank is the first goal in ICA management. For each taxon, eradication criteria, based on seed longevity and time elapsed since plants seen, need to be established. NRS will work to do this for appropriate taxa in the coming year.

NRS reviewed Appendix 3.1, *Priority Weeds for Selected Management Units,* from the Final MIP dated May 2003. In this table, weeds were ranked to express the extent of their distribution by MU. This year, NRS reviewed each weed believed to be incipient/targeted for eradication (assigned a number "one" in the table). For a number of taxa, additional information has led to a change in status. For some, the weed management code as referenced in MIP Appendix 3.1 changed because they were found to be more abundant than previously thought and total removal is no longer feasible. In other cases, NRS resurrected particular weed taxa as their threat to rare plant PUs were clarified. Taxa reported as widespread last year are not reported on this year.

A summary of the weeds still believed to be high threats can be found below (Table1.1.4). The specific sites and/or distributions of many of the weeds are still being clarified by NRS. This is mostly the case on offsite areas, where NRS have not seen the species because they have not been into the areas where they occur. Where current locations are unknown, NRS aim to work with land managers to determine the locations of all of these weeds, to assess their threat levels, and begin control of the species if determined incipient. Although NRS still strive to achieve a better understanding of the list of weeds in Table 1.3, NRS already target several incipient weed species, mostly on Army controlled land. Please refer to the Incipient Weed Report for detailed control discussion.

Table 1.1.4 Summary of Incipient Taxa in MUs from Appendix 3.1 Final MIP

Management Unit	Incipient Taxa	Comments
ʻĒkahanui	*Dicliptera chinensis*	Investigate locations. Will evaluate and consider control.
	Heliocarpus popayanensis	Locations known. Will evaluate and consider control.
	Melaleuca quinquenervia	1 tree known from upper water tank. Will treat in the coming year.
	Schefflera actinophylla	Locations known. Will seek more info from Joel Lau, HBMPB.
	Sphaeropteris cooperi	No known locations. Will control within fence if found.
Haili to Keālia	*Schefflera actinophylla*	Some individuals found. Will control in MU.
Kaʻena	*Agave sisalana*	Current target within MU boundary.
Kaluakauila	*Casuarina glauca*	Currently targeted along fenceline only.
ʻŌhikilolo	*Aracauria columnaris*	Currently targeted. See Incipient Weed Report
	Morella faya	Treated in the past. Will monitor known sites.
Upper Kapuna	*Ehrharta stipoides*	Locations known. Will target in coming year.
	Rubus argutus	One location known and targeted. See Incipient Weed Report.
	Setaria palmifolia	Site controlled, presumed extirpated.
	Sphaeropteris cooperi	Widespread below MU. Will control only in course of regular management. See Incipient Weed Report.
	Toona cilliata	Some locations known. Will target in coming year.

Kahanahāiki	*Acacia mearnsii*	Currently targeted. See Incipient Weed Report.
	Axonopus compressus	Location known. Treated in the past. Will work towards eradication this year.
	Casuarina glauca	Currently targeted. See Incipient Weed Report.
	Ehrharta stipoides	Currently targeted. See Incipient Weed Report.
	Pennisetum clandestinum	Location known (State land). Population not spreading; no seed produced. Work with State to determine level of control.
	Rubus argutus	Currently targeted. See Incipient Weed Report.
	Sphaeropteris cooperi	Currently targeted when seen. No matures seen for years.
	Triumfetta semitriloba	Currently targeted. See Incipient Weed Report.
Palikea	*Ficus macrophylla*	Locations known. Will monitor movement.
	Juniperus bermudiana	Locations unknown. TNC feels it is not present within the MU.
	Montanoa hibiscifolia	Locations known. Will consider control options.
	Schefflera actinophylla	Locations unknown. TNC feels it is not present within the MU
	Sphaeropteris cooperi	Locations known. Will monitor quarterly, and treat in managed areas.
	Toona ciliata	Locations unknown. Will investigate.
West Makaleha	*Sphaeropteris cooperi*	Locations unknown. Work with State to determine level of control
Waiʻanae Kai	*Chrysophyllum oliviforme*	Locations unknown. Will target if deemed necessary
Kaluaa and Waieli	*Angiopteris evecta*	Known from South Central Kaluaʻā. See Incipient Weed Report.
	Ardisia elliptica	Locally common. See Incipient Weed Report
	Mallotus philippensis	Found in Gulch 3 site C. Will map/control as deemed appropriate.
	Schefflera actinophylla	Locations known. Will treat where found.
Pahole	*Acacia mearnsii*	Currently targeted. See Incipient Weed Report.
	Angiopteris evecta	Same as Upper Kapuna site.
	Axonopus compressus	Same site as Kahanahāiki location
	Ehrharta stipoides	Targeted at known sites. See Incipient Weed Report.
	Glycine wightii	Locations unknown. Possibly same as Upper Kapuna site.
	Passiflora suberosa	Will target in course of regular management, esp in Gulch 4.
	Rubus argutus	Locations unknown. Possibly same as Upper Kapuna site.
	Setaria palmifolia	Same as Upper Kapuna site.
	Sphaeropteris cooperi	Targeted by Kay Lynch of Oʻahu Trail and Mountain Club
	Toona ciliata	Some locations known. Will target in coming year.

During conversations with TNCH staff, some species not included in Appendix 3.1 were recognized as possible threats. They are listed in Table 1.1.5 below. These species and sites will be evaluated and ICAs established if deemed necessary.

Table 1.1.5 Additional Incipient Taxa In Honouliuli

Management Unit	Incipient Taxa	Comments
Ekahanui	*Montanoa hibiscifolia*	2 locations known in subunits 1 and 2. Target.
Palikea	*Erigeron karvinskianus*	Control in managed areas.
	Eriobotrya japonica	Localized, half acre population. Target.
	Crocosmia x crocosmiiflora	Localized, focus on containment.
Kaluaʻā and Waiʻeli	*Dicliptera chinensis*	Focus on keeping off trail
	Setaria palmifolia	Focus on keeping off trail
Pualii	*Angiopteris evecta*	One plant seen and killed. Survey for additional plants.
	Trema orientalis	Target in managed areas.

NRS continue to participate in the Oahu Invasive Species Committee (OISC), attending strategy and prioritization meetings, sharing data, and coordinating effort on joint incipient control projects.

Management Unit Level Weed Control

For weed control projects on the MU level, priority setting criteria include the size of intact native habitats, the overlap of these with IP PU locations and reintroduction sites, and the feasibility of the control project. NRS have broken up the MUs into smaller units, or Weed Control Areas (WCA). In most cases WCAs contain managed PUs and the native habitat surrounding those PUs and focus on ecosystem level weed control. Weed control is easier to track over time within WCAs, as weed control issues are generally similar across a particular WCA. All WCA results are discussed in the Ecosystem Management Report. Most WCA boundaries are defined for ecosystem-level habitat improvement, but some are defined around fencelines and trails, and others are very small areas defined as a five meter radius around IP taxa. The purpose of trail WCAs is to prevent weed spread to ecologically significant areas. Weed control in the five-meter WCAs is not likely to be expanded because often the areas are too degraded, and the goal for the IP taxa is fruit production, rather than 'Manage for Stability'. The Weed Control Summary Tables in the Ecosystem Management Report use six letter abbreviations for most weed and rare plant species. These abbreviations use the first three letters of a plant's genus and species. A list of these codes in their unabbreviated form can be found in Appendix 1-1.

Figure 1.1.3 NRS conducting weed control with Garlon 4

Table 1.1.6 summarizes the MU weed control efforts. Combining both MIP and OIP MUs, there are approximately 45 MUs; NRS conducted weed control in 22 of them this year. Eighty-two % of person hours were spent in eight of the 22 weeded MUs. These eight MUs are the largest, include many resources, and are the highest priority for weed control work at this time. While additional staff were hired this year, NRS are still not yet fully staffed. NRS chose to begin intense MU level weed control where there are exclosures or where ungulates are not considered a threat. Less weed control has been initiated outside exclosures. Also, it is essential that NRS acquire formal permission to conduct IP management actions. Formal permission has not been granted for a number of sites which therefore are not weeded regularly.

Table 1.1.6 IP Management Units: Weed Effort Summary from 9-1-2006 to 8-31-2007

	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	# of Visits	Effort (Person Hrs)
IP MU: Ekahanui	8.84	3.40	38.47%	12	77.50
IP MU: Haili to Kealia	1.79	0.57	31.72%	4	20.50
IP MU: Kaala	41.76	9.81	23.50%	18	370.85
IP MU: Kaena	1.60	1.40	87.54%	5	64.50
IP MU: Kaena East of Alau	0.14	0.05	38.68%	1	5.00
IP MU: Kahanahaiki	19.41	6.16	31.74%	31	352.75
IP MU: Kaleleiki	0.80	0.03	3.79%	1	24.00
IP MU: Kaluaa and Waieli	12.04	2.76	22.88%	25	128.50
IP MU: Kaluakauila	2.94	2.94	100.00%	2	25.00
IP MU: Lower Ohikilolo	7.81	7.81	100.00%	34	455.50
IP MU: Makaha	21.26	3.13	14.72%	26	266.50
IP MU: MMR No MU	1.45	0.11	7.63%	1	5.00
IP MU: Ohikilolo	63.67	9.34	14.67%	17	226.50
IP MU: Oio	1.33	0.21	15.70%	1	21.00
IP MU: Opaeula/Helemano	49.12	10.63	21.65%	7	78.00
IP MU: Pahole	29.02	8.24	28.41%	29	251.50
IP MU: Palikea	11.71	2.52	21.51%	12	43.70
IP MU: SBE No MU	3.95	2.40	60.82%	1	5.00
IP MU: SBS No MU	1.57	0.35	22.63%	3	30.00
IP MU: SBW No MU	0.21	0.21	100.00%	1	11.00
IP MU: South Haleauau	0.53	0.30	56.92%	2	3.00
IP MU: Upper Kapuna	8.66	1.56	18.01%	17	134.25
IP MU: West Makaleha	2.68	1.14	42.77%	8	111.00
Total for all IP MU:	292.31	75.10		258	2710.55

4. Monitoring of IP related weed control

No ecosystem monitoring was conducted over the past year, due to a vacancy in the Monitoring Program Manager position. Starting in September 2007, Jim Jacobi, PhD, USGS BRD, will be contracted to help develop monitoring protocols for NRS. One of his priorities will be developing vegetation monitoring methods to evaluate management efficacy. Previous monitoring efforts are detailed in OANRP 2006.

5. Research

While there are many weed-related research issues NRS are interested in, little work has been done on them thus far. In the coming year, NRS will work with J. Jacobi to define goals and strategies for monitoring the success of weed management over time. NRS will also develop new, more effective weed control techniques as needed. NRS will also work with the Propagule Management Specialist to look at the longevity of seed viability for invasive species. NRS drafted a priority list of weed species which will guide this effort in the coming year. This information will assist NRS in strategizing how best to plan management at both ICAs and WCAs. In the future, NRS will identify other such projects and will strive to establish lines of communication with other agencies (especially on neighbor islands) so that findings can be shared between organizations.

1.2 Incipient Weed Report

All incipient species and their general locations are summarized in the two tables below. Table 1.2.1 lists all regions and MUs where an incipient taxa is controlled, summarizing the data by species. This table gives an idea of the distribution of the species, and of where each poses a significant threat to native areas. The second table, Table 1.2.2, presents the same data, but groups it by region and MU. This table gives a better idea of the number of invasive species affecting each MU. Figures 1.2.1-7 show the specific locations of each ICA. Discussion of incipient species control and status is arranged alphabetically by species. Control efforts are summarized in a table, and then discussed by ICA. While eradication may not be an option for every species across all managed lands, it is the goal for each ICA. In order to achieve this, NRS generally strive to visit ICAs quarterly.

Table 1.2.1 Overview of Incipient Taxa Distribution, Organized by Species

Incipient Target	Region	Management Unit (MU)	Number of ICAs
Acacia mangium	KTA	Not in MU	4
Acacia mearnsii	MMR	Kahanahāiki	2
	Mokuleia Forest Reserve	Not in MU	1
Achyranthes aspera	MMR	Kahanahāiki	3
Angiopteris evecta	Honouliuli	Kaluaʻā and Waiʻeli	1
	Pahole NAR	Upper Kapuna	1
Araucaria columnaris	MMR	ʻŌhikilolo	1
Ardesia elliptica	Honouliuli	Not in MU	1
Arthrostema ciliatum	KLOA	Not in MU	2
	SBE	Not in MU	3
Buddleia madagascariensis	SBE	Not in MU	2
Casuarina glauca	MMR	Kahanahāiki	1
	Honouliuli	Not in MU	1
Cirsium vulgare	MMR	ʻŌhikilolo	1
	MMR	Kaluakauila	1
Desmodium intortum	MMR	Not in MU	1
	Pahole NAR	Upper Kapuna	2
Ehrharta stipoides	MMR	ʻŌhikilolo	1
	Pahole NAR	Pahole	4
	Pahole NAR	Upper Kapuna	2
Festuca arundacea	SBW	Kaʻala	1
Fraxinus uhdei	Pahole NAR	Upper Kapuna	1
	MMR	ʻŌhikilolo	1
Grevillea robusta	Pahole NAR	Upper Kapuna	1
Hedychium gardnerianum	KLOA	Koloa	1
	KLOA	Not in MU	1
Ilex cassine	SBW	Not in MU	1
Juncus effuses	SBW	Kaʻala	3
Leptospermum scoparium	KLOA	Poamoho, in and out of MU	2
	KLOA	Not in MU	1
Melochia umbellata	KTA	Not in MU	5
Montanoa hibiscifolia	Pahole NAR	Pahole	1

	Pahole NAR	Not in MU	1
Morella faya	Honouliuli	Not in MU	1
Neonotonia wightii	Pahole NAR	Upper Kapuna	2
Pennisetum setaceum	KTA	Not in MU	1
	MMR	Lower ʻŌhikilolo	1
	SBE	Not in MU	1
	DMR	Not in MU	1
Panicum maximum	Honouliuli	Kaluaʻā and Waiʻeli	1
Pterolepis glomerata	Pahole NAR	Pahole	1
Rhodomyrtus tomentosa	KTA	Not in MU	1
	SBE	Not in MU	1
Rubus argutus	MMR	Kahanahāiki	2
	MMR	ʻŌhikilolo	2
	Pahole NAR	Upper Kapuna	1
	MMR	Not in MU	1
	Mokuleia Forest Reserve	Not in MU	1
Senecio madagascariensis	SBS	Not in MU	1
Setaria palmifolia	KLOA	Opaeula/Helemano	14
	Honouliuli	Kaluaʻā and Waiʻeli	1
Smilax sp.	SBE	Not in MU	1
Sphaeropteris cooperi	Pahole NAR	Upper Kapuna	1
Syzigium jambos	MMR	Kaluakauila	1
Tecoma capensis	Pahole NAR	Pahole	1
Tibouchina urvilleana	KLOA	Whitmore Village, not in MU	1
Trema orientalis	Honouliuli	Kaluaʻā and Waiʻeli	1
	Waiʻanae Kai	Not in MU	1
Triumfetta semitriloba	MMR	Kahanahāiki	5
	Pahole NAR	Pahole	1
	Pahole NAR	Upper Kapuna	1
Vitex trifolia	SBE	Not in MU	1

Table 1.2.2 Overview of Incipient Taxa Distribution, Organized by Region and MU

Region	Management Unit (MU)	Incipient Target	Number of ICAs
Waiʻanae Kai	Not in MU	*Trema orientalis*	1
DMR	Not in MU	*Pennisetum setaceum*	1
MMR	Kaluakauila	*Cirsium vulgare*	1
		Syzigium jambos	1
	Kahanahāiki	*Acacia mearnsii*	2
		Achyranthes aspera	3
		Casuarina glauca	1
		Rubus argutus	2
		Triumfetta semitriloba	5
	ʻŌhikilolo	*Araucaria columnaris*	1
		Cirsium vulgare	1
		Ehrharta stipoides	1
		Fraxinus uhdei	1
		Rubus argutus	2
	Lower ʻŌhikilolo	*Pennisetum setaceum*	1

	Not in MU	*Desmodium intortum*	1
		Rubus argutus	1
Pahole NAR	Pahole	*Ehrharta stipoides*	4
		Montanoa hibiscifolia	1
		Pterolepis glomerata	1
		Tecoma capensis	1
		Triumfetta semitriloba	1
	Upper Kapuna	*Angiopteris evecta*	1
		Desmodium intortum	2
		Ehrharta stipoides	2
		Fraxinus uhdei	1
		Grevillea robusta	1
		Neonotonia wightii	2
		Sphaeropteris cooperi	1
		Rubus argutus	1
	Pahole, not in MU	*Montanoa hibiscifolia*	1
Mokuleia Forest Reserve	Kuaokala, not in MU	*Rubus argutus*	1
		Acacia mearnsii	1
SBW	Kaʻala	*Festuca arundacea*	1
		Juncus effuses	3
	Not in MU	*Ilex cassine*	1
SBS	Not in MU	*Senecio madagascariensis*	1
Honouliuli	Kaluaʻā and Waiʻeli	*Angiopteris evecta*	1
		Setaria palmifolia	1
		Panicum maximum	1
		Trema orientalis	1
	Not in MU	*Ardesia elliptica*	1
		Casuarina glauca	1
		Morella faya	1
KTA	Not in MU	*Acacia mangium*	4
		Melochia umbellata	5
		Pennisetum setaceum	1
		Rhodomyrtus tomentosa	1
KLOA	Koloa	*Hedychium gardnerianum*	1
	Poamoho, in and out of MU	*Leptospermum scoparium*	2
	Opaeula/Helemano	*Setaria palmifolia*	14
	Not in MU	*Arthrostema ciliatum*	2
		Hedychium gardnerianum	1
		Leptospermum scoparium	1
		Tibouchina urvilleana	1
SBE	Not in MU	*Arthrostema ciliatum*	3
		Buddleia madagascariensis	2
		Pennisetum setaceum	1
		Rhodomyrtus tomentus	1
		Smilax sp.	1
		Vitex trifolia	1

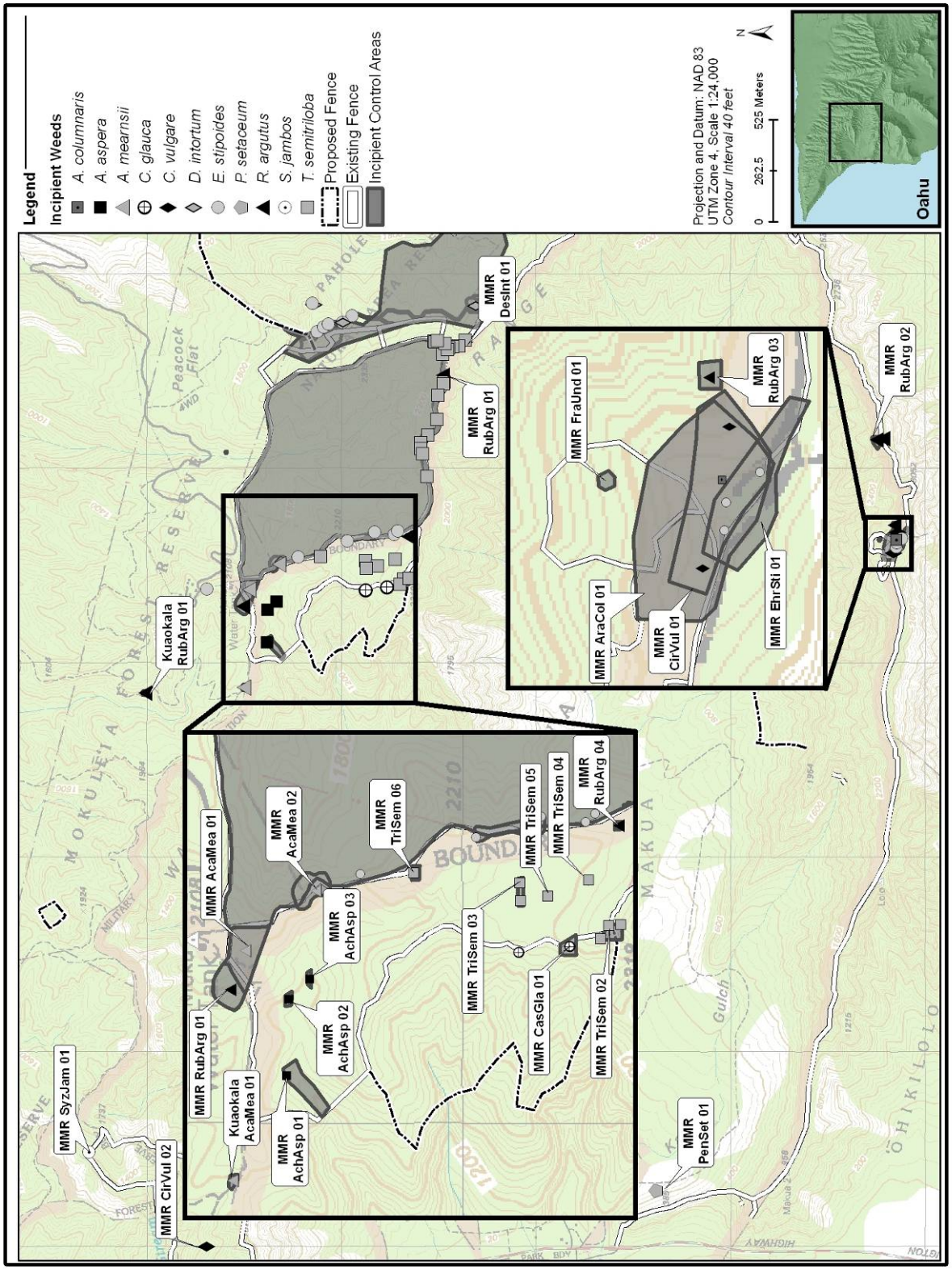

Figure 1.2.1 MMR: Locations of Incipient Weed Species

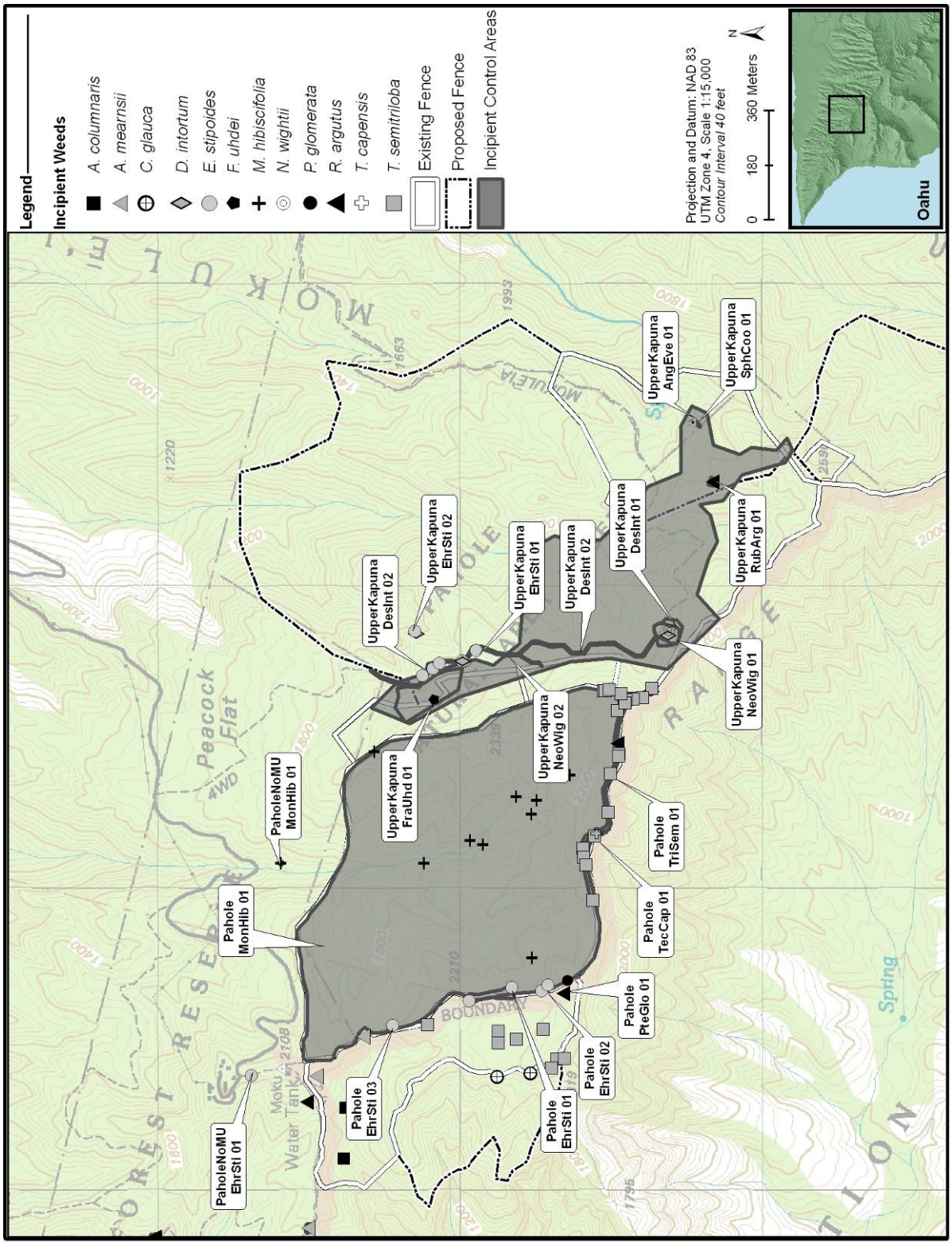

Figure 1.2.2 Pahole NAR: Location of Incipient Weed Species

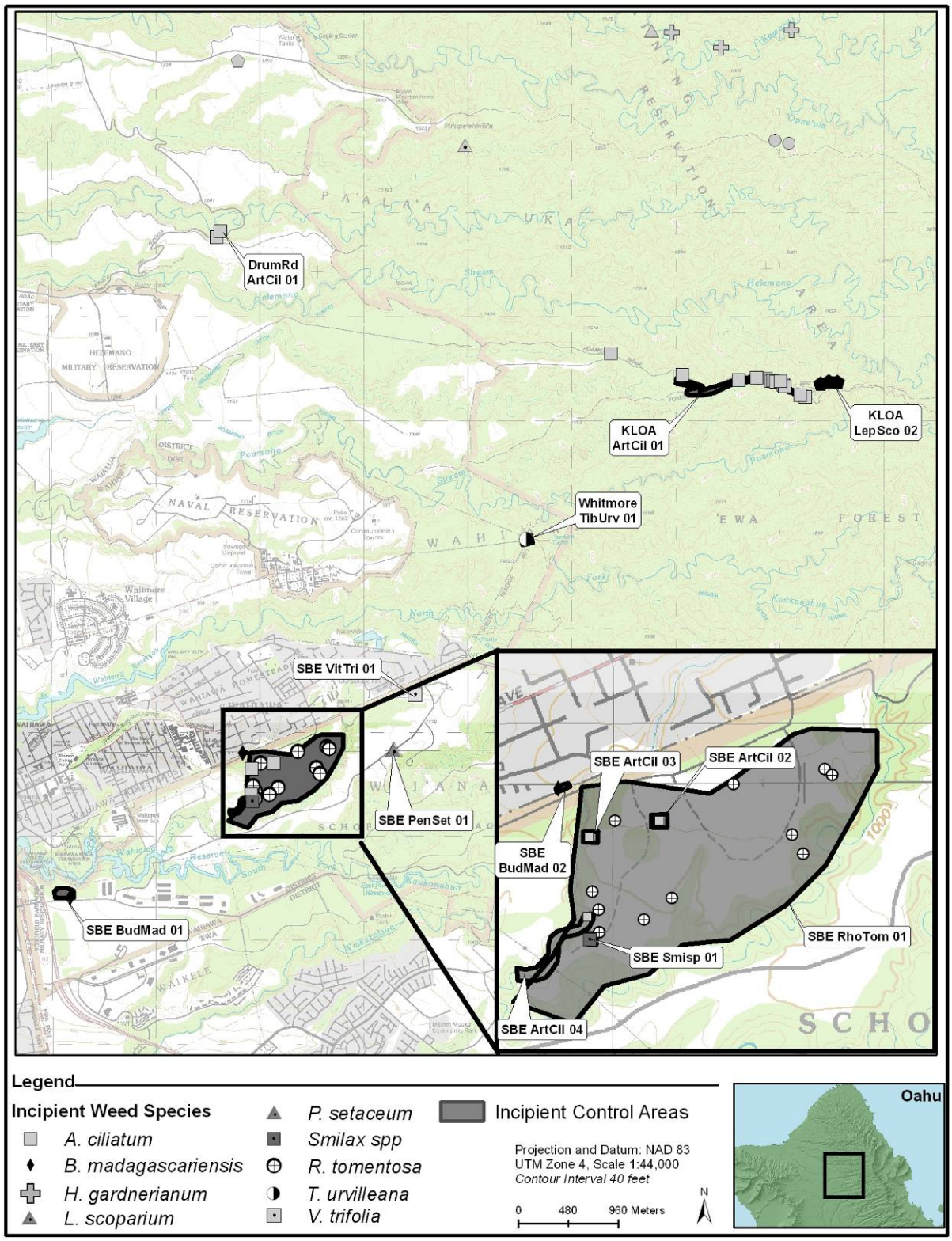

Figure 1.2.3 KLOA and SBE: Location of Incipient Weed Species

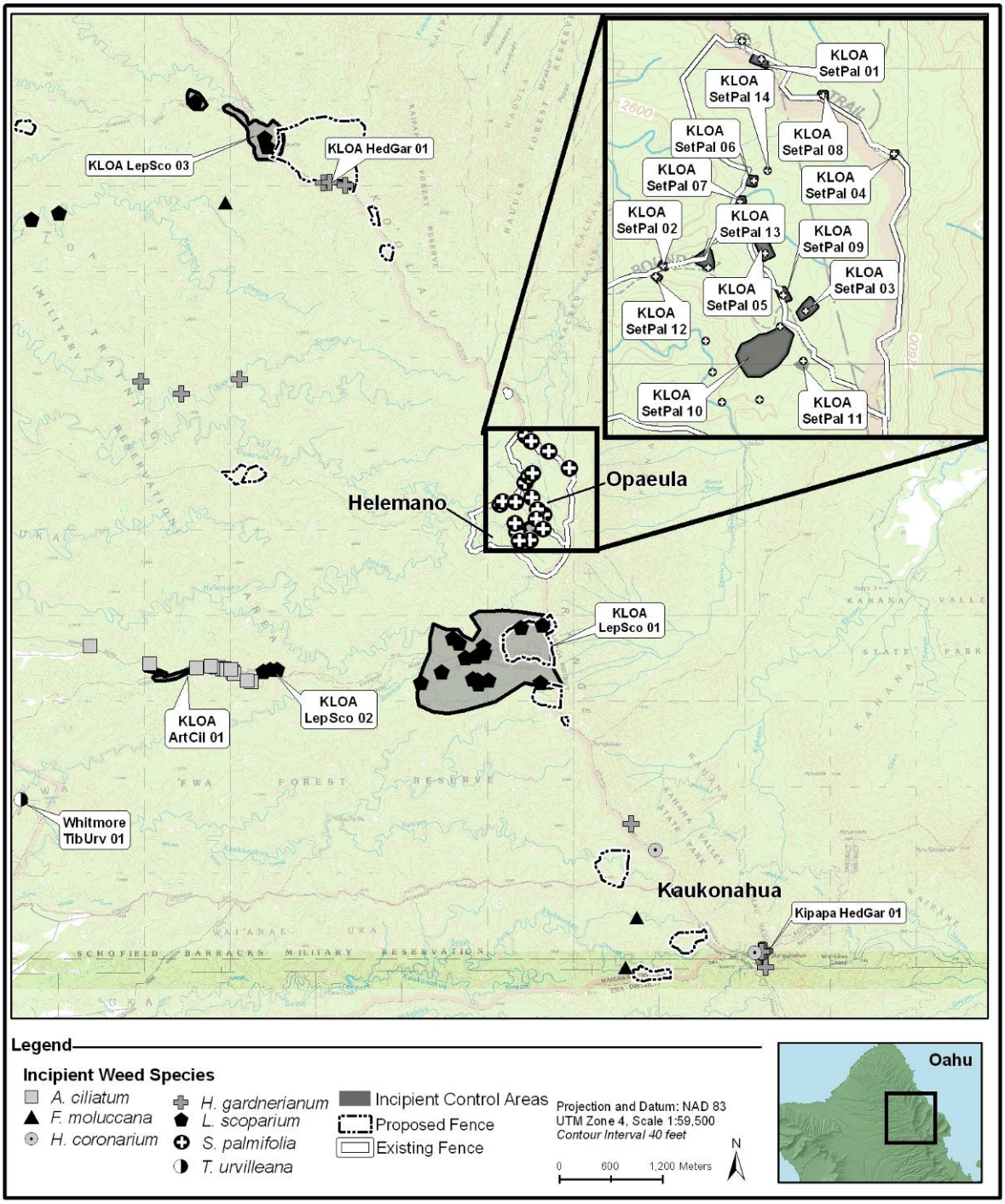

Figure 1.2.4 KLOA: Location of Incipient Weed Species

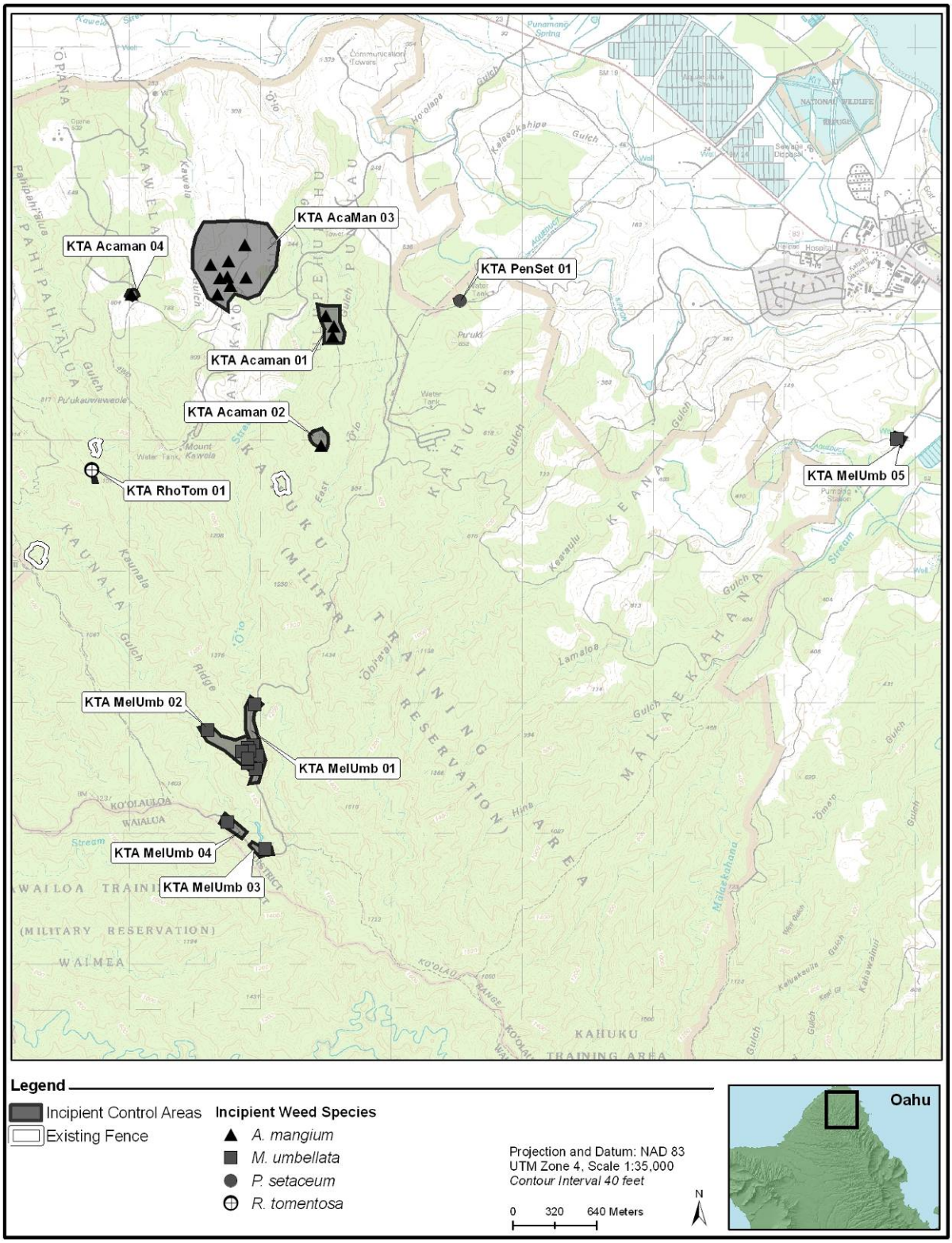

Figure 1.2.5 KTA: Location of Incipient Weed Species

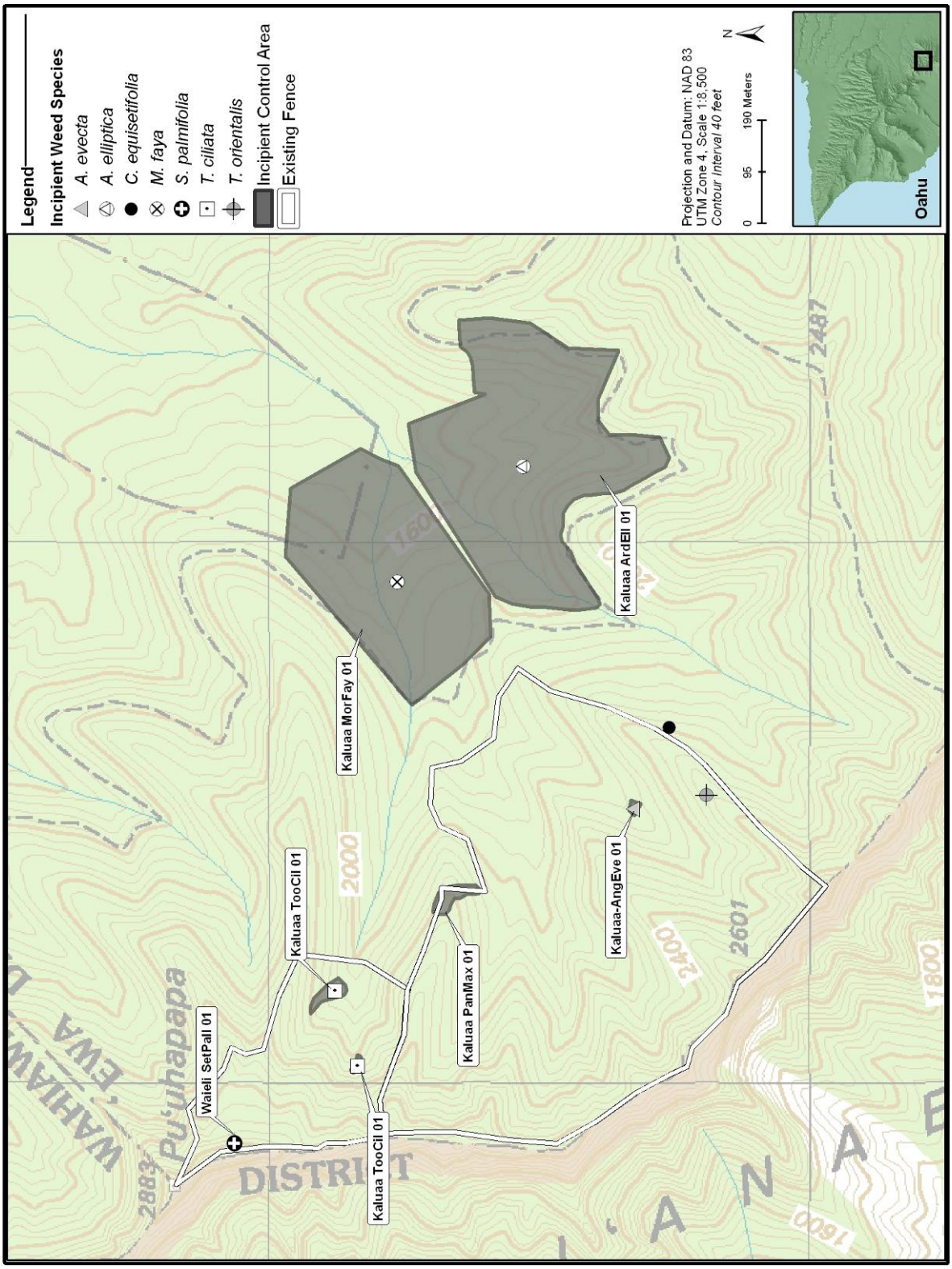

Figure 1.2.6 Kalua'ā and Wai'eli: Locations of Incipient Species

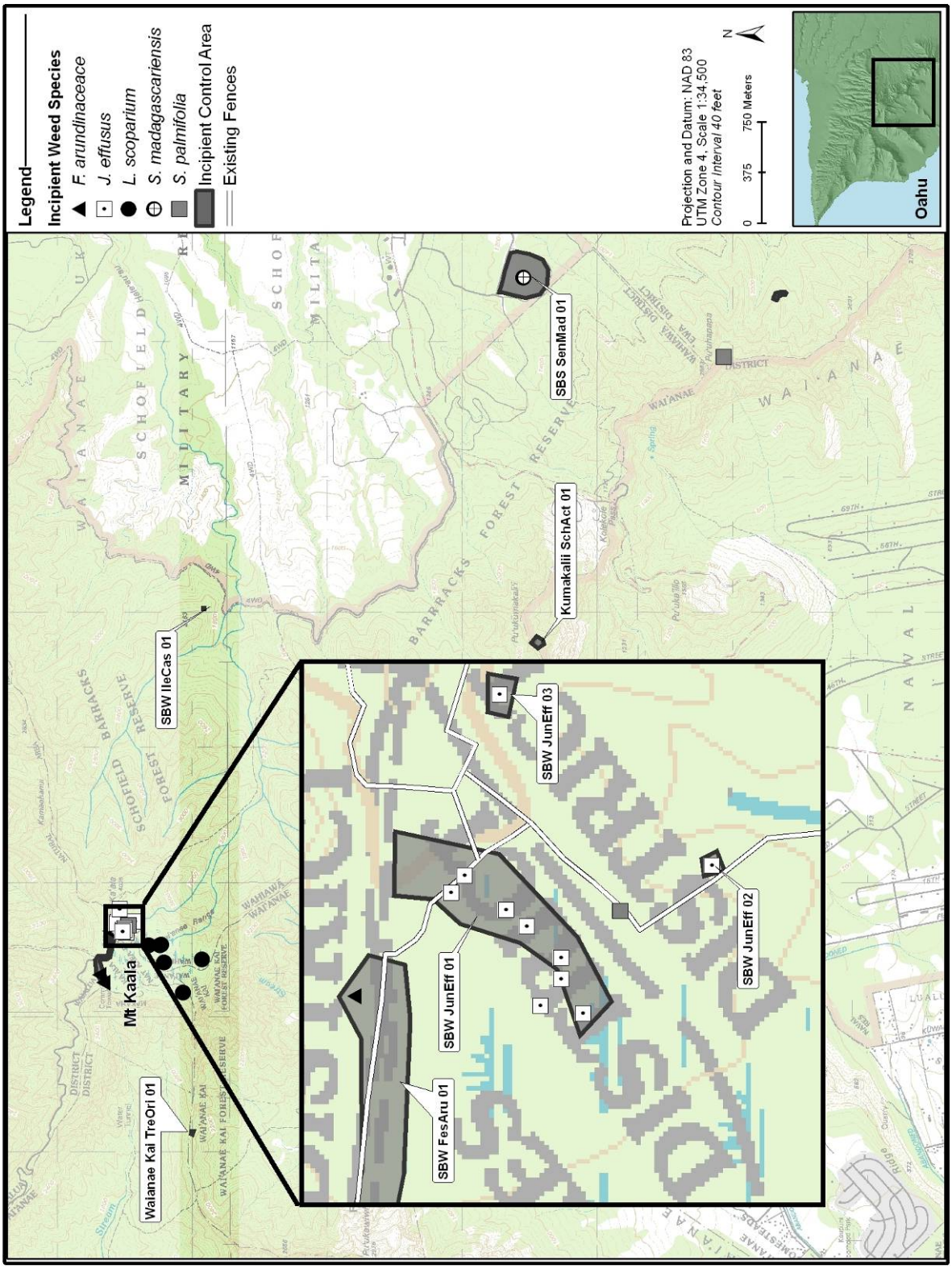

Figure 1.2.7 SBW, SBS, Waiʻanae Kai: Locations of Incipient

Incipient Control Discussion

Acacia mangium

Silk Leaf Acacia is the common name. It is native to northern Australia, Papua New Guinea, and eastern Indonesia. Its ability to rapidly colonize roadsides, abandoned, degraded or open areas and marginal lands is well known. It has a high weed risk assessment (WRA) score of 8, and therefore is regarded as an undesirable weed. In addition to the WRA score, NRS is controlling this species because there is a possibility that it may hybridize with *Acacia koa*. NRS treats this species by cutting the base of the trunk and applying Garlon 4 at a 20% concentration in Forestry Crop Oil. *Acacia mangium* is not tolerant of shade, but is very fast growing. NRS was short staffed and was not able to visit the four ICAs designated for this species this year. All are located in KTA (Figure 1.2.5). In the coming year, NRS will prioritize the Canes Complex ICA, KTA-AcaMan-03, which has been deemed the most important site to monitor due to the high number of seedlings in this area. It is a difficult site because the grass is tall making it hard to get 100% coverage on every trip. Other sites will be surveyed to ensure that at a minimum all the mature trees are removed. NRS will strive to visit all four ICAs quarterly.

Acacia mearnsii

The common name for this species is Black Wattle. The Pacific Islands Ecosystems at Risk (PIER) website classifies this species as high risk due to the risk assessment score of 15. This high score was the result of a number of factors including a tendency for this species to form dense thickets, be fire tolerant, have prolific seed production, become naturalized in tropical or subtropical climates, etc. This species is already widespread in some areas of Oahu. However, NRS have stopped the spread of this species throughout their MUs by containing the known populations to the outer edges of the MUs that they are found near/in. All ICAs designated for this species are located in the greater Mākua region, see Figure 1.2.1. Control efforts for all ICAs are summarized in Table 1.2.3.

Figure 1.2.8 *Acacia mearnsii* seedlings

MMR-AcaMea-01; Kahanahaiki AcaMea

Acacia mearnsii is now nearly non-existent in Kahanahāiki, and NRS feel that keeping it out of the MU is a high priority. This ICA is the core site for this incipient weed, formerly a large stand of mature trees. NRS have been returning to this site for the past six years and pulling new seedlings. NRS visited this site five times last year. In the coming year, NRS will re-visit the site quarterly to survey for and eradicate all new seedlings found. It is possible that with constant pressure, *A. mearnsii* can be eradicated from the site, although it may be a while before the seedbank is completely exhausted. NRS have begun to supplement their weeding efforts this

year by outplanting common natives in weeded areas. Two volunteer groups (Halau Mohala Ilima and Davianna McGregors Hawaiian Ethnic Studies class) helped outplant 50 Palapalai (*Microlepia strigosa*) ferns throughout this ICA. This area will be visited quarterly over the next year for weeding efforts.

MMR-AcaMea-02; Black Wattle by Schwepps trail/Pahole crossover
This ICA is made up of two outlier sites each with large mature trees. This site was weeded three times last year and each time only 1 plant was found. Since this site is located partially on a regularly hiked trail, it is checked at least once a week. NRS plan to revist the sites in the coming year and scope the areas for possible seedlings or other plants not seen on previous trips. It is highly possible that *A. mearnsii* can be completely eradicated from this ICA.

Kuaokalā-AcaMea-01; Easternmost Kuaokalā AcaMea
Two mature trees were cut, treated and dragged off the re-vegetation road. NRS was driving this road to carry outplantings into Kahanahāiki. It is not an area NRS usually drive. NRS will monitor this site on the way to Kaluakauila at least once per year. This site is an isolated spot away from the main infestation on Kuaokalā road.

Table 1.2.3 Summary of *Acacia mearnsii* Control Efforts

ICACode	IPManagementUnit	# of Visits	Effort (Person Hrs)	Date Last Mature Plant Found	Date Last Non-Mature Plant Found
IncipientTaxon: AcaMea	**Acacia mearnsii**				
Kuaokala-AcaMea-01	Mokuleia FR No MU	1	2.00	10/3/2006	
MMR-AcaMea-01	Kahanahaiki	5	26.50	4/30/2007	4/30/2007
MMR-AcaMea-02	Kahanahaiki	3	0.61	10/16/2006	4/16/2007

Achyranthes aspera

A common name for this species is Devil's Horsewhip. *Achyranthes aspera* is widespread across the entire island of O'ahu, but is a species of concern to NRS because it is incipient within the Kahanahāiki MU in MMR. It has a short lifecycle and is easily dispersed via a spine tipped bract on the seeds that can stick to clothing. For these reasons, NRS have a zero-tolerance for this species in Kahanahāiki. This taxon is found at several specific sites within the same small gulch (Figure 1.2.1). NRS visit the sites quarterly, and can manually pull all plants found within each location in a short time. Regular quarterly visits are important to prevent plants from maturing. It appears that eradication of this species from within the MU is a very attainable goal. With each visit, fewer and fewer immature plants and seedlings have been found.

MMR-AchAsp-01; Kahanahāiki AchAsp Lowest
This year only one seedling was found at this site (Table 1.2.4). This is much improved compared to previous years. Last year two adults, five immatures and four seedlings were found, and the year before that one adult, four immatures, and 120 seedlings were found. The seed bank is slowly being exhausted by NRS efforts. NRS only visited this site twice this year, but next year will try and visit this site quarterly.

MMR-AchAsp-02; Kahanahāiki AchAsp Middle
No plants have been observed at this site since April 2006. The last mature plant was seen in May 2002. We only visited this site once this year (Table 1.2.4), but NRS will continue to try and monitor this site quarterly over the next year. If no plants are seen, NRS may choose to monitor this site once a year or less.

MMR-AchAsp-03; Kahanahāiki AchAsp Upper
No plants have been observed at this site since June 2003. The original site was only 0.08 acres so NRS is confident that this area has been thoroughly searched. We only visited this site once this year (Table 1.2.4), but NRS will continue to try and monitor this site quarterly over the next year. If no plants are seen, NRS may choose to monitor this site once a year or less because mature plants have not been seen at this site since May 2002.

Table 1.2.4 Summary of *Achyranthes aspera* Control Efforts

ICACode	IPManagementUnit	# of Visits	Effort (Person Hrs)	Date Last Mature Plant Found	Date Last Non-Mature Plant Found
IncipientTaxon: AchAsp	**Achyranthes aspera var. aspera**				
MMR-AchAsp-01	Kahanahaiki	2	3.00	4/25/2006	10/3/2006
MMR-AchAsp-02	Kahanahaiki	1	1.00	5/13/2002	4/25/2006
MMR-AchAsp-03	Kahanahaiki	1	1.00	5/13/2002	6/24/2003

Angiopteris evecta

Commonly known as mule's-foot fern, *Angiopteris evecta* scores 7 on the PIER weed risk assessment, designating it an undesirable invasive. This giant fern can form thick, dense, very shady stands, and is itself shade-tolerant. It prefers wet gulches, and is very effective at crowding out native species. It produces thousands of wind dispersed spores. It is well established in many areas of Oahu, including both Mānoa and Poamoho. However, it is not common on NRS managed lands and is a priority target for areas where it is incipient. NRS experimented with a variety of treatment methods for *A. evecta* this year. See the UpperKapuna-AngEve-01 ICA discussion below for more detailed information. In general, Garlon 4 is effective at killing this species when either applied foliarly or to a cut/smashed base.

Kalua'ā-AngEve-01; South Central Gulch
This site was treated in 2005-2006 by TNCH. In 2006-2007, a total of 8 matures, 25 immatures and 30 seedlings were killed (Table 1.2.5). One adult may need to be chainsawed to prevent resprouting. NRS will conduct control at this site once per year. This is the only known site in Kalua'ā (Figure 1.2.6). It is two small patches separated by about 10m. The sites are both in a gulch bottom with seedlings and immatures on both sides. The mature plant treated is on the north facing slope. The area looks similar to those pictured in Figure 1.2.9 for Upper Kapuna. With regular monitoring twice per year, it is possible that this site can be extirpated within three years. It is likely that there are more sites probably hidden in thick alien habitat in areas exposed to northern trade rainfall. NRS will do surveys of these areas as staff members increase.

UpperKapuna-AngEve-01; Kapuna *Angiopteris*
This ICA was created in October of 2006, when NRS noted it during rare plant surveys. After talking with the NARS Specialist, NRS began control. The 230m² infestation is confined to one

gulch in Keawapilau (Figure 1.2.2). Over three control trips, NRS effectively treated all plants (Table 1.2.5). Giant mature plants with 3m fronds thickly shaded the gulch bottom, while hundreds of immature plants dotted the gulch walls. The NARS Specialist suggested that a 5% spray of Garlon 4 in water would be an effective control method. In order to reduce non-target effects on the surrounding area, which included some native ferns as well as the endangered *Cyrtandra dentata*, NRS first cut and stacked all large fronds prior to basal spraying. While this initial effort was effective in killing some plants, many started to grow new croziers within four months. NRS think that cutting fronds prior to spraying resulted in low herbicide absorption. A second control trip in February 2007 tested the efficacy of 10% and 20% Garlon 4 in water. Also, the few fronds and croziers present were not cut prior to spraying and both leaf and basal material were sprayed. Both concentrations were effective at killing *A. evecta*. On a third control trip in May 2007, sporelings and immatures were treated with 20% Garlon 4 in Forestry Crop Oil (FCO), again without cutting fronds. This method, standard for all NRS weed control, was also very effective. Given the success of these control efforts in reducing the population from hundreds to tens of plants, large scale spray operations are no longer needed, see Figure 1.2.9. Future efforts will focus on thoroughly surveying the ICA twice a year, treating any plants with 20% Garlon 4 in FCO. Eradication of *A. evecta* at this site appears achievable. However, there were three very large mature plants at this ICA, and NRS need to research how long spores can remain viable, and how long gametophytes persist in order to better determine a long-term monitoring strategy. NRS will thoroughly survey the perimeter of the infestation for outliers in the coming year. Discussions with the NARS Biologist suggest that there are two other distinct *A. evecta* sites in Keawapilau. NRS will investigate these other sites and create new ICAs if needed.

Figure 1.2.9 On the left, the *Angeopteris evecta* infestation after one treatment. On the right, the same site from a different angle, showing no *Angeopteris evecta* after multiple treatments. Unfortunately no photos were taken prior to treatment.

Table 1.2.5 Summary of *Angiopteris evecta* Control Efforts

ICACode	IPManagementUnit	# of Visits	Effort (Person Hrs)	Date Last Mature Plant Found	Date Last Non-Mature Plant Found
IncipientTaxon: AngEve	**Angiopteris evecta**				
Kaluaa-AngEve-01	Kaluaa and Waieli	1	1.00	2007-05-29	2007-05-29
UpperKapuna-AngEve-01	Upper Kapuna	3	8.50	2006-10-03	2007-05-02

Araucaria columnaris

Frequently used as a forestry planting by the state in the past, *A. columnaris*, or Cook Pine, received a Weed Risk Assessment of -5 by the PIER project. This score suggests that this species is not an invasive threat. However, NRS decided to target this species within MMR because it is incipient at ʻŌhikilolo and has begun to naturalize. While common elsewhere on the island, it is not well-established on the ʻŌhikilolo ridgeline. *A. columnaris* often forms dense monocultures, with little understory persisting beneath it. It can produce copious amounts of wind dispersed fruit, and is fire tolerant. According to the PIER website, *A. columnaris* seeds are do not store well, and only remain viable up to 24 months. *A. columnaris* responds well to treatment with 20% Garlon 4 in FCO, although very large trees may require multiple treatments. Seedlings can usually be controlled with handpulling.

<u>MMR-AraCol-01; Norfolk Control at ʻŌhikilolo Campsite</u>

The origin of this infestation was one large mature tree, planted many years ago (Figure 1.2.10). This tree was killed September 2001. Multiple treatments were required to kill this giant, and it finally fell to the ground in early 2004. NRS are attempting to eradicate this taxon from ʻŌhikilolo and hope to eradicate all seedlings before they reach maturity. Given the slow growth of this species, this can be accomplished with yearly sweeps. Since the seed of this species is wind dispersed, it is difficult to predict how far seed may have spread. The infestation area includes the ridge and gulches immediately adjacent to the former location of the mature plant, as well as both the Forest Patch and *Pritchardia kaalae* MMR-A exclosures (Figure 1.2.1). This year, NRS conducted one control trip (Table 1.2.6). Thirty plants were found in the region closest to the mature tree, and one was found in the makai end of the Forest Patch exclosure. This is slightly lower than quantities found in previous years. Given the short seed life of *Araucaria*, NRS hope the existing seedbank will continue to be depleted. The prognosis for eradication is very good for this ICA. Next year, NRS will thoroughly sweep this ICA one time, focusing on the region at the top of the *P. kaalae* MMR-A exclosure.

Figure 1.2.10 *Araucaria columnaris* at ʻŌhikilolo Camp

Table 1.2.6 Summary of *Araucaria columnaris* Control Efforts

ICACode	IPManagementUnit	# of Visits	Effort (Person Hrs)	Date Last Mature Plant Found	Date Last Non-Mature Plant Found
IncipientTaxon: AraCol	**Araucaria columnaris**				
MMR-AraCol-01	Ohikilolo	1	6.00	2001-09-19	2006-12-14

Ardesia elliptica

Commonly refered to as Shoebutton Ardesia, this plant is widely distributed in lower elevation mesic sites throughout the Wai‘anae Mountains. However, NRS plan to target this species in select native areas where it is not yet established. This species had a PIER high risk score of 11. Bird dispersal and a tolerance to a wide range of soils makes the control of this species more difficult. The possibility of eradicating *A. elliptica* is possible considering the seed bank lasts only 6 months. However, the population needs to be reduced and monitored because regrowth happens quickly.

Kalua‘ā-ArdEll-01

NRS spent 16 hours controlling *A. elliptica* on two trips in May. The core population boundary has been scoped and flagged (Figure 1.2.6). Most of the half acre area was treated this year (Table 1.2.7). The ICA where the plant is seen is still large at nearly 26.5 acres. NRS hopes to reduce at least the majority of the mature plants in certain gulches for this species. NRS plan to return to this site quarterly. Analyzing control efforts for this area will give NRS a better understanding of whether *A. ellitica* spread can be mitigated.

Table 1.2.7 Summary of *Ardesia elliptica* Control Efforts

ICACode	IPManagementUnit	# of Visits	Effort (Person Hrs)	Date Last Mature Plant Found	Date Last Non-Mature Plant Found
IncipientTaxon: ArdEll	**Ardisia elliptica**				
Kaluaa-Ardell-01	Kaluaa and Waieli	2	16.00	5/31/2007	5/31/2007

Arthrostemma ciliatum

Arthrostemma ciliatum is a member of the *Melasomataceae* family, along with two other well known invasive species *Miconia calvescens* and *Clidemia hirta.* The weed is widely naturalized throughout much of the Ko‘olau Mountains, but is uncommon in KLOA. NRS target *A. ciliatum* in areas where activities like foot traffic or vehicles might lead to the spread of this weed to places where it is not currently found (Figures 1.2.3-4). NRS is currently controlling *A. ciliatum* at five locations.

Figure 1.2.11 *Arthrostemma ciliatum*

SBE-ArtCil-02; East Range Eucalyptus Patch ArtCil Control Area

The *A. ciliatum* at this site has the potential to be spread by military personnel, via foot and/or vehicle traffic within the East Range land navigation area. This area was roped off at the beginning of the year to restrict

vehicle and personnel access. NRS visited this site four times this year (Table 1.2.8). Forty-three plants (mature 1, immature 16, seedling 26) were controlled during site visits by hand pulling and/or spraying. NRS will continue to deplete the seed bank during quarterly site visits.

SBE-ArtCil-03; East Range Mid Gulch ArtCil Control Area

The *A. ciliatum* at this site does not have the potential to be spread by military personnel or vehicles. This patch of A. cliliatum is located about mid-slope on a steep bank of a gulch. This site was visited two times this year, in which 11 immature plants were hand pulled (Table 1.2.8). This site is on a steep slope making both hand pulling and spraying difficult. NRS will continue to spray immature and seedlings in this area during quarterly site visits.

SBE-ArtCil-04; East Range Army Navigation Trail ArtCil Control Area

The *A. ciliatum* at this site has the potential to be spread by military personnel, via foot traffic. This patch is the largest of the three located in Schofield Barracks East Range. The patch is located in a gulch bottom with a preexisting navigation trail cutting through the patch. During scoping of the navigation trail at the beginning of 2006, it was found that this patch was much larger then first known. NRS made four site visits to this area and controlled 466 plants (mature 105, immature 129, seedling 232) by hand pulling and spraying (Table 1.2.8). NRS will continue to visit this site to reduce the number of mature plants.

KLOA-ArtCil-01; ArtCil along Poamoho Road

This weed is common in the area, but plants near the road are destroyed to avoid its transport to new areas via military traffic along the road. This site occurs along the Poamoho road, which makes spraying them easy. This ICA was weeded once last year using a backpack sprayer and an estimated 38 plants were killed (Table 1.2.8). Two trips will be made to this area next year to treat any regrowth. Over the years, NRS control has markedly decreased the amount of *A. ciliatum* in this ICA.

DrumRd-ArtCil-01; ArtCil on Drum Road near Paalaa Stream

NRS weeded this area 2 times this year for a total of 2 hours (Table 1.2.8). We found 50 plants, but none of them were mature. Since there was still quite a bit of recruitment from the seed bank, NRS will visit this area quarterly next year.

Table 1.2.8 Summary of *Arthrostemma ciliatum* Control Efforts

ICACode	IPManagementUnit	# of Visits	Effort (Person Hrs)	Date Last Mature Plant Found	Date Last Non-Mature Plant Found
IncipientTaxon: ArtCil	**Arthrostemma ciliatum**				
DrumRd-ArtCil-01	KLOA No MU	2	2.00	5/29/2006	4/24/2007
KLOA-ArtCil-01	KLOA No MU	1	2.00	4/12/2007	4/12/2007
SBE-ArtCil-02	SBE No MU	4	4.25	10/9/2006	5/30/2007
SBE-ArtCil-03	SBE No MU	2	0.95	7/20/2006	4/25/2007
SBE-ArtCil-04	SBE No MU	4	11.00	5/30/2007	5/30/2007

Buddleia madagascariensis

Buddleia madagascariensis is rare on O‘ahu, but is a widespread weed on Kaua’i. The O‘ahu Invasive Species Committee (OISC) targets this weed on O‘ahu and it is considered to be one of Hawai’i’s most invasive horticultural plants. It received a risk assessment score of 7 from PIER. It produces viable, bird dispersed seed, is a host for other pathogens and pests, and has a climbing, smothering habit. NRS feels it is important to control and eradicate this plant before it becomes established on this island. NRS currently controls this weed at two sites, both in Schofield Barracks East Range (Figure 1.2.3).

SBE-BudMad-01; East Range BudMad along Higgins Road

The mature plant found at this site appears to be dead and no seedlings were found in the surrounding area (Table 1.2.9). OISC also did not find any seedlings this year. NRS will continue to monitor this site every six months.

SBE-BudMad-02; East Range BudMad at Coqui site

No plants have been observed at this site since 2004 (Table 1.2.9). NRS will continue to monitor this site once a year during its annual road survey.

Table 1.2.9 Summary of *Buddleia madagascariensis* Control Efforts

ICACode	IPManagementUnit	# of Visits	Effort (Person Hrs)	Date Last Mature Plant Found	Date Last Non-Mature Plant Found
IncipientTaxon: BudMad	**Buddleia madagascariensis**				
SBE-BudMad-01	SBE No MU	1	0.10	3/15/2004	6/22/2006
SBE-BudMad-02	SBE No MU	1	0.10	11/8/2004	6/14/2004

Casuarina equisetifolia/ Casuarina glauca

There are two weedy *Casuarina* species naturalized on Oahu, *equisetifolia* (Ironwood) and *glauca* (Longleaf Ironwood). Both are highly invasive, and pose serious threats to the native habitats which they invade. They look very similar and share similar habitats. *Casuarina* stands are scattered across the Wai‘anae range, and are locally well-established. NRS target small stands within IP MUs. Two ICAs have been designated for *Casuarina* control by NRS, each for a different species of *Casuarina*. NRS plan to key out plants from each site to determine whether one site was misidentified as the wrong species. Both species respond well to herbicide control.

Casuarina equisetifolia can grow 5-10 feet per year, producing dense shade and a thick blanket of leaves that completely covers the ground. Chemicals in its leaves may inhibit the growth of other plants. It also fixes nitrogen, further altering soil chemistry. It has a PIER risk score of 15, making it a highly invasive species. It tolerates and may benefit from mutilation, cultivation, and fire. It creates a fire hazard in natural ecosystems. Its prolific seed production (>1000/m2), seeds adapted to wind dispersal, and tolerance of a wide range of soil conditions help this species migrate quickly to other areas. It also can reproduce vegetatively. *Casuarina equisetifolia* can cause allergies or is otherwise toxic to humans. Smith (1985) states of *C. glauca*: “this species is very similar to *C. equisetifolia*. However, it forms suckers prolifically, producing dense stands. It is the most aggressive ironwood in Hawaii.” This taxon also creates dense layers of duff and roots, which present a ready fuel for fire.

Kalua‘ā-CasEqu-01; Kalua‘ā South Fenceline

A total of 10 mature and 10 immature plants were killed this year. The area is about 50m² and is very controllable (Table 1.2.10). The infestation is located along the southern fence ridgeline, primarily outside the fence (Figure 1.2.6). There are no other *C. equisetifoia* populations anywhere in Kalua‘ā. NRS will visit this site once per year and monitor for seedlings/resprouts. This site is on the way to the site of the rare *S. kanehoana*, so periodic quick visual checks are possible.

MMR-CasGla-01; Kahanahāiki Ironwood Removal

This ICA is located along the Mākua rim within Kahanahāiki MU and covers approximately ¼ acre (Figure 1.2.1). It stretches from the edge of the exclosure, down a ridge into MMR. The ridge portion of the infestation is very steep, in some sections vertical. The *Casuarina* population poses both an ecosystem and fire threat to populations of *Cenchrus agrimonioides* and *Achatinella mustelia* which it abuts. NRS have been working at this site since 2002. All easily reachable plants were killed in previous years. This taxon spreads and matures slowly, and NRS did not conduct control this year (Table 1.2.10). Instead, the site was scoped and it was determined that rapelling gear is needed to reach the remaining plants. Very few resprouts and seedlings were seen. NRS plan to treat the cliff plants and sweep the area for resprouts once in the coming year.

Table 1.2.10 Summary of *Casuarina* Control Efforts

ICACode	IPManagementUnit	# of Visits	Effort (Person Hrs)	Date Last Mature Plant Found	Date Last Non-Mature Plant Found
IncipientTaxon: CasEqu	**Casuarina equisitifolia**				
Kaluaa-CasEqu-01	Kaluaa and Waieli	1	0.50	2007-01-04	2007-01-04
MMR-CasGla-01	Kahanahaiki	1	0.25	2005-08-08	2005-08-08

Cirsium vulgare

This species received a PIER score of 21, which suggests it is a highly undesirable and invasive taxon. It is well-established on Hawaii, but is less well-known from O‘ahu. Also known as Bull Thistle, it is considered highly invasive for several reasons. It produces copious amounts of seed which are widely dispersed by both wind and animals, particularly birds (Figure 1.2.12). There is evidence that a persistent propagule bank is formed. It grows in a number of climates and habitats, thriving particularly well in disturbed, dry to mesic habitats. Fortunately, it is not shade tolerant, and competes poorly with other pioneer species. It is also a host for recognized pests and pathogens. On Hawaii, it thrives in high-elevation pastures; fortunately this habitat type doesn’t really exist on O‘ahu. *Cirsium vulgare* is not common in any MU, and is a prime candidate for eradication. In the coming year, NRS will research seed longevity to better determine what is needed to attain eradication.

Figure 1.2.12 *Cirsium vulgare*. Note the seeds adapted for wind dispersal

MMR CirVul-01; ʻŌhikilolo CirVul Area

On Army land, the largest known population of this weed is located on ʻŌhikilolo Ridge, see Figure 1.2.1. The infestation covers approximately 1.5 acres of open, scrubby slope. NRS line up and sweep across the known infestation area, treating all plants found with a basal application of Garlon 4 or via hand pulling. Particular attention is paid to former sites of flowering plants. This year, the ICA was treated one time in December 2006; one immature plant was found at the former site of a mature plant (Table 1.2.11). The previous reporting year, no plants were found during surveys in January 2006. Numbers of plants found have been steadily decreasing over time, which is very encouraging for achieving eradication. In the coming year, NRS plan to re-visit this ICA one to two times, focusing effort during the rainy season.

MMR CirVul-02; Kaluakauila CirVul at Veg Plots

This ICA is located in Kaluakauila Gulch on the far side of Mākua Valley (see Figure 1.2.1). *Cirsium vulgare* was first discovered in this area in May 2006, when one immature individual was observed and removed. This year, one immature plant was found (Table 1.2.11). While it is promising that no mature plants were ever seen at this site, the mode of introduction of this light- and disturbance-loving plant to the area is unknown, and thus, a concern. If the introduction of *C. vulgare* was an isolated event, there is a good prognosis for achieving eradication. NRS will focus on preventing any new plants which may germinate from reaching setting fruit. This ICA will be monitored twice a year.

Table 1.2.11 Summary of *Cirsium vulgare* Control Efforts

ICACode	IPManagementUnit	# of Visits	Effort (Person Hrs)	Date Last Mature Plant Found	Date Last Non-Mature Plant Found
IncipientTaxon: CirVul	**Cirsium vulgare**				
MMR-CirVul-01	Ohikilolo	1	6.00	6/15/2005	12/14/2006
MMR-CirVul-02	Kaluakauila	1	0.25		12/20/2006

Desmodium intortum

This invasive species is widespread throughout the Pacific. It spreads via numerous hooked hairs on seed pods. Thus, it is easily carried and dispersed by hikers and hunters. In the past, NRS have targeted this species only in areas where it is not widespread or along trails where NRS, hikers, or hunters may disperse this species into native areas where it is not found ICA.

MMR-DesInt-01; Makua East Rim DesInt

Located on the Makua rim, this site is relatively small and covers approximately 0.05 acres (Figure 1.2.1). NRS visited this site twice last year and found a total of five plants (Table 1.2.12). NRS plan to visit this area quarterly in the coming year.

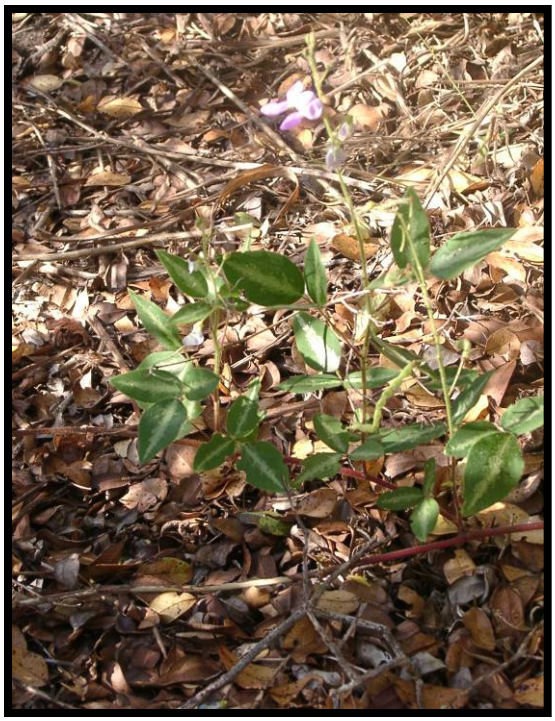

Figure 1.2.13 *Desmodium intortum*

UpperKapuna-DesInt-01
NRS established this ICA last year with the recommendation of NAR Specialist Talbert Takahama. It is an area that is frequently traversed, which is why it was weeded six times last year (Table 1.2.12). A camping area, emergency LZ, and rest spot (Hunter Cabin) is located within this ICA making it a highly visited area not only by NRS but also the public (Figure 1.2.2). NRS hope to prevent the spread of this weed throughout the MU by eradicating it from highly used areas. This site will be revisited quarterly over the next year.

UpperKapuna-DesInt-02
NAR Specialist Talbert Takahama consulted with NRS to establish this ICA. This ICA was designated along the Mokuleia trail to stop its spread throughout the MU (Figure 1.2.2). This site was visited three times last year and NRS treated five plants, none of which were mature (Table 1.2.12). NRS plan to visit this site quarterly next year in continuation of their weeding efforts.

Table 1.2.12 Summary of *Desmodium intortum* Control Efforts

ICACode	IPManagementUnit	# of Visits	Effort (Person Hrs)	Date Last Mature Plant Found	Date Last Non-Mature Plant Found
IncipientTaxon: DesInt	**Desmodium intortum**				
MMR-DesInt-01	MMR No MU	2	0.35	10/11/2005	6/18/2007
UpperKapuna-DesInt-01	Upper Kapuna	6	6.00		8/22/2007
UpperKapuna-DesInt-02	Upper Kapuna	3	3.00		6/14/2007

Ehrharta stipoides

Ehrharta stipoides, or Meadow Rice Grass, has the potential to drastically alter environments by creating a thick mat of vegetation in which it is difficult for native species to regenerate. It is not rated by the PIER program. It is known to respond well to fire. *E. stipoides* seeds are easily dispersed by awns that attach to clothing, see Figure 1.2.14. It is unknown how long the seeds remain viable in the soil. NRS have chosen to target this species as an incipient in all MUs where it occurs except Palikea. The infestation along the Wai‘anae summit at Pu‘u Palikea is too widespread for control, stretching approximately 3,000 meters along the summit and smaller ridges in the southern Wai‘anaes. This area is only treated along a small ridge that leads to the *Hesperomannia arbuscula* fence (see Chapter 3.1.14), and is discussed in the MU WCA Report. Of the seven ICAs designated for *E. stipoides*, six are on state land, see Figures 1.2.1-2. NRS work with the NARS Specialist at these sites. *Ehrharta stipoides* responds well to foliar sprays of 5-10% Roundup. To better direct management, NRS will research seed viability for this taxon. Unfortunately, *E. stipoides* is easily confused with a very similar species, *Vulpia bromoides*. NRS will strive to confirm positive identification of *E. stipoides* at all ICAs and become more familiar with both species.

Figure 1.2.14: *Ehrharta stipoides* fruit

MMR-EhrSti-01; ʻŌhikilolo EhrSti Areas

This ICA covers 1.1 acres of the primary ʻŌhikilolo campground, and areas along the fence both above and below camp. NRS have continued to struggle somewhat with correct identification of *E. stipoides* at ʻŌhikilolo, given its similarity to another, less invasive species, *V. bromoides*. While field identification has improved, NRS treat the ICA conservatively, treating all weedy grasses which may be *E. stipoides*. NRS treated the ICA three times this year on regular quarterly visits to ʻŌhikilolo (Table 1.2.13). In December 2006, dozens of mature and approximately 100 immature plants were treated. In March 2007, three mature clumps were found, and dozens of immature plants. In July 2007, two mature and 20 immature plants were found. This decreasing trend is probably due to both treatment and increasing dryness in summer months. It will be interesting to see if *E. stipoides* levels spike in the upcoming rainy season. NRS feel this infestation can be controlled and will continue to treat this site quarterly. If the 3-4 month gap between treatments dictated by the quarterly visitation schedule allows plants to reach maturity between visits, NRS will consider more aggressive control options.

Pahole-EhrSti-01; Pahole EhrSti along Kahanahāiki Fenceline

This ICA occurs along the Kahanahāiki/Pahole fenceline, and was likely introduced via hikers coming from the nearby State snail enclosure. There are three sites within this ICA, two of which seem to have been eradicated. This year, some immature plants were found and treated at the third spot along the fenceline (Table 1.2.13). NRS will continue to monitor these sites quarterly. NRS feels that it can be controlled with continued monitoring.

Pahole-EhrSti-02; Pahole EhrSti in State Snail Exclosure

This ICA occurs in and around the State *Achatinella* enclosure along the Pahole rim. It is thought that *E. stipoides* was introduced during monitoring of the snail site. While the infestation here is sparse, it has been persistent and difficult to eliminate. At last treatment, five matures and many immatures were found within the snail enclosure (Table 1.2.13). The mature plants were found underneath other introduced grasses. Next year NRS will spray all grasses to eliminate any cover. NRS feel this ICA can be controlled, but regular visits are vital to prevent recruiting individuals from maturing. NRS will monitor *E. stipoides* quarterly.

Pahole-EhrSti-03; Pahole EhrSti along Pahole Trail

A new ICA was created this year after a single immature *E. stipoides* was discovered along the trail near the western boundary of Pahole. It was likely introduced by hikers coming from the State snail exclosure. The plant was eliminated (Table 1.2.13) and NRS will continue to monitor this site quarterly for any seedlings or resprouts. NRS feel that this site will be easily eradicated since it was discovered so early.

PaholeNoMU-EhrSti-01; Pahole EhrSti at Trail Head

The presence of *E. stipoides* at the Pahole/Kahanahāiki trail head was brought to the attention of NRS by the NARS Specialist. The NARS Specialist treated this small patch (1m²) in the past and asked us to monitor and treat it in the future (Table 1.2.13). NRS feel this infestation can be controlled due to its small size and will continue to treat this site quarterly.

UpperKapuna-EhrSti-01; EhrSti on Mokulē‘ia Trail

Both Upper Kapuna *E. stipoides* ICAs were designated this year, after discussions with the NARS Specialist. Along the Mokulē‘ia trail, small clumps of *E. stipoides* are scattered between the trailhead and the hunter’s shelter, a portion of the trail covering approximately one kilometer. The clumps are quite cryptic and difficult to see mixed with a variety of other trailside grasses. The NARS Specialist oriented NRS to the site, and conducted an initial control effort. NRS followed up with three maintenance trips, spaced two months apart (Table 1.2.13). As Figure 1.2.15 shows, overall plant numbers were never high, but have steadily decreased with consistent effort. In February 2007, three mature and 22 immature plants were found, but by August 2007, only one immature and two seedlings were found. NRS want to prevent any plants from reaching maturity, and plan to continue to visit the ICA every two to three months. While there is a positive control trend at this site, NRS recognize that the cryptic nature, quick germination, and fast-growing nature of this species will make it difficult to eradicate.

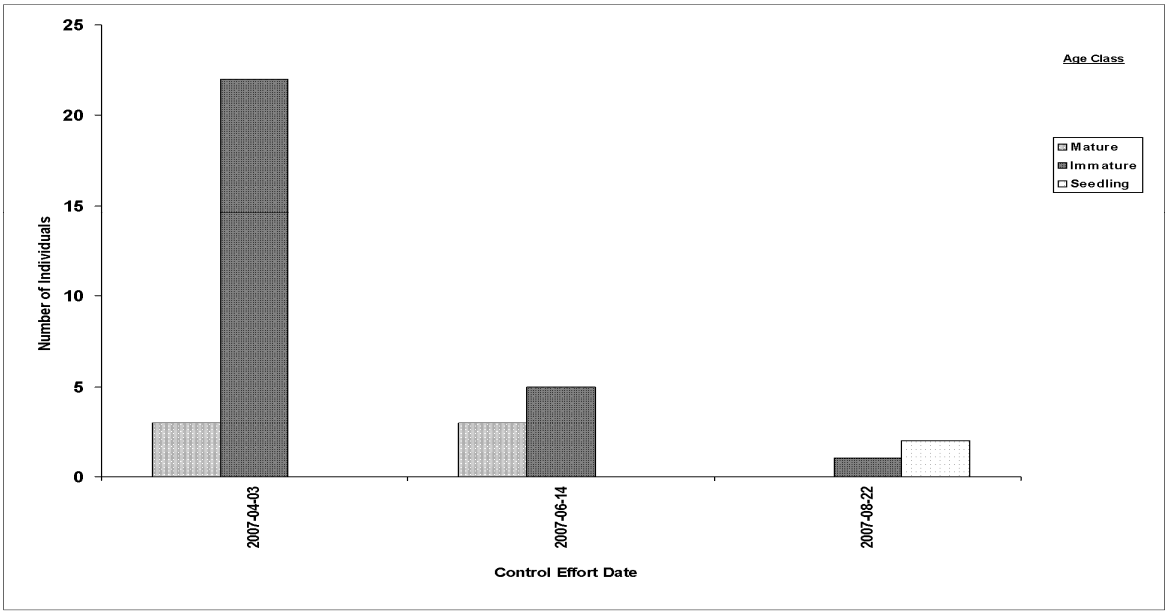

Figure 1.2.15 Number of *Erharta stipoides* Individuals Controlled at UpperKapuna-EhrSti-01

UpperKapuna-EhrSti-02; Talbert’s EhrSti Patch below Mokulē‘ia Trail

This ICA is located well off the Mokulē‘ia trail, in an open gap. The infestation covers some very steep area, including a small dirt cliff. While small in area, this infestation was very dense, consisting of one thick patch and numerous scattered clumps. The small dirt cliff in the site has made control challenging, as it is difficult to thoroughly survey and treat the cliff. Initial control in November 2006 was successful in killing all treated plants. No plants were seen at the site again until February 2007, when 10 each mature and immature plants were seen and treated. Four months later, three mature and 50 immature plants were seen at the site (Table 1.2.13). It is encouraging to see a decreasing number of plants reaching maturity at the site. NRS plan to revisit the site at regular two to three month intervals over the coming year.

Table 1.2.13 Summary of *Ehrharta stipoides* Control Efforts

ICACode	IPManagementUnit	# of Visits	Effort (Person Hrs)	Date Last Mature Plant Found	Date Last Non-Mature Plant Found
IncipientTaxon: EhrSti	**Ehrharta stipoides**				
MMR-EhrSti-01	Ohikilolo	3	4.00	2007-07-19	2007-07-19
Pahole-EhrSti-01	Pahole	2	1.00	2006-05-30	2007-05-14
Pahole-EhrSti-02	Pahole	3	1.75	2006-08-02	2006-08-02
Pahole-Ehrsti-03	Pahole	1	0.10		2007-05-14
PaholeNoMU-Ehrsti-01	Pahole	1	0.25	2007-05-14	
UpperKapuna-EhrSti-01	Upper Kapuna	3	3.25	2007-06-14	2007-08-22
UpperKapuna-EhrSti-02	Upper Kapuna	4	3.50	2007-06-14	2007-06-14

Festuca arundinacea

Festuca arundinacea is a deep rooted perennial grass from Europe. It is a cool-season, long-lived grass that grows in moist forests and grassland, reed swamps, riparian habitats, and seashores. The grass is mostly infected with an endophytic fungus, making it more drought tolerant and increasing its nitrogen utilization efficiency (Weber, 2003; p. 168). It is a persistent grass that strongly competes with native species. It forms dense, monotypic stands, displacing native herbaceous vegetation and reduces species richness.

SBW-FesAru-01

Festuca arundinacea at Kaʻala (Figure 1.2.7) continues to be a persistent problem. This ICA was aggressively sprayed five times this year (Table 1.2.14), but NRS continue to find mature seeding clumps. Seed heads were bagged and remaining stalks sprayed. NRS will continue to spray the area once per quarter and work with the NARS Specialist to eradicate the population. It is likely that this may be a long-term process because of a probable persistent seed bank. If deemed necessary, research can be conducted on the seeds and a management plan developed accordingly. NRS is looking into using pre-emergent herbicide in other areas. The proximity to the bog may rule out using pre-emergent herbicide here.

Table 1.2.14 Summary of *Festuca arundinacea* Control Efforts

ICACode	IPManagementUnit	# of Visits	Effort (Person Hrs)	Date Last Mature Plant Found	Date Last Non-Mature Plant Found
IncipientTaxon: FesAru	**Festuca arundinacea**				
SBW-FesAru-01	Kaala	5	13.00	8/20/2007	8/20/2007

Fraxinus uhdei

This species is widely distributed in lower elevation mesic sites throughout the Waianae Mountains. According to Weber (from the PIER website) “Where invasive, it colonizes disturbed areas in forests and precludes the establishment of native plants. The large canopies shade out most understory species and prevent forest succession" (Weber, 2003; p. 174). NRS plan to target this species in select native areas where it is not yet established. This incipient will be controlled by girdling the bigger trees and basally applying Garlon 4A.

MMR-FraUhd-01; ʻŌhikilolo Campsite FraUhd
This ICA once contained one large mature and several small individuals within the ʻŌhikilolo PriKaa A fence (Figure 1.2.1). NRS visited this area once last year and controlled all known individuals (Table 1.2.15). NRS will visit this ICA every six months to confirm the mature tree died and to treat any seedlings.

UpperKapuna-FraUhd-01
NRS established this ICA with the help of NAR Specialist Talbert Takahama (Figure 1.2.2). This area was visited twice last year and weeding efforts were mainly focused on trees no greater than 8" in diameter (Table 1.2.15). This was the dominant canopy species in some of the areas that were weeded. Focusing on the selective weeding of smaller trees is important to prevent the opening up of huge light gaps that are highly favorable to weedy species. This area will be visited quarterly next year with weeding efforts focused on smaller trees beneath the canopy.

Table 1.2.15 Summary of *Fraxinus uhdei* Control Efforts

ICACode	IPManagementUnit	# of Visits	Effort (Person Hrs)	Date Last Mature Plant Found	Date Last Non-Mature Plant Found
IncipientTaxon: FraUhd	**Fraxinus uhdei**				
MMR-FraUhd-01	Ohikilolo	1	0.50	2006-12-13	
UpperKapuna-FraUhd-01	Upper Kapuna	2	49.75	2007-06-25	2007-06-25

Grevillea robusta

This tree, native to Eastern Australia, may reach heights of 30m and produces seeds that are dispersed in the wind (Figure 1.2.16). In newly disturbed areas this tree may become established and prevent the regeneration of native plants due to allelopathic properties found in its leaves. This is a cultivated, introduced, and invasive plant that has naturalized on the island of Oʻahu. It is mainly a threat to management in the Waianae Mountain Range because it prefers drier habitats. Mature trees are found in low numbers throughout its established areas, making eradication from certain MUs an achievable goal.

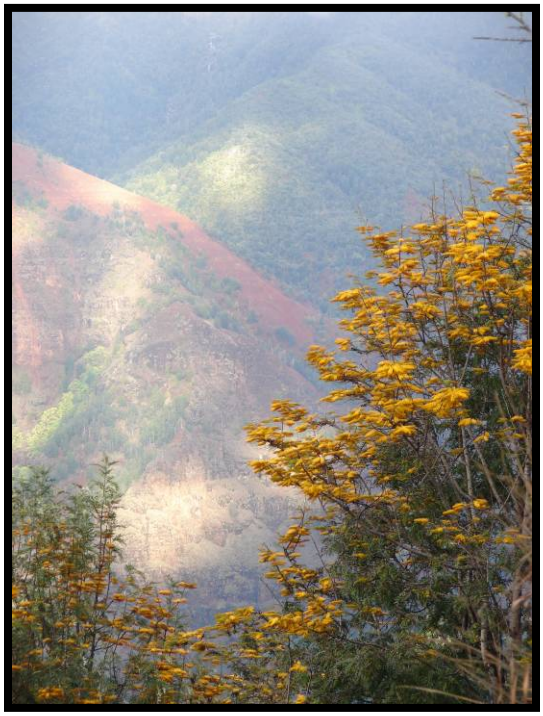

Figure 1.2.16 Flowering *Grevillea robusta*

UpperKapuna-GreRob-01
This ICA was established this past year by NRS under the direction of NAR Specialist Talbert Takahama. It includes most of the Upper Kapuna MU (Figure 1.2.2). NRS visited this ICA once last year and killed three mature trees using a chainsaw (Table 1.2.16). NRS used a chainsaw to girdle the trees, which were then treated with a 20% Garlon 4A in Forestry Crop Oil. NRS plan to visit this MU quarterly next year and will focus their efforts on killing trees that will not open up large light gaps.

Table 1.2.16 Summary of *Grevillea robusta* Control Efforts

ICACode	IPManagementUnit	# of Visits	Effort (Person Hrs)	Date Last Mature Plant Found	Date Last Non-Mature Plant Found
IncipientTaxon: GreRob	**Grevillea robusta**				
UpperKapuna-GreRob-01	Upper Kapuna	1	1.00	2007-05-02	

Hedychium gardnerianum/coronarium

Hedychium gardnerianum, or Kahili ginger, is an invasive member of the ginger family (Zingiberaceae). In wet higher elevation forests of Hawai‘i, it has become a serious ecosystem-altering understory pest. This species received a score of 16 from the PIER Weed Risk Assessment and is considered a very high risk for becoming invasive. It is less common on O‘ahu than other islands, and control of this weed in its known locations in Ka‘ala bog and the Ko‘olau summit is a high priority for NRS. *H. gardnerianum* control on Mount Ka‘ala is discussed in the MU WCA Report; this taxa is so widespread at Ka‘ala that it is no longer treated as an incipient.

Hedychium coronarium, or White ginger, is another widespread, naturalized ginger which threatens native ecosystems. With a Weed Risk Assessment score of 10, it is not as dangerous a pest as *H. gardnerianum*, but still is highly undesirable. Like *H. gardnerianum*, it is shade-tolerant, forms dense stands, produces viable seed, and is adapted for moist environments. Unlike *H. gardnerianum*, it is not thought to be bird-dispersed. *Hedychium coronarium* is widespread in low elevation valleys, particularly on the windward side of O‘ahu.

Kipapa-HedCor-01; HedGar at Puu Kaaumakua

The goal of this eradication effort is to keep *H. coronarium* off the summit and limit it to the windward side (Figure 1.2.4). This year NRS was not able to visit the site due to logistical problems, but NRS will continue to kill large patches on the windward side near the summit and continue to monitor one to two times per year.

Koloa-HedGar-01; Kawailoa Kahuku Cabin

Only two seedlings were found this year (Table 1.2.17). NRS will continue to monitor once or twice per year. Monitoring efforts were focused on the trails. Sites were spotted off the trail in the past (Figure 1.2.4). NRS will survey the area thoroughly next year. Because plants were removed before seeds are produced, the identification of this population still needs to be confirmed, although it is suspected to be *H. gardnerianum*, based on the widespread *H. gardnerianum* patches found in low elevations in the region.

Table 1.2.17 Summary of *Hedychium gardnerianum* Control Efforts

ICACode	IPManagementUnit	# of Visits	Effort (Person Hrs)	Date Last Mature Plant Found	Date Last Non-Mature Plant Found
IncipientTaxon: HedGar	**Hedychium gardnerianum**				
Koloa-HedGar-01	Koloa	1	2.50	3/17/2005	2/15/2007

Ilex cassine

Ilex cassine is a member of the holly family (Aquifoliaceae) and is native to the Eastern United States. It received a score of 3 from the PIER Weed Risk Assessment, but is not considered invasive yet, because the score is listed as needing re-evaluation. It is unclear as to the invasiveness of this species, but it has already naturalized at an old low elevation botanical site in Helemano, where it is a common component of the alien-dominated forest. NRS does not want new populations to get established in management areas. The only other place on the island that this plant is known is Schofield West Range (SBW). One mature plant was found in June 2006 during a fire survey (Figure 1.2.7) and NRS hopes to eradicate it from this MU.

SBW-IleCas-01; Haleauau/Pulee Ridge Fire Area

NRS visited this site once in Septemer 2006 (Table 1.2.18) and retreated the one mature plant since it had resprouted. NRS will try to monitor this plant at least once a year. Access into SBW is often very limited.

Table 1.2.18 Summary of *Ilex cassine* Control Efforts

ICACode	IPManagementUnit	# of Visits	Effort (Person Hrs)	Date Last Mature Plant Found	Date Last Non-Mature Plant Found
IncipientTaxon: IlexCas	**Ilex cassine**				
SBW-IleCas-01	SBW No MU	1	0.25	9/19/2006	

Juncus effusus

Juncus effusus is a member of the rush family (Juncaceae), and is an invasive plant in higher elevations on O‘ahu. NRS control it at three sites in the Ka‘ala bog (Figure 1.2.7). It forms dense aggregations that may inhibit natural regeneration of native bog flora. The current control technique for *J. effusus* is manual removal, however, in the coming reporting year NRS plans to experiment with using Rodeo herbicide (formerly Roundup) as a control of this weed.

SBW-JunEff-01; Ka’ala Bog JunEff Core

This year two volunteer groups spent 86 hours manually removing *J. effusus* around the beginning portion of the Ka‘ala boardwalk (Table 1.2.19). There are still some large clumps left and other species of introduced grasses are starting to fill in. Next year, this area has been designated as a target for volunteer groups. They will continue to manually remove clumps of *J. effusus* and there are also plans to outplant native plants in an effort to rehabilitate this area. NRS will continue to monitor the area and try to develop an effective control strategy.

SBW-JunEff-02;Ka’ala Bog JunEff South

No *J. effusus* was found at this site when NRS check in September 2007 (Table 1.2.19). It is very likely that it has been eradicated from this location. NRS will continue to monitor this site when we are in the area.

SBW-JunEff-03; Ka’ala Bog JunEff Northeast

The population at this location is not that dense. In one ten hour trip NRS were able to remove all of the *J. effusus* from the area (Table 1.2.19). NRS have not had much time to dedicate to this problem in past years, but in the next reporting period we are expecting to have volunteer groups work this area more frequently.

Table 1.2.19 Summary of *Juncus effusus* Control Efforts

ICACode	IPManagementUnit	# of Visits	Effort (Person Hrs)	Date Last Mature Plant Found	Date Last Non-Mature Plant Found
IncipientTaxon: JunEff	**Juncus effusus**				
SBW-JunEff-01	Kaala	2	86.00	4/22/2006	11/18/2006
SBW-JunEff-02	Kaala	1	0.10		
SBW-JunEff-03	Kaala	1	10.00	8/30/2007	8/30/2007

Leptospermum scoparium

Leptospermum scoparium received a PIER Weed Risk Assessment score of 3, and is deemed a high risk. Its fast growth, quick rate of maturation, and wind dispersed seeds make it highly invasive. Its wet forest habit means it threatens some of the most intact native forest on O‘ahu. This species is known from the extreme northern end of KLOA, Poamoho, and KTA. While it is very well established in the northern Ko‘olau Mountains, this weed is present in fairly low numbers in the Poamoho region. NRS control efforts focus on Poamoho, but in the future, NRS may expand efforts to the Pu‘uka‘inapua‘a region of northern KLOA, the frontline of *L. scoparium* expansion in the northern Ko‘olaus (Figure 1.2.4).

Figure 1.2.17 *Leptospermum scoparium*

KLOA-LepSco-01; LepSco Poamoho

Despite a relatively low population in Poamoho, *L. scoparium* is distributed across a large are including the Poamoho trail ridge and both bordering valleys. Reaching all plants is difficult. The terrain is steep and the native vegetation is thick. This year NRS visited this site twice and killed hundreds of mature and immature plants (Table 1.2.20). Next year NRS will visit this site quarterly and perform weed sweeps expanding out from the trail towards the waterfall. NRS will also do an aerial survey to seek out any outliers.

KLOA-LepSco-02; LepSco Poamoho Trailhead

No control was done in this ICA this year. It was swept two years ago, and NRS plan to sweep the area again in the next year.

KLOA-LepSco-03; Pu‘uka‘inapua‘a

This year NRS revisited an older *L. scoparium* site in KLOA that has not been controlled since 2002. There were large mature trees scattered throughout this area, but it was not as abundant as

it once was. NRS was able to hit the most of the core area, but more time is needed to sweep the surrounding areas thoroughly (Table 1.2.20). NRS will visit this area two times next year.

Table 1.2.20 Summary of *Leptospermum scoparium* Control Efforts

ICACode	IPManagementUnit	# of Visits	Effort (Person Hrs)	Date Last Mature Plant Found	Date Last Non-Mature Plant Found
IncipientTaxon: LepSco	**Leptospermum scoparium**				
KLOA-LepSco-01	KLOA No MU	2	34.00	2007-04-11	2007-04-11
KLOA-LepSco-03	KLOA No MU	1	8.00	2007-02-15	2007-02-15

Melochia umbellata

M. umbellate, also called Gunpowder Tree, is an invasive tree, native from southeast Asia and certain islands in the western Pacific Ocean. In Hawai'i, the major infestations are located near Hilo and Puna on the island of Hawai'i. On O'ahu, it is only known from five sites, all located in KTA (Figure 1.2.5). *M. umbellata* has not been ranked by PIER yet. It is probable that the weed was inadvertently transported there by military personnel or vehicles coming from the Big Island. *M. umbellata* is a fast growing tree capable of invading disturbed areas and replacing native vegetation. It is possible that ICAs 03, 04, and 05 were established by dirt containing *M. umbellata* seeds spread around by vehicles traveling through KTA MelUmb-01. This makes eradication of plants along the road a high priority to avoid further spread of the weed to other areas, possibly even outside KTA. NRS remove this species by hand-pulling seedlings. For larger tress that can not be pulled a cut stump or frill treatment with Garlon 4 20% concentration is used. Control efforts for all ICAs are summarized in Table 1.2.21. NRS has done a literature search to find information on the longeivity of the seed bank. NRS will pursue this research in the future.

<u>KTA MelUmb-01; Kahuku MelUmb Along Road</u>

This ICA is one of the highest priority incipient sites that NRS manage. This is the core site for *M. umbellata* in KTA. A total of 11 immatures were found in October 2006 and 6 were found in January 2007. NRS will plan to visit this site at least twice in the next year to insure that any new plants are removed before maturity. Figure 1.2.18 shows that there has been a steady decline in the number of immatures and seedlings found over the years. This suggests that the seed bank is being exhausted and that the goal of eradication is being approached. The graph does not show the removal of matures that happened prior to 2004.

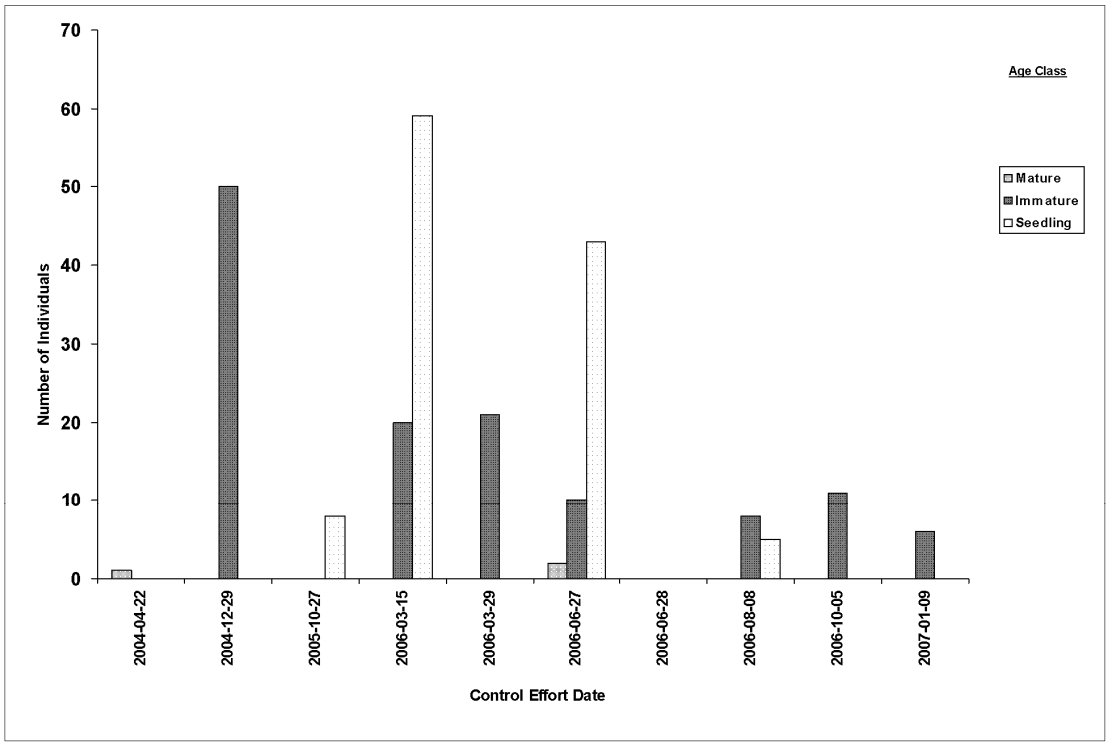

Figure 1.2.18 Number of *M. umbellata* Individuals Controlled in KTA-MelUmb-01

KTA MelUmb-02; Kahuku MelUmb Below Road

This site is where the original mature *M. umbellata* plants were found. The area is thick with *Psidium cattleianum* and other non-native trees, making it unfavorable for *M. umbellata*, which prefers full sunlight. In the 2005-2006 report year, NRS found a large mature tree from the air. This year, NRS navigated to the site and removed the tree and in addition found nine immatures and two seedlings. NRS will revist this area at least once in the coming year to remove any additional plants. As there were no aerial surveys done this year, NRS will also conduct a survey in the next year. This survey will be conducted during the flowering season in March.

KTA MelUmb-03; Kahuku MelUmb West Outlier

This ICA was created around a single outlying mature plant found in June 2006. The tree was near the road, approximately 700 meters from KTA-MelUmb-01. The tree was killed in 2006 and no plants have been seen since. NRS will monitor the site at least once in the coming year. This frequency should be sufficient to control any seedlings that come up before they become mature. When the aerial survey is conducted at KTA Mel Umb-02, NRS will also survey this area.

KTA MelUmb-04; Kahuku MelUmb East Outlier

This ICA is only 100 meters down the road from KTA-MelUmb-03, and like that ICA, was created with the discovery of a single mature tree found on the same day in June of 2006. The tree was killed, and like the previous ICA, no plants have been seen since. NRS plans to re-visit the site and sweep for seedlings at least once a year. A yearly aerial survey in conjunction with the other sites is recommended for the following report year.

KTA MelUmb-05; Kahuku MelUmb Delta Gate

NRS has not surveyed this site in two years due to the closure of Delta Road. NRS believe the road repair was completed and that it is passable. NRS will make it a high priority to survey this area in the next year. It will also be considered as a site for aerial survey pending the results of ground survey.

Table 1.2.21 Summary of *Melochia umbellata* Control Efforts

ICACode	IPManagementUnit	# of Visits	Effort (Person Hrs)	Date Last Mature Plant Found	Date Last Non-Mature Plant Found
IncipientTaxon: MelUmb	**Melochia umbellata**				
KTA-MelUmb-01	KTA No MU	2	3.10	6/27/2006	1/9/2007
KTA-MelUmb-02	KTA No MU	1	10.00	10/5/2006	10/5/2006
KTA-MelUmb-03	KTA No MU	1	0.50	6/27/2006	
KTA-MelUmb-04	KTA No MU	1	0.50	6/27/2006	

Montanoa hibiscifolia

The common name of *Montanoa hibiscifolia* is Tree Daisy. According to the PIER Weed Risk Assessment, *M. hibiscifolia* is given a score of 13, and is deemed a high risk. It is also listed on the Noxious Weed List for the State of Hawai‘i. It occurs in mesic to dry areas and is able to form dense stands. This species is widely distributed in lower elevation mesic sites throughout the Wai‘anae Mountains. Prolific seed production (>1000/m^2) and shade tolerance make the spread of this plant in native areas a threat. NRS hopes to control the spread into sensitive native areas that are managed.

Kalua‘ā-Monhib-01; Airplane gulch

A large patch was found and treated, however, further scoping uphill found a patch probably too large to attack (Figure 1.2.6). A 200 square meter area in the portion closest to the gulch was treated (Table 1.2.22). This area is right above the *A. elliptica* site. NRS will no longer manage for *M. hibiscifolia* at this site.

Pahole-MonHib-01; Pahole MonHib

Montanoa hibiscifolia is found along the rim and throughout the interior gulches of Pahole. It will be difficult to eradicate it from the NAR, but in cooperation with the state NARS Specialist, NRS has designated the entire Pahole MU as an ICA for *M. hibiscifolia* (Figure 1.2.2). There are records of NRS controlling patches of *M. hibiscifolia* in Pahole since 2004. NRS has revisited and retreated all of these sites and have documented several more this year (Table 1.2.22). NRS will try to conduct an aerial survey next spring while they are flowering to determine the full extent of *M. hibiscifolia* in the valley.

PaholeNoMU-MonHib-01; Pahole MonHib Outside the Fence

NRS controlled a 100m^2 patch of *M. hibiscifolia* that was just outside the exclosure (Figure 1.2.2). All plants were killed and the surrounding area was also surveyed for additional plants (Table 1.2.22). This site needs to be checked three to four times next year for seedling or resprouts.

Table 1.2.22 Summary of *Montanoa hibiscifolia* Control Efforts

ICACode	IPManagementUnit	# of Visits	Effort (Person Hrs)	Date Last Mature Plant Found	Date Last Non-Mature Plant Found
IncipientTaxon: MonHib	**Montanoa hibiscifolia**				
Kaluaa-Monhib-01	Kaluaa and Waieli	1	1.50	2007-05-31	
Pahole-MonHib-01	Pahole	3	29.75	2007-05-16	2007-01-11
PaholeNoMU-MonHib-01	Pahole No MU	1	6.00	2007-04-18	2007-04-18

Morella faya

The PIER risk assessment gave this species a score of 8, meaning that it should be rejected for importation. This species, commonly known as the Firetree, is common in the Southern Waiʻanae Mountains from Palikea to Pualiʻi. NRS will control any *M. faya* north of Pualiʻi. Problems of this plant include prolific seed production (>1000/m2) and evidence that a persistent propagule bank is formed (>1 yr). *M. faya* often forms dense thickets and propagules can be bird and pig dispersed. The fact that it is a nitrogen-fixing woody plant makes it possible for other weeds such as *Ehrharta stipioides* to grow in the understory. NRS plan to target this species in select native areas where it is not yet established.

Kaluaʻā-MorFay-01

A small population of *M. faya* was treated in the Kaluaʻā area (Figure 1.2.6). The area containing mature *M. faya* measured a little more than 9 acres (Table 1.2.23). NRS hopes that early treatment will prevent the spread uphill into the native patches. All trees had multiple trunks so chainsaws were useful for girdling the plants before treating them with 40% Garlon4. NRS will survey this area again to see if any mature trees still exist.

Table 1.2.23 Summary of *Morella faya* Control Efforts

ICACode	IPManagementUnit	# of Visits	Effort (Person Hrs)	Date Last Mature Plant Found	Date Last Non-Mature Plant Found
IncipientTaxon: MorFay	**Morella faya**				
Kaluaa-Morfay-01	Kaluaa and Waieli	1	68.00	7/12/2007	

Neonotonia wightii

This plant was given a risk assessment score of 7, which means it has a high risk of becoming invasive. It grows as a vine that may reach lengths of 4.5m. It smothers native plants by forming dense mats on the ground; it may even creep up trees. It produces seeds that cling easily to anything that brushes up against it. These plants are widely distributed in lower elevation mesic sites throughout the Waiʻanae Mountains. In Upper Kapuna it is mainly found along the trail and in a rest spot that is frequently used by the public. NRS plan to target this species

Figure 1.2.19 *Neonotonia wightii*

in select native areas that are regularly used to stop it from being transported throughout the MU. ICA locations are shown in Figure 1.2.2. NRS began targeting this species in the Pahole NAR this year at the request of the NARS Biologist. Control efforts are summarized in Table 1.2.24.

UpperKapuna-NeoWig-01; NeoWig at the Hunters Shelter
NRS visited this site six times this past year and treated the plants with Round Up that was applied using a hand-pump sprayer. Although the dilution rates varied each time, from 4% to 10%, all treatments resulted in success. NRS will weed this area quarterly next year in efforts to exhaust this plant from the seed bank.

UpperKapuna-NeoWig-02; NeoWig at Mokuleia trailside clearing
NRS began controlling this species at a clearing along the Mokulēʻia trail within this past year. Several plants were treated although just two were observed to be mature. Most of the plants treated were seedlings and were concealed in the grass. NRS will revisit this area quarterly to keep this weed from spreading onto the trail.

Table 1.2.24 Summary of *Neonotonia wightii* Control Efforts

ICACode	IPManagementUnit	# of Visits	Effort (Person Hrs)	Date Last Mature Plant Found	Date Last Non-Mature Plant Found
IncipientTaxon: NeoWig	**Neonotonia wightii**				
UpperKapuna-NeoWig-01	Upper Kapuna	6	5.50		2007-08-22
UpperKapuna-NeoWig-02	Upper Kapuna	6	2.90	2007-05-15	2007-08-22

Panicum maximum

Although this species is very wide spread throughout lower elevation areas on Oʻahu, NRS would like to prevent its spread in sites near or adjacent to particular MUs. This species got a 17 PIER rating, defining it as a highly invasive grass. Prolific seed production (>1000/m2), propagules adapted to wind dispersal, and high toleration of a wide range of soil conditions makes it a dominant invader. It is allelopathic and forms dense thickets, creating a major fire hazard in natural ecosystems. *Panicum maximum* has a very high burn index and was the major fuel source in all fires which affected NRS projects this year. This grass is relatively easy to kill, and responds well to foliar sprays of as low as 0.5-1% Roundup.

Kalua'ā-PanMax-01
Two small populations of *P. maximum* were treated near the fenceline to prevent the development of a larger unmanageable population (Table 1.2.25). This opportunistic treatment was facilitated by a helicopter drop carrying fence maintenance supplies and water necessary for conducting spray operations. This site is of low priority to NRS and will be monitored infrequently. In the future, with more staff, NRS will manage this site while conducting other ecosystem management work in the area.

Table 1.2.25 Summary of *Panicum maximum* Control Efforts

ICACode	IPManagementUnit	# of Visits	Effort (Person Hrs)	Date Last Mature Plant Found	Date Last Non-Mature Plant Found
IncipientTaxon: PanMax	**Panicum maximum**				
Kaluaa-PanMax-01	Kaluaa and Waieli	1	1.00	4/4/2007	

Pennisetum setaceum

Pennisetum setaceum or Fountain grass, received a PIER Weed Risk Assessment score of 26, making it highly invasive and undesirable. It is easily dispersed and is apomictic, meaning it can produce lots of clonal seed, giving it the ability to spread very quickly. It is a fire-stimulated grass which can carry intense fires throughout its range; extirpating any infestations is crucial. There are three well established population of *P. setaceum* in the Koʻolau Mountains: Diamond Head crater, Lanikai and Pālolo valley. It is a high priority to keep this species out of the Waiʻanae Mountains and off all Army lands. Given that eradication efforts have been very successful at all designated ICAs, NRS will research seed bank viability for this taxon and create guidelines for determining when an infestation can be deemed extirpated.

KTA-PenSet-01; Kahuku PenSet

The area is thick with weedy vegetation, dominated by tall *P. maximum,* making surveys of this site difficult (Figure 1.2.5). No plants were found this year indicating that *P. setaceum* may be extirpated from this area. However, NRS will continue to survey the area in the coming reporting year to ensure its complete eradication from the ICA. If the area proves difficult to survey due to thick vegetation, NRS will consider spraying the area with herbicide to kill any hidden plants.

DMR-PenSet-01; Dillingham Gate PenSet

This site is monitored during the annual Road survey and spot checked upon each DMR visit. No plants were found this year (Table 1.2.26). No plants have been seen since 2001, suggesting the taxon may be extirpated. NRS will monitor this site again next year. If there are no plants found again next year NRS will remove this site as an ICA.

MMR-PenSet-01; Lower ʻŌhikilolo PenSet

NRS found and eliminated one flowering plant in 2006 in a frequently visited WCA, Lower ʻŌhikilolo 01 (Figure 1.2.1). NRS visited the lower patch several times this year and no *P. setaceum* was noticed (Table 1.2.26). NRS will continue to monitor the area once a quarter.

SBE-PenSet-01; East Range PenSet

NRS and OISC found one plant with a flowering head in 2004 on Centerline Road (Figure 1.2.3). It was pulled and disposed of. The area has been monitored during road surveys since 2005 and no regrowth has occurred (Table 1.2.26). NRS will continue to monitor this area during the annual road survey.

Table 1.2.26 Summary of *Pennisetum setaceum* Control Efforts

ICACode	IPManagementUnit	# of Visits	Effort (Person Hrs)	Date Last Mature Plant Found	Date Last Non-Mature Plant Found
IncipientTaxon: PenSet	**Pennisetum setaceum**				
DMR-PenSet-01	Haili to Kealia	2	0.50	8/30/2001	8/30/2001
MMR-PenSet-01	Lower Ohikilolo	4	0.40		3/13/2006
SBE-PenSet-01	SBE No MU	1	0.10	9/21/2004	

Pterolepis glomerata

Pterolepis glomerata is a member of the *Melasomataceae* family, along with two other well known invasive species *Miconia calvescens,* and *Clidemia hirta.* It is native to tropical regions of eastern South America. In Hawai‘i, this weed has naturalized in wet to mesic disturbed sites and trail margins, primarily in the Ko‘olau Mountains. In an attempt to keep it from establishing in the Wai‘anae Mountains, NRS will target any small incipient populations found (Figure 1.2.2).

Pahole-PteGlo-01; Pahole Pteglo Near the Mākua Overlook

In May of 2007, an 84m² patch of *Pterolepis glomerata* was discovered on a trail in Pahole right before the Mākua overlook, most likely brought in by hikers with contaminated gear. It was treated by NRS staff a week later, and after three subsequent retreats the population was killed (Table 1.2.27). The seed bank is expected to be substantial and seedlings will very likely appear after the next big rain in Pahole. NRS will check this spot at least once a quarter and more frequently during the winter months.

Table 1.2.27 Summary of *Pterolepis glomerata* Control Efforts

ICACode	IPManagementUnit	# of Visits	Effort (Person Hrs)	Date Last Mature Plant Found	Date Last Non-Mature Plant Found
IncipientTaxon: PteGlo	**Pterolepis glomerata**				
Pahole-PteGlo-01	Pahole	6	3.75	5/10/2007	7/9/2007

Rhodomyrtus tomentosa

This species is a member of the Myrtaceae family, and was probably introduced to Hawai’i intentionally as an ornamental plant. It received a score of 8, meaning high risk, from the PIER Weed Risk Assessment. It is a widespread weed on other islands, but on O’ahu it is locally common only in a few valleys on the Windward side of the Ko’olau Mountains, where it forms dense monotypic stands in disturbed areas. It is a rare weed on NRS managed lands, occurring in only two currently known sites (Figures 1.2.3 and 1.2.5). It is important that NRS keep this weed out of management areas in KTA and SBE.

KTA-RhoTom-01; Kahuku RhoTom at Puu 1010

One mature individual was found at this site in June of 2005. The tree was killed, and since then NRS have made informal checks as to any sort of regeneration or appearance of seedlings, since the site is adjacent to a commonly used parking area. No plants have been seen since the original one was found (Table 1.2.28). It is unclear how the plant could have dispersed to this location, possibly from mud in tires of motocross riders coming from the infested windward areas. NRS feel that eradication is necessary and possible. It may already be eradicated following the

removal of the one mature individual, however, official declaration of the weed's extirpation will require study of the longevity of its seeds in the soil. In the following year NRS plan to scope the site periodically and make a decision as to its status. NRS will use its Outreach Program to educate motorcross riders about the importance of cleaning their bikes to eliminate weed dispersal.

SBE-RhoTom-01; East Range RhoTom Control

This year NRS swept through the core *R. tomentosa* area twice. A total of nine matures, 46 immatures and 23 seedlings were controlled. A third day was spent surveying surrounding areas and no plants were found (Table 1.2.28). The number of matures found is less than last year (27 matures) but the number of immatures and seedlings are about the same (41 immatures and 20 seedlings). NRS will continue to visit the area three times a year, focusing on killing seedlings near areas where mature plants were found. NRS will also continue to complete surveys of surrounding areas to ensure that all mature plants were found. NRS is still considering using a pre-emergent herbicide to kill seeds in the soil to reduce seedling recruitment.

Table 1.2.28 Summary of *Rhodomyrtus tomentosa* Control Efforts

ICACode	IPManagementUnit	# of Visits	Effort (Person Hrs)	Date Last Mature Plant Found	Date Last Non-Mature Plant Found
IncipientTaxon: RhoTom	**Rhodomyrtus tomentosa**				
SBE-RhoTom-01	SBE No MU	3	40.64	4/25/2007	4/25/2007

Rubus argutus

Rubus argutus, or Blackberry, is a thorny shrub belonging to the Rosaceae family. It received a score of 21.5 on the PIER weed risk assessment, making it highly invasive and undesirable. It is native to the central and eastern United States and is a naturalized, highly invasive weed in Hawai‘i. It grows in a variety of climate, habitat, and soil types, from wet bogs to dry ridges. It is moderately shade tolerant and creates dense thickets. This brambling shrub produces edible fruit that is black when ripe, and is dispersed by birds (Foster and Robinson 2007). Seeds are not affected by passing through the gut. There is evidence *R. argutus* forms a persistent seed bank. It can also reproduce vegetatively and tolerates pruning well. It may host other pests and pathogens. While *R. argutus* is very well established at Mount Ka‘ala, and has spread down many of the side ridges of Ka‘ala, it is not well established north of West Makaleha. NRS would like to keep it out of the Pahole NAR and all areas north to the north. *Rubus argutus* poses some interesting control problems; clip and drip treatment with Garlon 4 at 20% in FCO is not always effective. This taxon grows via runners underground, and readily re-sprouts from untreated runners. Stronger concentrations of Garlon 4 (40%) have been somewhat more effective, but NRS have achieved greater success by digging up runner plants and treating as much of the roots/runner as possible. This method, while time consuming, is effective for small infestations. All control efforts for this taxon are summarized by ICA in Table 1.2.30. All ICA locations are mapped in Figures 1.2.1-2.

Kuaokalā-RubArg-01; RubArg Kuaokalā Road

This roadside site was treated once this year. Only four immature plants were found. As the Figure 1.2.20 shows, there is a decreasing population trend at this site. NRS feel that eradication is achievable, as very few mature plants were ever found at the site, and it is unlikely there is

much of a seed bank. However, to achieve this, more frequent monitoring is needed and NRS will strive to treat this ICA quarterly in the coming year. Also, NRS will strive to implement the digging/herbicide application method at this site.

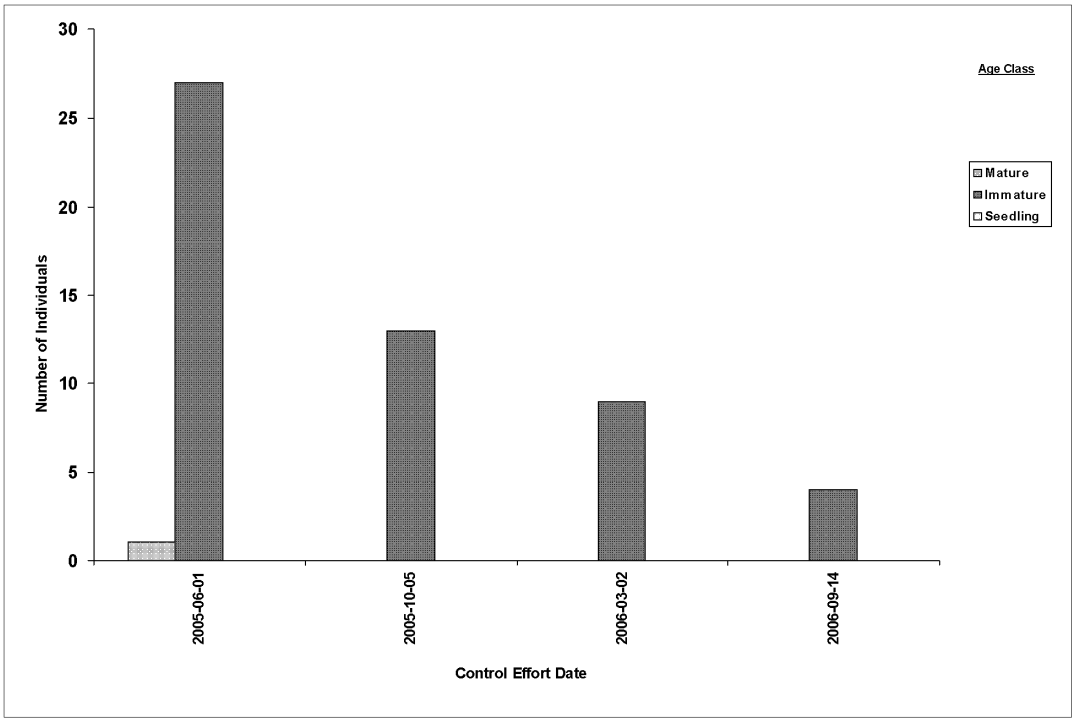

Figure 1.2.20: Numbers of *Rubus argutus* Individuals Controlled at Kuaokala-RubArg-01

MMR-RubArg-01; Kahanahāiki RubArg at Black Wattle

This ICA is located just outside of the Kahanahāiki exclosure. *Rubus argutus* was discovered during surveys at the *A. mearnsii* ICA in Kahanahāiki and was first controlled in May 2003. Part of the infestation is located on a small steep cliff; webbing is needed to treat plants in this area. NRS visited this ICA three times last year. Two trips in October 2006 were within days of each other; four mature, four immature, and one seedling were found during these trips. Sixty-three immature plants were found in April 2007. Population numbers seem to fluctuate greatly at this ICA; to counteract this, NRS plan on treating the site quarterly in the coming year and consistently using the dig/herbicide control method.

MMR-RubArg-02; ʻŌhikilolo RubArg at Red Dirt Puu

This ICA is located just above the *Hedyotis parvula* MMR-C population. Weeding began in December 2001. NRS visited this ICA twice last year. On the first trip in December 2006, three plants were found, one of each size class. However, the second trip in July 2007 resulted in five seedlings and 60 large plants. While none of these 60 were fruiting, they were large enough to have reproduced. Last year, very few plants were seen at the site. This year's flush may have been in response to winter rains, or the artifact of a pulse in the seed bank, or some unknown factor. In order to prevent more plants from reaching maturity, NRS will monitor this site three times in the coming year, and will implement the digging/herbicide control method.

MMR-RubArg-03; ʻŌhikilolo RubArg in Lancam Gulch
Three immature plants were discovered and treated in November 2005. Since that time, no seedings/resprouts have been seen. NRS visited the site once in the past year. No mature plants have ever been found in this area. This population was controlled before it could reproduce, which increases the chance of eradication at this ICA. This area will be monitored yearly.

MMR-RubArg-04; Kahanahāiki RubArg at SE Quad
NRS visited this ICA once this year and did not find any *R. argutus* (Table 1.2.30). The last time a mature plant was found here was in 1999 and the last time any immature plants were found was in 2003. These results suggest it may take at least four years to exhaust the seed bank. NRS need to determine guidelines for extirpation for this species. Effective control was achieved by combining pesticide control with digging roots out. This ICA is fenced, making the re-establishment of this weed impossible via pigs. NRS will continue to monitor this area yearly for any re-growth.

MMR-RubArg-05; Mākua East Rim RubArg
Three immature *R. argutus* were found and treated on the east rim on Mākua in 2004. After three years of post-treatment monitoring, no plants have been found (Table 1.2.30). Though it has very likely been eradicated, given no mature plants were known from the site, NRS will continue to monitor this area yearly for any regrowth until guidelines for determining whether a site has been extirpation are developed.

UpperKapuna-RubArg-01; Kapuna RubArg Above PhyKaa Fences
This infestation lies within a WCA in Keawapilau, close to *Cyanea longiflora* PIL-B. While small in area (5x5m), the site is relatively dense, with upwards of 70 plants found when it was first treated in September 2005. While no mature plants have been seen on site by NRS, given the population size, it is likely that some kind of seed bank is present. This year, NRS monitored the site twice. No plants were found in January 2007, but 60 immature canes were found in August 2007. As Figure 1.2.21 shows, there is no consistent pattern for this ICA. This may be due to seasonality; this year no monitoring was done directly after the winter rains. In future, NRS will visit the site quarterly and implement the digging/herbicide treatment method.

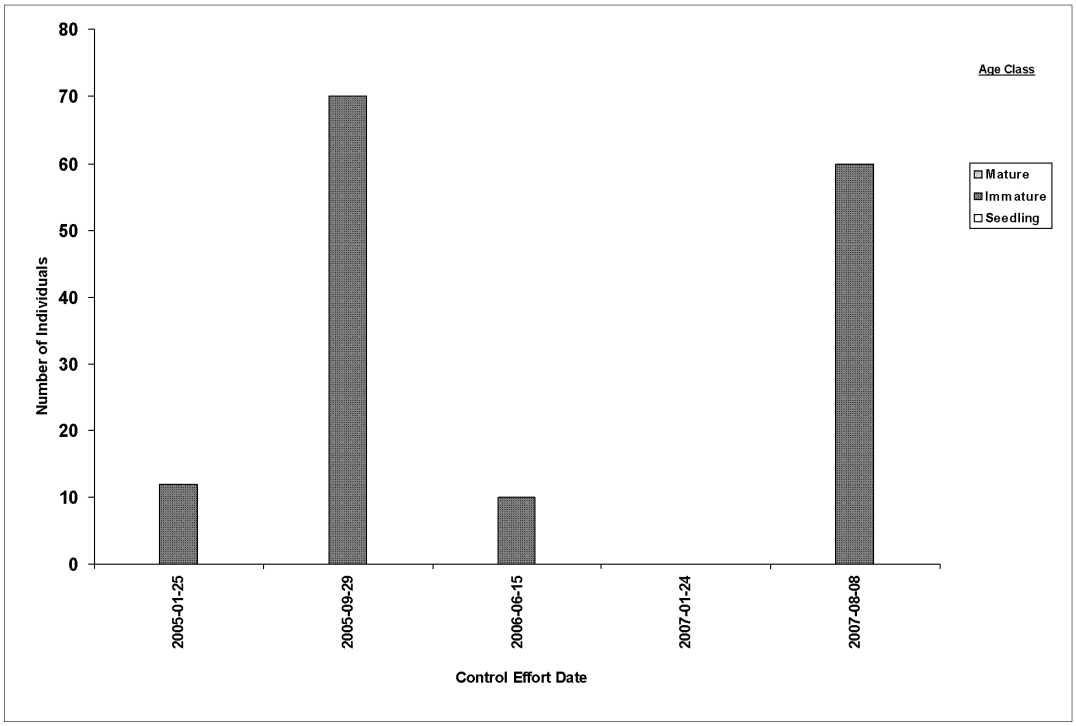

Figure 1.2.21 Number of *Rubus argutus* Individuals killed at UpperKapuna-RubArg-01

Table 1.2.29 Summary of *Rubus argutus* Control Efforts

ICACode	IPManagementUnit	# of Visits	Effort (Person Hrs)	Date Last Mature Plant Found	Date Last Non-Mature Plant Found
IncipientTaxon: RubArg	**Rubus argutus**				
Kuaokala-RubArg-01	Mokuleia FR No MU	1	0.50	6/1/2005	9/14/2006
MMR-RubArg-01	MMR No MU	3	6.75	10/24/2006	4/30/2007
MMR-RubArg-02	Ohikilolo	2	4.50	7/19/2007	7/19/2007
MMR-RubArg-03	Ohikilolo	1	1.00		11/8/2005
MMR-RubArg-04	Kahanahaiki	1	0.25	6/6/1999	8/19/2003
MMR-RubArg-05	MMR No MU	2	0.60		9/13/2004
UpperKapuna-RubArg-01	Upper Kapuna	2	2.50		8/8/2007

Senecio madagascariensis

It is probable that *S. madagascariensis*, or Fireweed, was introduced to O‘ahu by the accidental transportation of contaminated soil by military personnel or vehicles coming from Hawai‘i or Maui. It had a PIER score of 15. Prolific seed production (>1000/m2) and evidence that a persistent propagule bank is formed (>1 yr) make quick elimination of this population difficult. It is also spread by wind, birds, animals and man. It can spread locally by rooting from nodes. It can quickly spread in disturbed areas. However, it is susceptible to control via herbicide.

SBS-SenMad-01; South Range SenMad at FP Halo

Located on an actively used training site in SBS, *S. madagascariensis* is found at only site on military land (Figure 1.2.7). The infestation included both Firing Point (FP) and Observation

Point (OP) Halo, which are contiguous. The core of the infestation was centered at FP Halo; however, a training structure was built on FP Halo, effectively eliminating all possible habitat. Some outlying plants may persist just above the training facility, at OP Halo. NRS will monitor this ICA once or twice in the coming year.

Setaria palmifolia

Setaria palmifolia, or Palm grass, is an invasive grass that can be found in moist areas throughout the lower elevations of the Koʻolau Mountains on Oʻahu. It is an aggressive weed that forms dense monotypic aggregations, replacing native vegetation. It is rare in the higher elevations of the Koʻolaus, although it can become established in disturbed areas. Controlling this weed in higher elevation MUs of KLOA and the Waiʻeli MU is a high priority for NRS.

Control methods for all the *S. palmifolia* ICA's include hand-pulling when population sizes are small, and backpack spraying when numbers are larger. The latter is the case at the KLOA-SetPal-10, where there is a large population. Spraying a solution of 1% roundup has been found to be very effective at reducing the population. Timely follow-up with repeat treatments has been the hardest thing to accomplish as the weather can be very unpredictable on the Koʻolau summit.

Figure 1.2.22 Fruiting *Setaria palmifolia*

This species received a PIER score of 7 and is therefore deemed an undesirable weed . The seeds are very small, which make it easily dispersed (Figure 1.2.22). The probable vectors of dispersal include wind, pigs, humans, and stream flows. Research as to the longevity of *S. palmifolia*'s seeds in the soil would be very useful in designing control plans. Each control trip seems to reveal a handful of new plants at many of the sites, suggesting that the seedbank may be persistent for a long time, or that surveys are too infrequent, necessitating continued and possibly more frequent visitation. It is recommended that NRS survey each ICA once a quarter to keep *S. palmifolia* at manageable levels.

Waiʻeli-SetPal-01

This site is located on the trail from the Hāpapa Bench to the Summit LZ (Figure 1.2.6). Two mature plants were killed in November of 2006 at this site and one immature was pulled in August of 2007 (Table 1.2.31).

KLOA-Set Pal- ICAs 1-14; ʻŌpaeʻula sites

As mentioned above, NRS consider this species incipient in the higher elevations of KLOA. NRS have targeted this species as an incipient species within the ʻŌpaeʻula-Helemano MU and there are 14 ICAs (see Figure 1.2.23 below). New sites have recently appeared along the fence, emphasizing how easily spread this species can be. Overall NRS feel that this species can be

eradicated from within the fenced MU if there are enough revisits and surveys, especially in ʻŌpaeʻula. There are large populations in the Helemano fence that maybe too extensive to manage. Control efforts are summarized in Table 1.2.31.

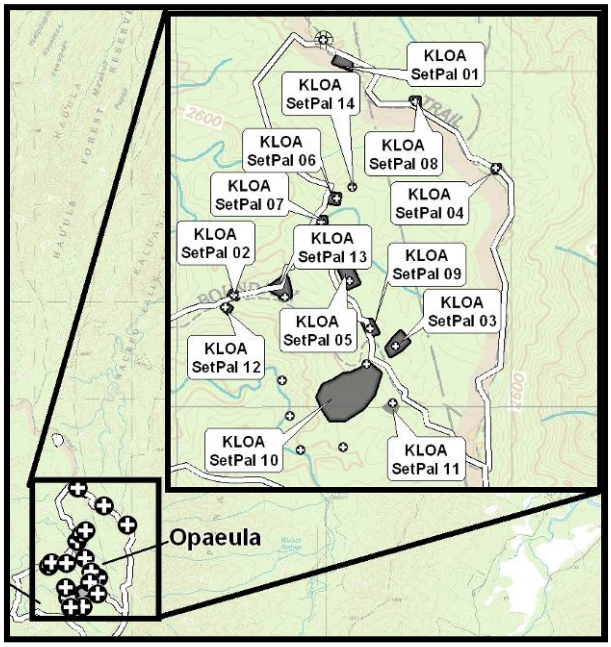

Figure 1.2.23 *Setaria palmifolia* Sites in ʻŌpaeʻula

KLOA SetPal-01; ʻŌpaeʻula SetPal along northern fenceline
One seedling was found here last year and no plants were seen this year.

KLOA SetPal-02; ʻŌpaeʻula SetPal along Peahinaia Trail
This population was found prior to 2002 and was the largest of the five original *S. palmifolia* sites. In that year, 90 mature plants and many seedlings were found. In 2006, it appeared the population was declining when four matures and three juveniles were found and pulled. However, this year NRS found a few matures, over 20 immature, and over 50 seedlings over the last 2 visits. NRS will need to revisit this site frequently to eradicate this population effectively.

KLOA SetPal-03; ʻŌpaeʻula SetPal at 260 Transect 12
Nine mature and two immature plants were originally removed from this spot in 2005. Three immature plants were removed last year and six immature plants were removed this year. NRS hope that as long as plants are removed before they mature, the soil seed bank will be reduced over time.

KLOA SetPal-04; ʻŌpaeʻula SetPal on Transect 14 Station 290
One individual was removed here in 2006 and no plants were observed this year. More surveys are needed to confirm there are no additional plants in this area.

KLOA SetPal-05; ʻŌpaeʻula SetPal at 370
One mature and one immature plant were seen in 2004 and 2005 respectively. No additional individuals have been observed here since that time.

KLOA SetPal-06; ʻŌpaeʻula SetPal at Goosehead
No plants have been observed here since the one mature and five immature individuals seen here in 2005.

KLOA SetPal-07; ʻŌpaeʻula SetPal at Hypalon
No plants have been observed here since the one immature was removed from this site in 2003.

KLOA SetPal-08; ʻŌpaeʻula SetPal at Shaka
No plants have been found at this site since the initial finding of one mature and two immature plants in January of 2003.

KLOA SetPal-09; ʻŌpaeʻula SetPal on Transect 12 Station 290
This ICA was visited once last year and no plants were found. NRS will visit this site once again next year to search for seedlings.

KLOA SetPal-10; SetPal Helemano bowl down to stream
This ICA contains the largest treated population of *S. palmifolia* known in the MU, and was discovered in August of 2003. Here, hand pulling is not feasible, and backpack spraying of Roundup herbicide at a 1% solution is the current control technique. No weeding was done in 2006-2007. Scouting surveys within the Helemano fence one gulch away from this site show extensive *S. palmifolia* populations in steep terrain. NRS will formalize a weed plan for *S. palmifolia* in this area for next year.

KLOA SetPal-11; Above Peahinaia Trail/Helemano fence
This population was not revisited in the past year as ungulate control was the priority. NRS will conduct *S. Palmifolia* control here as well as in other Helemano areas next year.

KLOA SetPal-12; North Helemano fenceline, west of LZ 66
This population was not revisited in the last year, however, on last visit, there were no individuals observed. Since the population is right on the fenceline, the possibility of spreading seeds from that site via people or pigs walking along the line is high. For this reason, extermination of this population is a high priority.

KLOA SetPal-13; Helemano fence/Peahinaia Trail SetPal
Six mature individuals were removed from this site in July 2006. NRS did not revisit this site in the past year, although, surveys are planned for the coming year.

KLOA SetPal-14; Hypalon bowl site
Two mature individuals were discovered and removed from this new site this year.

Table 1.2.30 Summary of *Setaria palmifolia* Control Efforts

ICACode	IPManagementUnit	# of Visits	Effort (Person Hrs)	Date Last Mature Plant Found	Date Last Non-Mature Plant Found
IncipientTaxon: SetPal	**Setaria palmifolia**				
KLOA-SetPal-01	Opaeula/Helemano	1	0.25		7/18/2006
KLOA-SetPal-02	Opaeula/Helemano	2	1.25	4/2/2007	4/2/2007
KLOA-SetPal-03	Opaeula/Helemano	1	0.50	10/20/2005	5/17/2007
KLOA-SetPal-04	Opaeula/Helemano	1	0.50		7/18/2006
KLOA-SetPal-05	Opaeula/Helemano	1	0.33	10/19/2004	5/3/2005
KLOA-SetPal-06	Opaeula/Helemano	1	0.08	10/20/2005	10/20/2005
KLOA-SetPal-07	Opaeula/Helemano	2	0.18		1/13/2003
KLOA-SetPal-08	Opaeula/Helemano	1	0.50		
KLOA-SetPal-09	Opaeula/Helemano	1	0.08		
KLOA-SetPal-12	Opaeula/Helemano	1	0.25	3/20/2006	3/20/2006
KLOA-SetPal-14	Opaeula/Helemano	1	0.25	8/2/2007	
Waieli-SetPal-01	Kaluaa and Waieli	2	0.75	11/29/2006	

Smilax sp.

This genus is a group of species with woody climbing vines, tendrils and thorny stems originating from the Eastern United States. NRS found an introduced species of *Smilax* in Schofield Barracks East Range (Figure 1.2.3). Formal identification of this species would require flower and/or fruit, neither of which has been seen by NRS. It appears that this *Smilax* sp. can invade an area quickly with runners and seeds. NRS is monitoring this site closely. Rather than risking this species from spreading to multiple sites, NRS will continue eradication efforts.

SBE-Smisp.-01

The *Smilax* site in East Range has been visited three times this year (Table 1.2.32). Spraying with Glyphosate twice a year for three years has not been effective at killing this persistent taxon. In April 2007, NRS attempted to dig up the *Smilax* tubers and Triclopyr was applied to the cut ends that remained in the ground. NRS will go back next year to monitor if this method was more effective in eradicating this target pest. NRS will continue to check on this site twice per year, trying different control techniques.

Table 1.2.31 Summary of *Smilax* sp. Control Efforts

ICACode	IPManagementUnit	# of Visits	Effort (Person Hrs)	Date Last Mature Plant Found	Date Last Non-Mature Plant Found
IncipientTaxon: SmiSp.	**Smilax sp.**				
SBE-Smilax-01	SBE No MU	3	5.00		11/14/2006

Sphaeropteris cooperi

Known as Australian tree fern and previously known as *Cyathea cooperi*, this species received a Weed Risk Assessment score of 8 from the PIER website. This score designates it as an undesirable invasive species. A versatile species, *S. cooperi* thrives in a variety of climates. On

O‘ahu, it is widely distributed across both the Ko‘olau and Wai‘anae ranges, particularly mid-elevation mesic to wet sites. It is shade tolerant, prolifically produces wind dispersed spores, and matures to reproductive stage quickly. *Sphaeropteris cooperi* is relatively easy to kill via cut stump and Garlon application. NRS targets this species in high priority areas. Due to the scattered distribution typical of the species, treatment effort will be focused in WCAs or incidental to other management effort. Thus far, only one ICA has been designated for *S. cooperi*.

UpperKapuna-SphCoo-01; Kapuna *Sphaeropteris*
During the course of weed control in the *A. evecta* ICA in Upper Kapuna, NRS discovered one large mature *S. cooperi* (Figure 1.2.2). The tree was cut and treated with 5% Garlon 4 in water, which was effective in killing it. Subsequent trips to the site for *A. evecta* control did not reveal any seedlings or resprouts (Table 1.2.33). While this species is relatively widespread throughout the Waianaes, it is not well known from the Upper Kapuna MU. Whenever it is found during the course of other management work, NRS will treat and track this species.

Table 1.2.32 Summary of *Sphaeropteris cooperi* Control Efforts

ICACode	IPManagementUnit	# of Visits	Effort (Person Hrs)	Date Last Mature Plant Found	Date Last Non-Mature Plant Found
IncipientTaxon: SphCoo	**Sphaeropteris cooperi**				
UpperKapuna-SphCoo-01	Upper Kapuna	1	0.50	10/3/2006	10/3/2006

Syzygium jambos

Native to continental Southeast Asia, *S. jambos,* commonly known as Rose Apple, is now a naturalized weed on many islands across the Pacific Ocean. Its fruit are dispersed readily by birds as well by humans and possibly feral pigs. This tree is detrimental to native ecosystems because it does not need disturbance to become established, and can germinate and thrive in shade, eventually overtopping and replacing most native canopy trees. Also, it is a carrier for the devastating *Puccinia*, or ‘Ōhi‘a rust, which affects all *Myrtaceae*, including *Metrosideros sp.* and *Eugenia sp.* While widespread in the Ko’olaus and southern parts of the Wai‘anae Mountains, *S. jambos* is not well known from the Kaluakauila region, and thus is considered a priority weed in this area. NRS did note a large population of *S. jambos* in Mākaha that was devastated by the rust.

MMR-SyzJam-01; Kaluakauila Upper Transect SyzJam
This ICA was created when one immature *S. jambos* was found along a weed transect in 2005 (Figure 1.2.1). It is likely that pig traffic is responsible for the spread of this incipient to the region. NRS controlled it, and will monitor the site in the future. Only one individual was found and it is hoped that NRS will be able to keep this weed out of Kaluakauila MU. *S. jambos* was not observed in 2006-2007 when the ungulate transect was read. No *S. jambos* were seen on all trips for baiting and rare plant re-introductions for Kaluakauila last year. NRS will monitor the transect site at least once next year.

Tecoma capensis

Tecoma capensis or Cape honeysuckle, is a vine-like shrub that is native to South Africa. It is widely cultivated in the tropics and subtropics for its bright orange flowers and attractive leaves (Figure 1.2.24). It can flower continuously throughout the year and its fruits contain many winged seeds. It received a score of 6 from the PIER Weed Risk Assessment and has been given the designation of 'L' which means that it is not currently recognized as invasive in Hawai'i. Though it is not considered to be invasive, NRS has decided to target any plants found before it becomes a problem.

Figure 1.2.24 Flowering *Tecoma capensis*

Pahole-TecCap-01; Pahole TecCap South Rim

Tecomaria capensis was discovered on the south rim of Pahole by the NARS Specialist in 2004 (Figure 1.2.2). Since it does not seem to be reproducing by seed, it is thought that it was likely planted there by someone. The patch was first treated in 2004, but was not revisited until May 2007. It now covers 261m², five times bigger from when it was first discovered. With renewed effort NRS has targeted *T. capensis* for eradication. NRS has visited the area three times this year (Table 1.2.34), and will continue to go back until the entire patch has been treated. Once that is completed, NRS will monitor it quarterly for resprouts.

Table 1.2.33Summary of *Tecomaria capensis* Control Efforts

ICACode	IPManagementUnit	# of Visits	Effort (Person Hrs)	Date Last Mature Plant Found	Date Last Non-Mature Plant Found
IncipientTaxon: TecCap	**Tecomaria Capensis**				
Pahole-TecCap-01	Pahole	3	14.00	6/18/2007	

Tibouchina urvilleana

Tibouchina urvilleana is a shrub native to Brazil. It forms dense thickets in wet disturbed areas and apparently is not spread by seed, but easily roots from stem fragments. It is currently listed on the HDOA noxious weed list and is considered highly invasive by the PIER Weed Risk Assessment System (Score 10). This species is currently found in only four spots on O'ahu.

Whitmore-TibUrv-01; Whitmore *Tibouchina*

In 1998, a large population of *T. urvilleana* was found on Navy lands in Whitmore Village (Figure 1.2.3). It was planted as a part of a botanical garden, which is no longer in operation. NRS has been monitoring this population ever since the initial treatment in 1999. NRS visited the Whitmore site once this year and found only seven plants (Table 1.2.35). There was one mature hidden beneath thick brush, but since it does not reproduce from seed it is not such a big concern, numbers are still quite low. NRS will continue to monitor this site once a year.

Table 1.2.34 Summary of *Tibouchina urvilleana* Control Efforts

ICACode	IPManagementUnit	# of Visits	Effort (Person Hrs)	Date Last Mature Plant Found	Date Last Non-Mature Plant Found
IncipientTaxon: TibUrv	**Tibouchina urvilleana**				
Whitmore-TibUrv-01	KLOA No MU	1	2.30	5/30/2007	5/30/2007

Trema orientalis

This species is widely distributed in lower elevation sites across both mountain ranges. However, NRS plan to target this species in select native areas where it is not yet established. There is no rating from PIER yet. Common names for this plant are Gunpowder or Charcoal tree. It spreads well in disturbed areas and birds spread it into new areas. It prefers sites on well-drained, exposed soils without leaf litter, demonstrating an ability to become established on poor or disturbed soil. *T. orientalis* produces 370,000 seeds per kilogram of fruit. The germination rate is 75%. Germination length is 10-30 days. Seeds have been shown to be stored effectively for 6 months. Seedlings show rapid growth in a nursery, and will reach 1 m within 6 weeks of germination. It flowers throughout the year and generally lives only 8 to 10 years (PIER website).

Kalua‘ā-TreOri-01

One mature tree was found along the southern Central Kalua‘ā fenceline (Figure 1.2.6). The ICA is just 1 meter at this point. Scoping a larger area would be difficult as the area drops off steeply. Control efforts are summarized in Table 1.2.36. NRS will be able to monitor this site at least once next year while checking the *S. kanehoana* re-introductions just above this site. It is likely that this was an isolated bird dispersed individual tree and no other individuals will be found.

Wai‘anaeKai-TreOri-01

A total of 4 mature trees were killed near the landing zone (Figure 1.2.7). The ICA area is 5 X 20 meters. Control efforts are summarized in Table 1.2.36. NRS will be able to monitor this site while visiting nearby sites in Mākaha at least twice in the upcoming year. NRS would like to contain this species because the large disturbed burn area nearby could easily become infested with seeds spread by birds.

Table 1.2.35 Summary of *Trema orientalis* Control Efforts

ICACode	IPManagementUnit	# of Visits	Effort (Person Hrs)	Date Last Mature Plant Found	Date Last Non-Mature Plant Found
IncipientTaxon: TreOri	**Trema orientalis**				
Kaluaa-Treori-01	Kaluaa and Waieli	1	0.50	7/19/2007	
Waianaekai-Treori-01	Waianae Kai	1	3.00	7/11/2007	

Triumfetta semitriloba

Sacramento bur is common in dry disturbed sites on O‘ahu, however, NRS would like to eradicate this species from areas where it is still considered incipient and keep it out of MUs. PIER has not ranked this species yet. This plant produces copious amounts of seed burrs (Figure 1.2.25), which are easily transported by pigs and hikers. It reaches maturity quickly, and as a result, small populations can explode exponentially in a short time if not controlled. Control in areas of high traffic such as trails and along fence lines will also help to prevent dispersal and keep weeding effort down. This will allow NRS to eventually eliminate the main source of spread. Control efforts are summarized in Table 1.2.37. More research needs to be done on seedbank longevity for this species.

Figure 1.2.25 *Triumfetta semitriloba* seed burrs

MMR-TriSem-01; Makua East Rim TriSem

This site was found just inside the Pahole fence, on the east rim of Mākua (Figure 1.2.1). It is possible that pigs spread this plant to this area before it was fenced. Ungulate control has reduced this influx. This site was not visited this year. NRS will monitor this site periodically but have not placed a high priority status for this site because *T. semitriloba* is found in many other areas along the east rim of MMR.

MMR-TriSem-02; C-Ridge corner

Including this site, there are a total of five sites of *T. semitriloba* in Kahanahā‘iki (all sites listed below; MMR-TriSem-02 to MMR-TriSem-06) that NRS check with regularity (Figure 1.2.1). No new sites in Kahanahā‘iki were found this year. NRS aim to treat all sites at the same time so that the frequency of visitation can be monitored more easily. NRS take care when walking through the sites so as to not disperse *T. semitriloba* further. At the C-Ridge site, eleven mature plants were found in the beginning of the year and none have been seen since. NRS will continue treatment at all Kahanahā‘iki sites twice per quarter.

MMR-TriSem-03; Pisonia patch

NRS have been treating this site since 2003. In 2004, NRS removed several mature plants and over 200 seedlings. Since this time, there have been a low number of individuals observed. NRS try to revisit this site often to prevent any seedlings from becoming mature. Three immature plants were removed this year.

MMR-TriSem-04; SE Quad

NRS have been treating this site since 2005. NRS revisited this site five times this year and several mature plants and a handful of seedlings were removed.

MMR-TriSem-05; Orange Trail

NRS have been treating this site since 2005, when one mature and four seedlings were removed. No plants were observed in 2006; however, this year NRS removed one immature individual.

MMR-TriSem-06; Top of Switchback
NRS have been treating this site since 2005 when 10 immature plants were removed. No plants were observed last year. However, this year one mature and approximately 30 seedlings were removed this year.

Pahole-TriSem-01; Pahole TriSem along South Rim Fence Line
Mature *T. semitriloba* plants were found along almost the entire south fence line in Pahole (Figure 1.2.2). It was probably spread by people or ungulates walking along the fence. NRS established a new 8941m² ICA to control this population. This year 47 mature plants were removed in two visits (Table 1.2.37). NRS observed a lot of seeds on the ground under these mature plants. NRS will visit this area quarterly to treat all seedlings and resprouts.

Table 1.2.36 Summary of *Triumfetta semitriloba* Control Efforts

ICACode	IPManagementUnit	# of Visits	Effort (Person Hrs)	Date Last Mature Plant Found	Date Last Non-Mature Plant Found
IncipientTaxon: TriSem	**Triumfetta semitriloba**				
MMR-TriSem-02	Kahanahaiki	4	7.75	1/2/2007	3/12/2007
MMR-TriSem-03	Kahanahaiki	4	2.75	8/1/2006	3/12/2007
MMR-TriSem-04	Kahanahaiki	5	1.75	3/23/2007	3/12/2007
MMR-TriSem-05	Kahanahaiki	3	1.00	1/9/2005	3/12/2007
MMR-TriSem-06	Kahanahaiki	5	2.75	6/26/2007	5/15/2007
Pahole-TriSem-01	Pahole	2	3.00	6/20/2007	6/20/2007

Vitex trifolia

Vitex trifolia is a large coastal shrub that is native to parts of Africa, Asia, and Australia. It is commonly planted as an ornamental and is currently not recorded as naturalized in Hawai‘i. Though this plant is not particularly invasive, NRS targeted it to prevent it from becoming naturalized.

SBE-VitTri-01; East Range *Vitex trifolia*
NRS spotted a small patch of the non-native *Vitex* in East Range (Figure 1.2.3). A sample was submitted to Bishop Museum for identification and NRS was informed that there was no previous record of *V. trifolia* being naturalized in Hawai‘i. In response to that NRS decided to control the patch in East Range (Table 1.2.38). There were only few plants to kill, so it was very likely planted there. It did not seem to be reproducing by seed, so very little follow-up is anticipated. NRS will check this spot yearly during other East Range ICA control efforts.

Table 1.2.37 Summary of *Vitex trifolia* Control Efforts

ICACode	IPManagementUnit	# of Visits	Effort (Person Hrs)	Date Last Mature Plant Found	Date Last Non-Mature Plant Found
IncipientTaxon: VitTri	**Vitex trifolia**				
SBE-VitTri-01	SBE No MU	1	0.50	5/30/2007	

1.3 Weed Survey Report

Surveys are conducted both on Army land and partner agency land (see Figures 1.3.3 - 6). Three types of surveys are conducted by NRS: road, landing zone, and transect. Transect survey results are discussed in the relevant IP MU sections of the Ecosystem Management Report. Road and landing zone survey results are summarized in Tables 1.3.1 and 1.3.2, respectively, and discussed below.

The tables present results of all surveys done this year. The 'First Survey Date' column refers to the first date the survey was ever conducted by NRS. The 'Significant Pest' column refers only to significant weed pests found in the last year. Species are listed in the table as six letter codes; refer to Appendix 1-1 for a definition table for these codes. In some cases, the weed is determined not to be a threat, and no action is taken. In other cases, the weed is monitored and control postponed until the potential threat is better understood. In the remaining cases, the weed is determined to be a threat and control is implemented. An ICA is drawn around the infestation, and control efforts are reported in the Incipient Weed Report.

Figure 1.3.1 NRS conducting a road survey in KTA

Figure 1.3.2 NRS conducting an LZ survey at a military LZ in KLOA

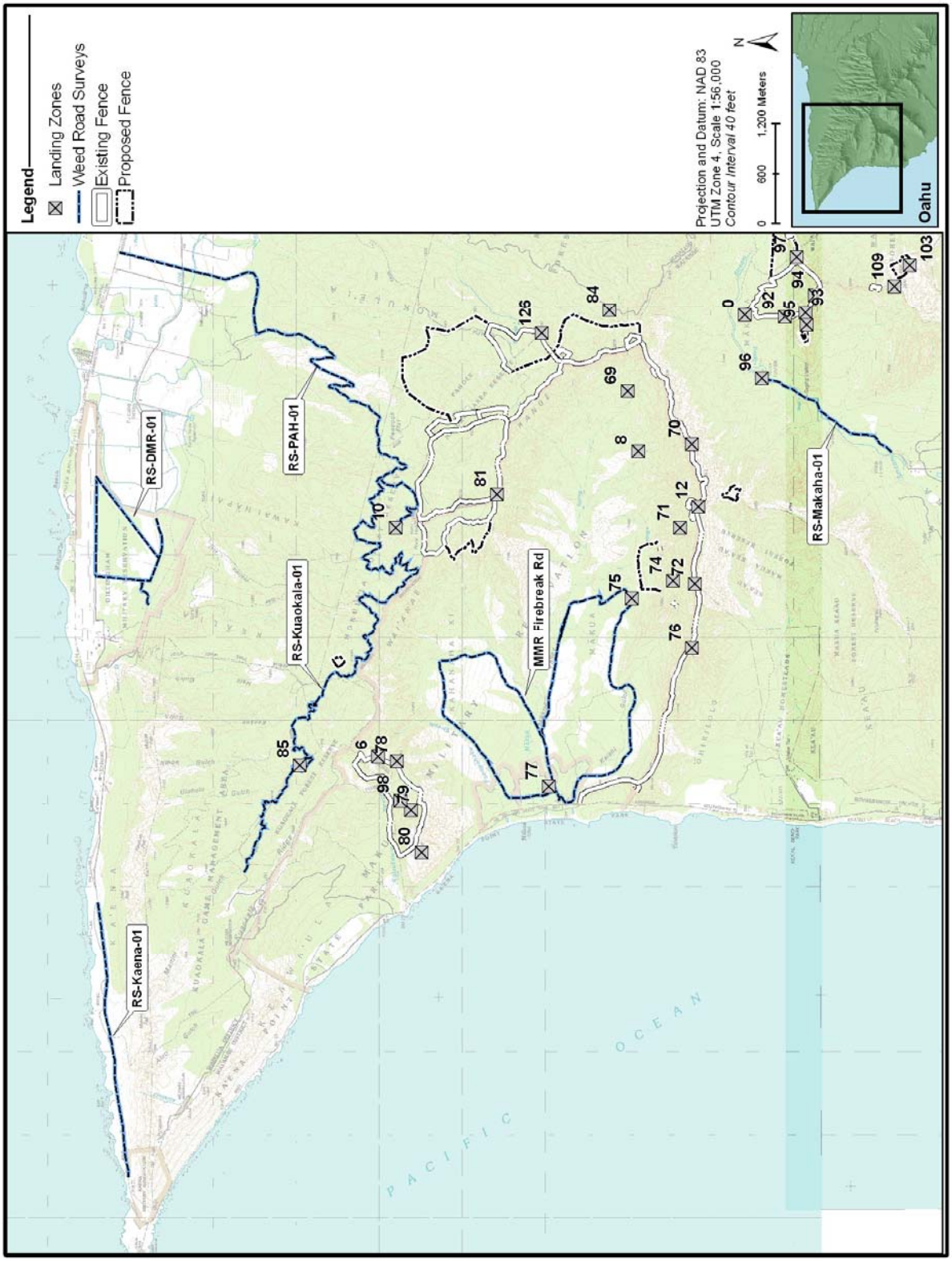

Figure 1.3.3 Northern Wai'anae

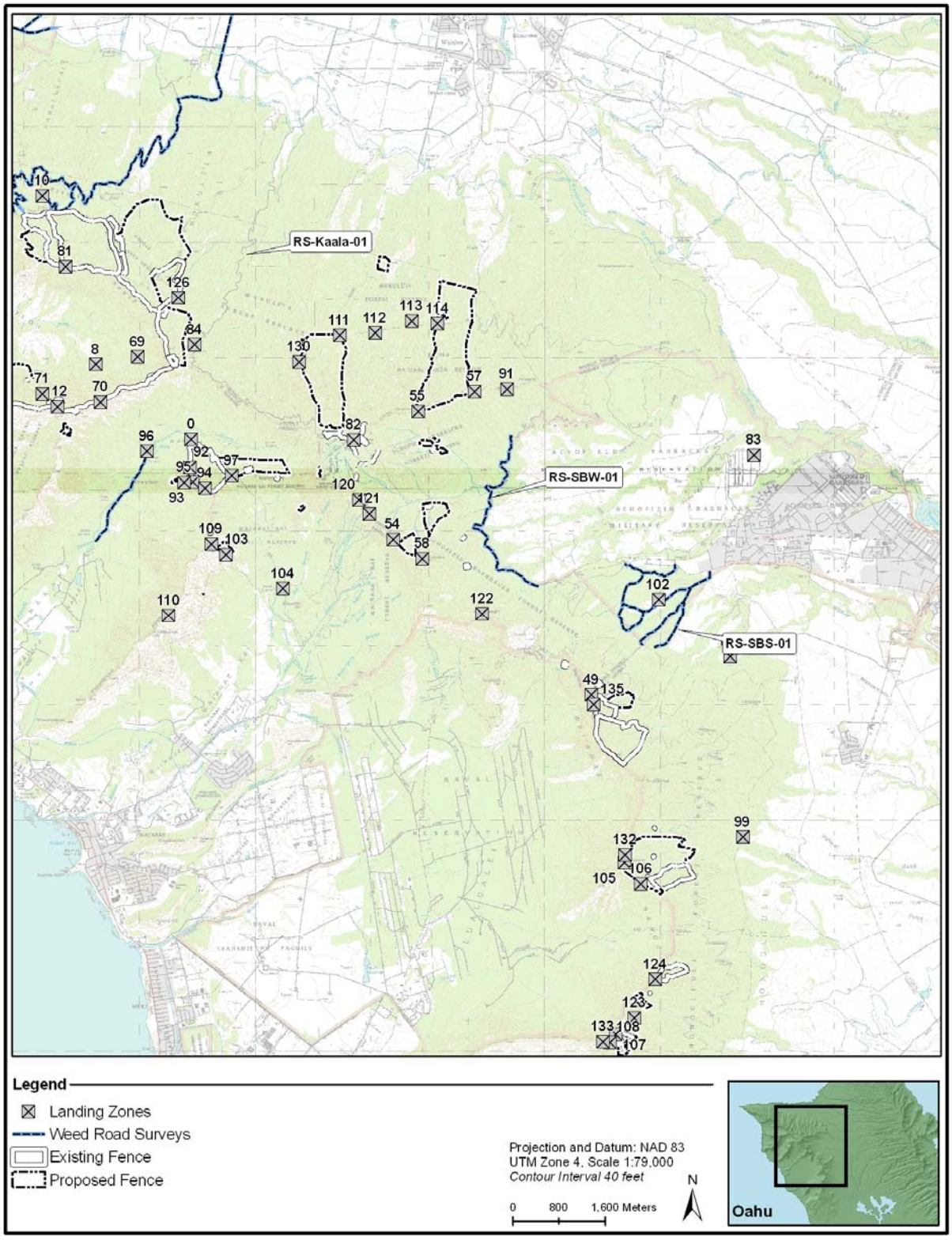

Figure 1.3.4 Southern Wai‘anae Surveys

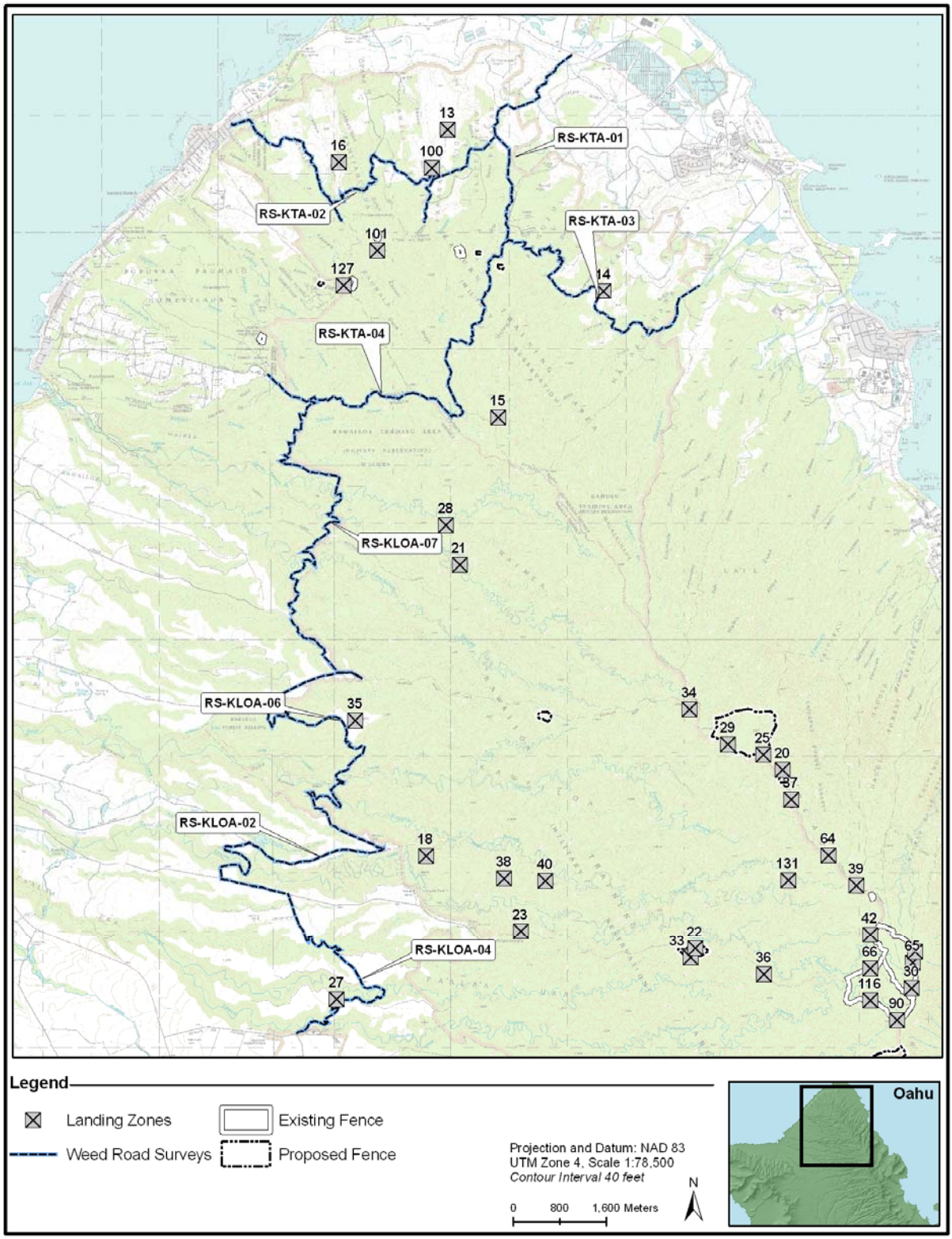

Figure 1.3.5 Landing Zone & Road Surveys, Kahuku and Kawailoa Military Training Areas

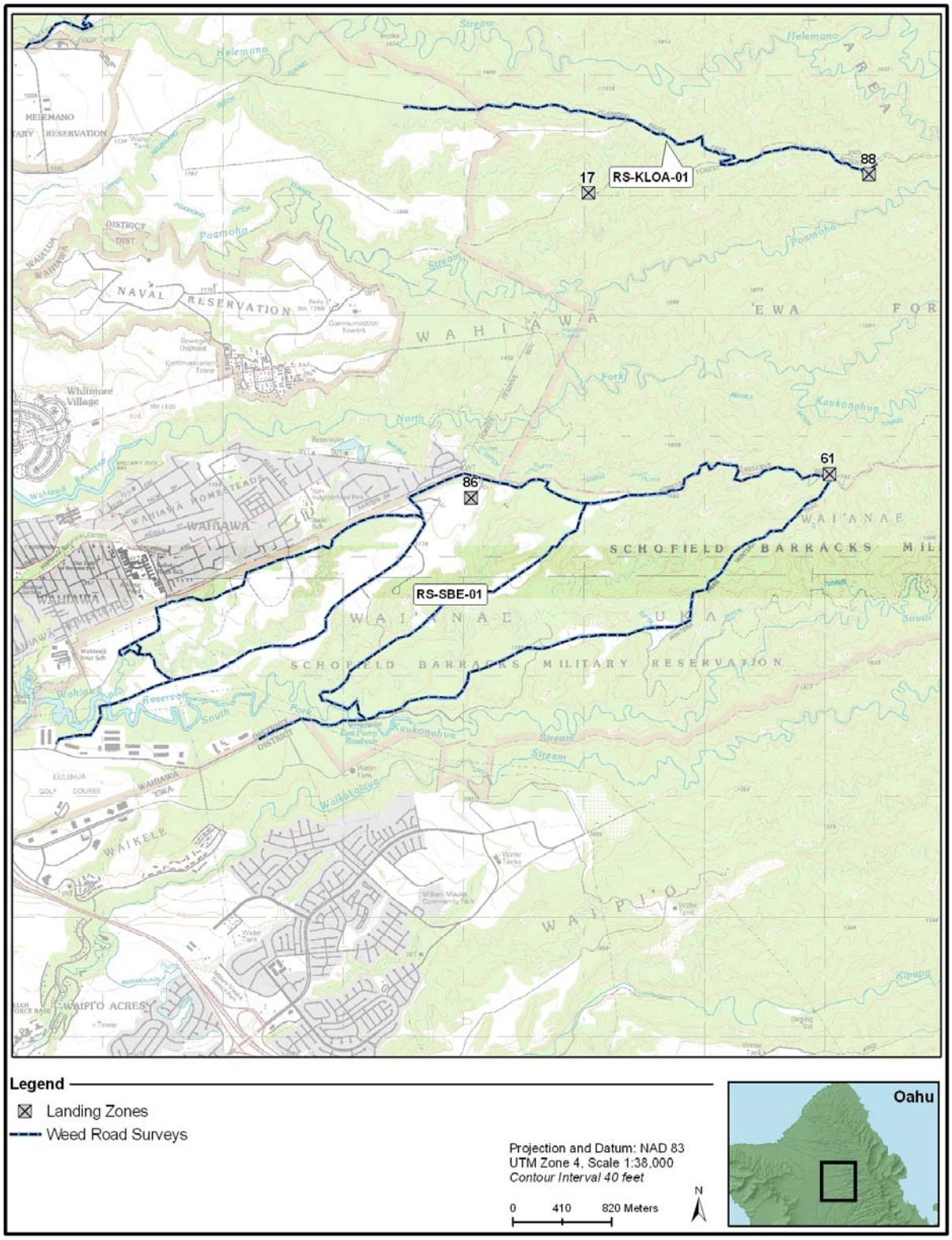

Figure 1.3.6 Landing Zone & Road Surveys, Poamoho to Schofield Barracks East Range

Road Survey Report

Road surveys are conducted once a year, usually in the first quarter of the year. Some of the surveys are conducted along roads used for military training, and some are conducted along roads used often by NRS. Three road surveys were not conducted this year. RS-KLOA-03 was not surveyed because the road was in disrepair and was not drivable; also, it appears that the Army has discontinued use of this road. If Army use changes, NRS will resume survey efforts. RS-SBW-01 was not surveyed due to access limitations to this high-use live-fire training area. When SBW training temporarily ceases during September and October 2007, NRS plan to complete the survey. RS-Makaha-01 was not surveyed due to organizational changes in the allocation of management areas between field crews. However, this area appears to have a relatively stable weed population and is not used by the military. NRS will continue this survey next year.

Next year, Stryker operations are scheduled to commence. When they do, NRS will begin surveying roads used by Strykers several times a year. Surveys will be conducted as needed, generally quarterly. Frequency of surveys will depend on whether roads were used by Strykers during a given quarter. During the dry, summer quarter, when many roadside weeds die back, surveys may not be conducted. Roads used by Strykers will include those in KTA, SBS, KLOA, and SBE.

No new potentially significant pests were found on any road surveys this year. Table 1.3.1 lists all road surveys completed. Some potentially significant species identified in last year's report are still extant, and NRS will continue to monitor them for any changes, such as sudden spread, which would trigger control. These include *Casuraina equisitifolia* and *Agave sisalana* at Ka'ena, *Sideroxylon persimile* at Makaha, *Caesalpinia decapetala* at KTA-02 and SBW, and *Callitris sp.* at SBW. When RS-SBW-01 is completed in September-October, NRS will map the perimeter of the *Callitris* infestation. It is unclear whether this infestation is expanding, as access to this area is so limited. This population occurs on both sides of the firebreak road, in high-density UXO areas. Due to possible high UXO hazard, conducting control may not be an option below the firebreak road. Creating an accurate picture of the current distribution will aid NRS decision-making. *Schefflera actinophylla*, previously noted as a potentially significant weed, was observed across almost all KLOA and KTA road surveys. While its spread is distressing, it appears to be too widespread to merit control. *Solanum mauritianum*, tree tobacco, is colonizing many of the fallow agricultural fields in Wahiawa, Kunia, and Waialua. It is a noxious weed in New Zealand, Australia, Tonga, and Rarotonga. As of yet, it has not been seen on any road surveys or near to any significant resources, although it is thought to be present in SBE. This species is bird-dispersed, widespread, and thus unlikely to be a candidate for control in the future. However, it is interesting to note it's exceptional rate of spread.

In the coming year, NRS plan to survey one additional road. The access road to the Palikea MU runs through the small, remote housing community of Palehua. Given the variety of ornamental plants in this area and greatly increased NRS use, NRS feel it would be prudent to monitor the portion of this road above Camp Timberline for invasive species.

The Army recently acquired a portion of Kalua'ā, termed the SBS Acquisition Area. Training has not yet begun on this parcel, but once it does, NRS plan to survey all roads. In addition, the

Army is ramping up for Stryker use both in SBS and KLOA. When this training begins, NRS will establish appropriate new road surveys and evaluate whether surveys in these areas should continue to be conducted yearly, or increased to quarterly.

Table 1.3.1: Road Survey Summary

SurveySiteCode	SurveySiteName	SiteLength (km)	SurveySiteType	First Survey Date
Property Name: Dillingham Military Reservation				
RS-DMR-01	Dillingham Roads	2.692	Road Survey	2004-02-23
Property Name: Kaena Natural Area Reserve				
RS-KAENA-01	Kaena Point Road	3.477	Road Survey	2006-02-08
Property Name: Kahuku Training Area				
RS-KTA-01	Charlie 1 Gate to Foxtrot Gate	5.81	Road Survey	2003-01-28
RS-KTA-02	Charlie 2 Gate to Alpha Gate	7.24	Road Survey	2003-01-29
RS-KTA-03	Hill 904 Junction to Delta Gates	4.143	Road Survey	2004-06-22
RS-KTA-04	Pupukea Gate to Foxtrot Gate	1.891	Road Survey	2004-02-10
Property Name: Kawailoa Training Area				
RS-KLOA-01	Poamoho Road	2.871	Road Survey	1997-12-19
RS-KLOA-02	Kawaiiki Ditch Trail to Brian's Mtn House Road Jnc.	3.469	Road Survey	2004-02-09
RS-KLOA-04	Brian's Mtn House Road Jnc to Helemano Gate	3.439	Road Survey	2004-02-09
RS-KLOA-06	Ashley Gate to Kawaiiki Ditch Trail	6.583	Road Survey	2004-02-09
RS-KLOA-07	McCormick Gate to Ashley Gate	4.327	Road Survey	2004-02-09
Property Name: Kuaokala Forest Reserve				
RS-KUAOKA-01	Kuaokala Road	9.954	Road Survey	2002-01-01
Property Name: Makua Military Reservation				
RS-MMR-01	Makua Firebreak Roads	12.118	Road Survey	2005-01-25
Property Name: Mokuleia Forest Reserve				
RS-KAALA-01	Kaala Road	10.353	Road Survey	2006-01-24
Property Name: Pahole Natural Area Reserve				
RS-PAH-01	Pahole Road	8.081	Road Survey	2005-02-01
Property Name: Schofield Barracks East Range				
RS-SBE-01	East Range Road to Sch-Wai Trailhead	13.938	Road Survey	2004-02-09
Property Name: Schofield Barracks South Range				
RS-SBS-01	South Range Roads		Road Survey	2004-02-12

Landing Zone Survey Report

Landing zone (LZ) surveys are generally conducted quarterly. Some LZs are used by Army personnel, and some are strictly used by NRS. Army LZs are surveyed once a year. However, some Army LZs in KTA and KLOA were not surveyed this year due to organizational changes in the allocation of management areas between field crews. NRS will strive to develop a complete list of Army LZs to aid in efficient monitoring. If NRS LZs are not used in a given year, no surveys are conducted at them. There are over 50 LZs each associated with MIP and OIP actions; NRS only survey those with the highest use. In the future, NRS plan to implement a policy of completing a survey every time an LZ is used; this will achieve a more consistent weed spread picture across management areas. Table 1.3.2 lists new weed species found on LZs during the 2006-2007 report year.

Table 1.3.2: Landing Zone Survey Summary

SurveySiteCode	SurveySiteName	SiteLength (km)	SurveySiteType	First Survey Date	Significant New Pest Species
Property Name: Honouliuli Preserve					
LZ-HON-1	Kaluaa Field LZ-QTR2		Landing Zone	2006-11-30	
LZ-HON-2	Wai'eli Ridge		Landing Zone	2006-11-29	
Property Name: Kawailoa Training Area					
LZ-KLOA-18	Black		Landing Zone	2001-08-14	
LZ-KLOA-20	Crispa		Landing Zone	2004-05-18	
LZ-KLOA-25	Kahuku Cabin		Landing Zone	2004-05-18	
LZ-KLOA-29	Northern LZ		Landing Zone	2004-05-18	
LZ-KLOA-30	Peahinaia Summit LZ		Landing Zone	1999-02-09	BleApp, Rhycad
LZ-KLOA-34	Puu Kainapuaa LZ		Landing Zone	2001-03-06	
LZ-KLOA-35	Puu Kapu		Landing Zone	2004-02-09	
LZ-KLOA-37	Radio		Landing Zone	1999-05-12	
LZ-KLOA-38	Red		Landing Zone	2001-08-14	
LZ-KLOA-42	Weatherport Opaeula		Landing Zone	2002-10-16	Rhycad
LZ-KLOA-66	Helemano Near SetPal Bowl		Landing Zone	2007-02-05	
LZ-KLOA-90	Southern Helemano Summit		Landing Zone	2005-08-17	
Property Name: Makua Military Reservation					
LZ-MMR -72	Koiahi LZ		Landing Zone	2005-06-14	
LZ-MMR-12	Ohikilolo Camp LZ		Landing Zone	1997-04-13	
LZ-MMR-70	Red Dirt LZ		Landing Zone	2005-11-19	
LZ-MMR-8	Lower Makua LZ		Landing Zone	2003-03-27	
Property Name: Schofield Barracks South Range					
LZ-SBS-49	Puu Hapapa		Landing Zone	2006-11-29	AcaAus

Potentially significant new weeds were found at three LZs. *Rhyncospora caduca* was found at two LZs at the Opaeula summit: Weatherport Opaeula and Peahinaia Summit. Unrated by the PIER website, this invasive species is widely naturalized throughout the state. While *R. caduca* is not an ecosystem-altering weed, it is not known from this portion of the summit. *Blechnum appendiculatum* was found at the Peahinaia Summit. This LZ was a staging area for flying fencing materials to the new Helemano fence; it is likely that these new species were introduced via NRS use. *Blechnum* is unlikely to thrive in the wet summit environment, but *Rhyncosporum* could adapt well to such rainy conditions. Typically, the set of weed species at the summit has been very stable, making these two introductions significant. NRS will designate ICAs and work to eliminate these weeds from these LZs in the coming year. *Acanthospermum australe* was noted at the Puu Hapapa LZ. It is not a highly invasive pest, but is previously unknown from the area. However, it is widespread at the Kalua'ā trailhead, the LZ often used to fly to Puu Hapapa. NRS removed the *Acanthospermum* from Puu Hapapa. These three species highlight the need for vigilant sanitation during field operations.

1.4 Ecosystem Management Report

Ecosystem scale management is reported by IP MU. The MUs are arranged geographically, from the northern Waiʻanae Mountains, to the southern Waiʻanae Mountains, and across to the Koʻolau Mountains. Each MU discussion begins with a brief introduction which covers MU-wide issues such as partner agencies, fire threat, large-scale fencing, and logistical considerations. Then, if relevant, ungulate control efforts and transect survey results are discussed. For some IP MUs, other sections relating to predator control (specifically, coquí in SBE) are included. Finally, there is a WCA discussion, in which strategy, this year's control efforts, and future plans are described for each WCA. For reference, a map is included for all WCAs in the MU, and a table summarizes weed control efforts at all WCAs.

Region: *Waiʻanae Kai Forest Reserve*

Two MUs have been designated in Waiʻanae Kai, both around *Neraudia angulata* populations (Figure 1.4.1). They are Waiʻanae Kai (*Neraudia angulata* Slot Gulch), and Waiʻanae Kai *Neraudia angulata* Mauka. Neither one is fenced. NRS has not worked extensively in the Waiʻanae Kai Forest Reserve. This reflects a conscious decision to focus weed management efforts within fenced MUs and ungulate management in areas that are manageable. The Waiʻanae Kai area is designated as a State Game Management Area (GMA) and is actively utilized by the community for pig and goat hunting. Although NRS have proposed MU fences, none have been built other than the small *Hesperomannia arbuscula* fence completed in 2006 by Plant Extinction Prevention (PEP) and NRS (OANRP 2006). NRS have proposed to build two small MU fences and one PU protection fence here in the near future. Until fences are built, NRS will continue managing this area on a minimal level for rare species protection and collection. Effort in Waiʻanae Kai will intensify as management goals are defined, logistical considerations resolved, and NRS staffing levels increase.

The area is accessed through numerous well maintained trails and a BWS road. Several of the MIP plant populations do require helicopter transport and rappelling for monitoring and collection work.

Fire remains a huge threat to this area with numerous wildland fires occurring annually near farming and residential areas. The lower portion of the MU is predominantly vegetated with *Panicum maximum* and *Leucaena leucocephala*. A large fire in 2003 started near the Kūmaipō saddle area and numerous other fires have regularly burned up to the forest edge in the lowlands. Importantly, the State continues to maintain a large fuel/fire break near the lower forest edge as a fire pre-suppression measure.

The short-term weed management goals for the Waiʻanae Kai Forest Reserve MU are:

1) Develop weed management plans for the MU following more intensive rare plant surveys, collection, and monitoring efforts in the area.
2) Control incipient, habitat modifying weeds in areas around MIP and OIP plant populations.
3) Participate in an interagency effort to control *Rubus argutus* in a roughly two acre area at the Kūmaipō burn site.

4) Assist PEP in weed control efforts at *H. arbuscula* fence.
5) Manage fire threats as necessary.

A small population of *Trema orientalis* was treated in the Wai‘anae Kai region. No other weeding was done in the 2007 report year. Future weed efforts will continue primarily around important *Neraudia angulata*, *Nototrichium humile, and H. arbuscula* plant populations. Fire planning and coordination will be better for any future fires in this area after discussions following the 2007 Kaukonahua/Waialua fire. NRS will assist BWS with replanting of common natives in the 2003 burn site in the upcoming year. Weed species to be controlled at the burn site include *B. asiatica* and *R. argutus.* Control of these species is needed to release regenerating koa trees from weed competition and prevent the further spread of blackberry in the area. Naturally recruited *A. koa* is already ten feet tall in the burn area as reported by the Board of Water Supply Biologist.

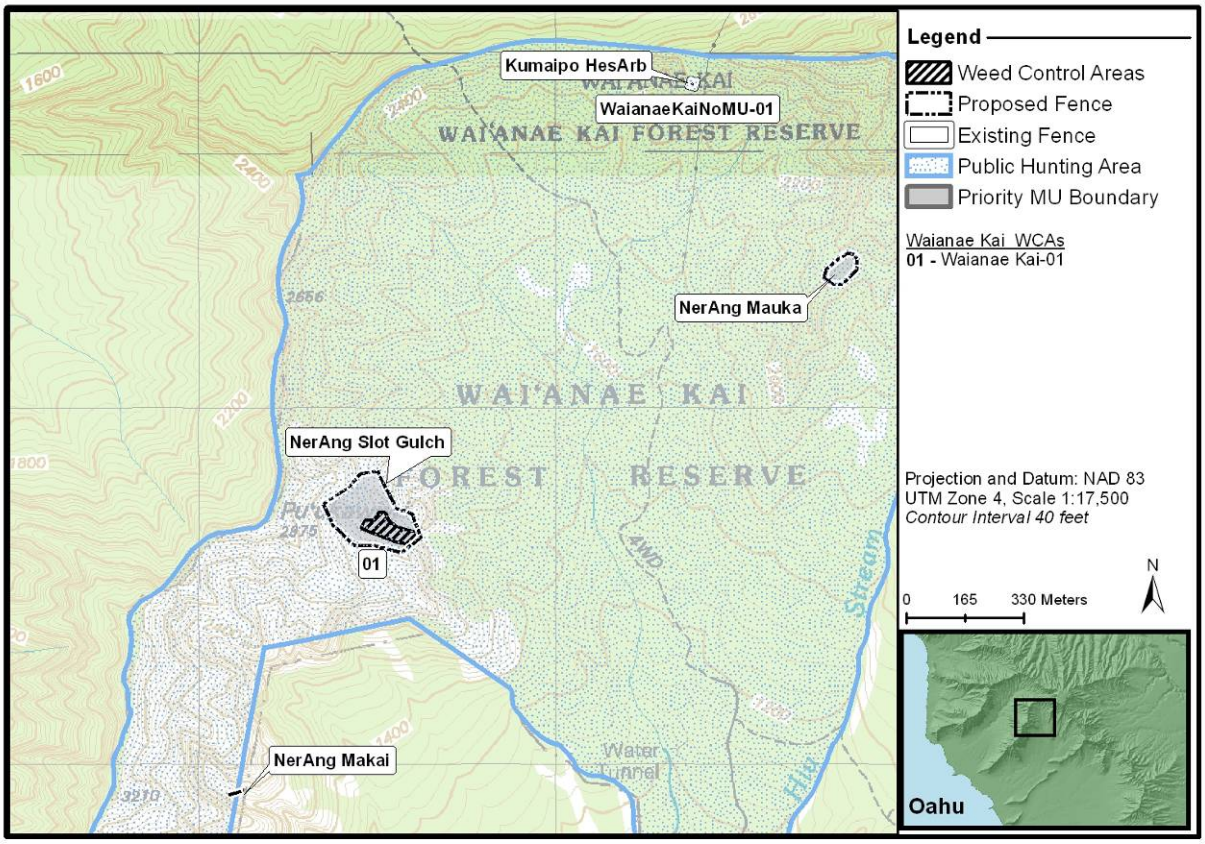

Figure 1.4.1 Ecosystem Management in Wai‘anae Kai

Ungulate Control Efforts

NRS assisted staff from PEP in erecting a small PU fence around a population of *H. arbuscula* in April 2006. No new fences have been constructed and no new ungulate control measures have been taken in the Wai‘anae Kai MU in 2006-2007.

The scale of the proposed fences for these MUs has been reduced significantly from what was proposed in the MIP. NRS feel the best approach to fencing issues here is to start off small with PU sized fences rather than MU fences. Three main reasons for this opinion are:

- The proximity of these plant populations to a very popular hunting area.
- The fact that the surrounding habitat is heavily degraded by feral goats, considerably impacted by introduced weeds.
- The difficulties and safety issues arising from working in such steep terrains.

NRS feel that in the short-term, constructing PU fences would protect the immediate habitat surrounding the populations from further degradation by ungulates. Weed control will also be potentially more effective and beneficial when concentrated in small, discrete areas. At this time, it is unclear whether the proposed PU fences will be large enough to ensure adequate habitat management for the various species to remain viable and reach stability but this is a reasonable first step in management of the populations.

IP MU: Wai‘anae Kai

This MU, labeled in Figure 1.4.1 as “NerAng Slot Gulch”, includes several IP taxa, including *N. angulata*, *Nototrichium humile*, *Tetramolopium filiforme*, and *Abutilon sandwichensis*. As fence construction, as discussed above, has not yet occurred in this MU, management has been limited. One WCA has been defined in the MU, and another was designated outside any MUs. Both are centered around rare plant populations. No weeding was done in the 2006-2007 Report Year.

WCA Discussion

Wai‘anae Kai-01; Nerang Slot Gulch

In the next two years, visit quarterly to maintain greater than 75% native cover on *N. angulata* cliff and reduce guinea grass and other non-native elements along 1/2 acre gulch bottom area (beneath *N. angulata* cliff to less than 25% cover.

This WCA is located in a slot gulch with very high cliff walls. The gulch houses important populations of *N. angulata* and *N. humile*. *Tetramolopium filiforme* also occurs in this area but mainly at the top of the cliffs. The vegetation in the gulch is mixed with some native elements, and large amounts of *L. leucocephala*. The cliff face with the largest concentration of *N. angulata* and *N. humile* is largely intact, although non-native elements are increasing. This cliff face offers an important reference site for high quality *N. angulata* and *N. humile* cliff habitat. Managing the weeds on this cliff is problematic given the lack of accessible anchor points for ropes. While the gulch is surrounded by grass, there is very little *P. maximum* in the WCA itself. In the future, NRS will target *L. leucocephala*, continue to treat other weedy trees and control grass as necessary to reduce fire threat and encourage rare species recruitment along the gulch bottom. This topographically isolated WCA is expected to respond well to weed control; once woody weeds have been removed and guinea grass knocked down the site may only require maintenance once or twice a year. As with any slot gulch, rock fall is a serious safety concern, and NRS staff will need to limit the time spent in the gulch bottom area to minimize exposure to falling rocks.

Waiʻanae Kai NoMU-01; Kūmaipō HesArb

In the next two years, continue to weed all habitat modifying understory weeds from the *H. arbuscula* fence with minimal disturbance to root zone of remaining *H. arbuscula* individuals on at least an annual basis.

PEP staff built a fence protecting *H. arbuscula* in May 2006, defining this WCA. This *H. arbuscula* site is not designated as MFS, therefore, NRS will focus on assisting on-going efforts rather than beginning any intensive weeding. The vegetation at the site is mixed, with a variety of native mesic canopy and understory species as well as many weed species. NRS will maintain a low level of effort at this site, and will continue to assist PEP management efforts to weed alien understory such as *C. hirta* and *R. argutus*.

Region: *Mākaha*

This region includes Mākaha Valley and the ridges that encompass it. This area is owned by BWS. The region includes several MUs, including Mākaha, Kamaileunu, and Keaʻau and Mākaha. With the cooperation of BWS, there has been considerable work done in this area over the last year, including the completion of the 85 acre Mākaha Subunit I fence, the completion of the approximately one acre Puʻu Kawiwi fence, weed control, and ungulate removal within the fences. A half acre fence surrounding a *Cyanea longiflora* population was completed in the 2006 reporting year. Over the next year, NRS plan to construct two fences: the 66 acre Subunit II fence and the 5 acre Kamaileʻunu fences. Vandalism is a serious problem in the area as the new Subunit I fence was repeatedly vandalized soon after the start of fence construction. Several large, mature *Cyanea longiflora* plants were also vandalized early in 2007. Fence construction at the Keaʻau and Makaha MU, centered around a population of *Sanicula mariversa* is not scheduled to begin next year. NRS will focus on monitoring the *S. mariversa* for goat damage until the fence is constructed.

Large goat populations exist along the back of Mākaha along the northern and western walls.

The short-term goals for the Mākaha MU are as follows:

1) Control weedy tree species in and around rare plant populations and reintroduction sites.
2) Expand weed control efforts as related to rare plant reintroduction sites.
3) Control all ungulates within fenced areas using community and staff.
4) Maintain fence integrity through periodic fence monitoring.
5) Continue and expand outreach with Waiʻanae community to educate about conservation.

NRS has seen evidence of old camp fires in the Mākaha Subunit I fence and more regularly along the access trail at the bottom of the main gulch. Continued education with volunteer hunters and Waiʻanae High School students who access this area on NRS work trips will hopefully spread the word of concern on this issue. A fire on Kūmaipō ridge in 2003 was believed to have been started by an abandoned camp fire.

IP MU: Mākaha

Mākaha Valley has many desirable elements for rare plant population management and reintroduction efforts. Weed control in Mākaha MU Subunit I focused around more intact mesic forest habitat, rare plant populations and adjacent areas where weed influx would originate. WCAs were created to capture such weed control efforts. Only WCAs in which control has been conducted this year are discussed below.

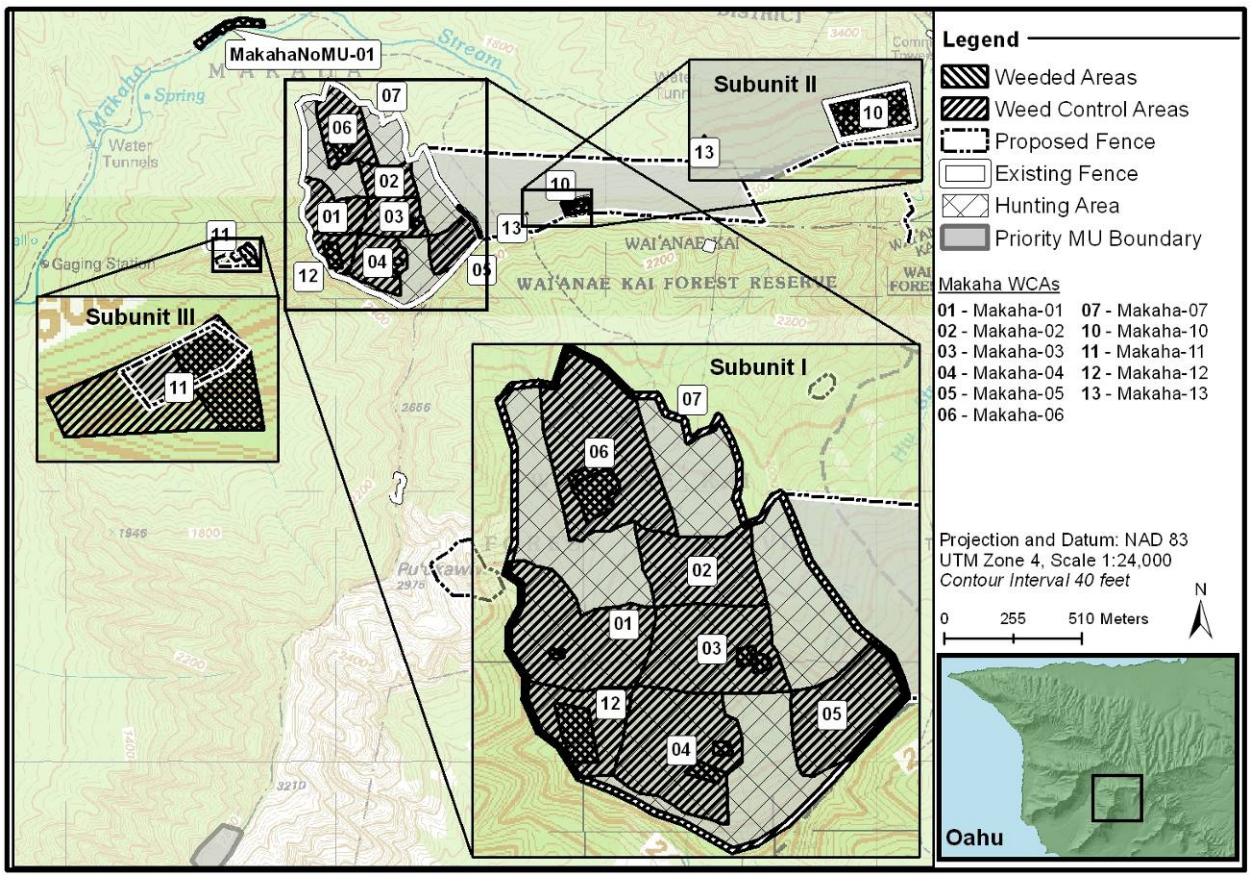

Figure 1.4.2 Ecosystem Management in Mākaha

Ungulate Control Efforts

A small-scale PU fence (0.5 acre) was erected to protect a population of *Cyanea longiflora* within subunit II and was completed October 2006. The fence was checked recently and found to still be pig-free and structurally sound. Larger fences for subunits II and III are slated for construction in Year 5 of the MIP (see Figure 1.4.2).

An 85-acre fence for Subunit I of the Mākaha MU protecting 21 threatened and endangered species was completed August 2007. The EA was approved in early 2005 but unforeseen delays with processing the CDUA forced the contractor to postpone construction and apply for continuances on the contract. The unanticipated lapse of time required using a subcontractor to build and complete the fence. During construction, there were a 3 incidences of vandalism where the fence had been cut or partially dismantled and propped open to allow access in and out of the area. The fence has since been repaired and reinforced by NRS. Periodic fence checks

will continue to be conducted to ensure fence integrity. Step-over crossings in strategic areas are also being built to allow hiking access where the fence crosses hiking trails.

NRS is currently in partnership with BWS, Mauna ʻOlu Estates, Kaʻala Farms, DLNR, and community hunters to implement a volunteer hunter program for ungulate control within the newly constructed fence. Community meetings were held to inform the public of the fence project and gain support by local hunters. As a popular hunting area, Mākaha Valley is frequented by many hunters and educating them on our efforts may minimize human impacts to the fence. BWS rules do not allow the use of firearms on any of their lands and so volunteer hunters must utilize knife-and-dog hunting methods to control pigs within the fenced area. Prior to the August 2007 fence completion, 7 community hunters and 4 NRS participated on 4 outings for a total of 76 person hours, removing 2 pigs. Unauthorized hunting continues to occur in the area so the 2 ungulates removed only includes confirmed removals. With the completion of the fence, more outings with community hunters are planned for complete removal of ungulates within the fenced area. As pigs re-enter the fence area in the future following fence breaks or other means, NRS will again utilize community hunters to re-clear the fence area.

WCA Discussion

Mākaha-01; Makai Ridge

In the next two years, visit at least quarterly to

1) Frill/chainsaw treat all *T. ciliata* greater than 20cm diameter at breast height (dbh) in a five acre area.
2) Basal or frill treat all *S. terebinthifolius, B. asiatica, P. guajava* and *P. cattleianum* in the core two acre mixed native area.
3) Foliar treat *T. ciliata* and other understory seedlings/saplings in the two acre core native area as needed on a bi-annual basis.

In the past, NRS have focused management efforts in Mākaha-01 around an individual of *F. neowawraea*. Management efforts included removal of one habitat altering species of tree, *Toona ciliata*. This is one site within the fence with a sizable population of *T. ciliata* and the most likely seed source in this area. In 2006-2007, NRS spent 7.5 hours primarily focusing on continued reduction of *Toona ciliata* canopy. The strategy NRS is using to manage this weed tree species is to control the large mature individuals to eliminate the seed source thus reducing the seed bank. With a maturity age of 6-8 years old, most *T. ciliata* will be controlled before reaching seed production capability. Continued weed sweeps of the area focusing first on matures and then on immatures are planned with ongoing management of the area.
In preparation for reintroduction of *Phyllostegia kaalaensis,* a 40 m^2 area was weeded of all *T. ciliata, S. terebinthifolius,* and *Coffee arabica*.

Mākaha-02; Lower Flag

In the next year, determine weed management objectives (if any for this area).
No weeding has been done in this WCA. Some understory native emergence was observed such as *Microlepia strigosa.* While it is not necessary to schedule major weed effort in this area, NRS recommends small scale strategic weeding to expand these native understory areas.

Table 1.4.1 Summary of Mākaha Weed Control Efforts

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
IP MU: Makaha						
Makaha-01	Habitat	3.54	0.04	1.00%		FluNeo
				Treatment Type	**# of Visits**	**Effort (Person Hrs)**	**Species Controlled**
				Ecosystem Weed Control	3	17.50	CofAra, PsiCat, PsiGua, SchTer, TooCil
				Totals	3	17.50	
Makaha-03	Habitat	3.09	0.16	5.13%		AleMacMac, FluNeo
				Treatment Type	**# of Visits**	**Effort (Person Hrs)**	**Species Controlled**
				Ecosystem Weed Control	4	16.00	BudAsi, CofAra, Lancam, PsiCat, PsiGua, RubArg, RubRos, SchTer, TooCil, TriSem
				Totals	4	16.00	
Makaha-04	Habitat	3.51	0.20	5.71%	CyaMem, DieFal, GouMey, PteMac, SicLan, StrRub, ZanDipDip	AleMacMac, MelTen, VioChaCha
				Treatment Type	**# of Visits**	**Effort (Person Hrs)**	**Species Controlled**
				Ecosystem Weed Control	2	26.00	BudAsi, PsiCat, PsiGua, RicCom, Rubarg, RubRos, SchTer, TooCil
				Totals	2	26.00	
Makaha-06	Habitat	4.54	0.55	12.18%		
				Treatment Type	**# of Visits**	**Effort (Person Hrs)**	**Species Controlled**
				Ecosystem Weed Control	5	151.00	CofAra, LanCam, PsiCat, SchTer
				Totals	5	151.00	
Makaha-07	Fenceline Clearing	2.57	0.13	5.22%		
				Treatment Type	**# of Visits**	**Effort (Person Hrs)**	**Species Controlled**
				Ecosystem Weed Control	3	22.00	CliHir, CofAra, PsiCat, rubros
				Totals	3	22.00	
Makaha-10	Habitat	0.45	0.45	100.00%		CyaLon
				Treatment Type	**# of Visits**	**Effort (Person Hrs)**	**Species Controlled**
				Ecosystem Weed Control	4	19.25	BleOcc, BudAsi, CliHir, LanCam, PsiCat
				Totals	4	19.25	

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
Makaha-11	Habitat	0.86	0.34	39.94%		AbuSan, MelTen, NerAng, NotHum

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	1	3.00	MelAze, PsiCat, SchTer
Totals	1	3.00	

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
Makaha-12	Habitat	1.91	0.48	100.00%		

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	1	9.00	TooCil
Totals	1	9.00	

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
Makaha-13	Habitat	0.00	0.00	100.00%		CyaGriOba

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	1	0.25	BleOcc, CliHir, PsiCat
Totals	1	0.25	

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
MakahaNoMU-01	Trail	0.79	0.77	97.59%		

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	2	2.50	TriSem
Totals	2	2.50	

Total IPMU: Makaha						
		21.26	3.13	14.72%	26	266.50

Mākaha-03; Upper Flag

In the next two years, treat all canopy weed trees in a two acre area and treat all habitat modifying understory weeds on at least a bi-annual basis. Continue treating all weeds in a five meter radius around all large, mature *A. macrococcus* trees.

Weeding was done to prepare reintroduction sites for *C. herbstii* reintroduction. Some *A. macrococcus* in the area were also liberated from encroaching weed trees. The area seems to respond well to weeding with no regeneration of weeds in the understory. NRS recommends continued removal of canopy weed species.

Mākaha-04; AleMac

In the next two years, treat all canopy weed trees in a two acre area and treat all habitat modifying understory weeds on at least a bi-annual basis in preparation for future reintroductions. Continue treating all weeds in a five meter radius around all large, mature *A. macrococcus* trees.

A total of 10 hours were spent targeting canopy and understory weeds. More weeding can be done uphill and to either side of this treated area. This area could eventually sustain other reintroduction sites.

Mākaha -06; Camp Ridge

In the next two years, 1) Continue treating all mature *P. cattleianum* surrounding mature koa trees at a rate of 2 acres each year through annual visits with larger work groups. 2) Continue 4 trips each year by Waianae High School to treat *C. arabica* and *P. cattleianum* in 20x20 m plots with minimal impacts to Elepaio pair breeding efforts.

A total of 94 hours were spent re-weeding plot areas treated in the previous report year and extending weed control to include areas under *Acacia koa* trees. *Acacia koa* seedlings have been observed recruiting in treated areas. The emergence of *M. strigosa* has been observed in the Wai'anae High School (WHS) plots. *Coffee arabica* regrowth from their plots is slow and controllable. WHS has multiple work trips scheduled in this area for 2007-2008. Trials of small diameter coffee stands weed whacked with a blade and sprayed with a lower dose 5% G4 show initial signs of success. Future trials will hopefully speed up the effectiveness of reducing this species in areas near native plants. NRS recommends continued efforts of *C. arabica* and *P. cattleianum* removal.

Mākaha -07; Fenceline

In the next two years continue treating all *P. cattleianum, S. terbinthifolius,* and *C. hirta* along two kilometers of fenceline in order to maintain the fence corridor for ease of fence and ungulate monitoring.

One hour was spent spraying *P . cattleianum* and *C. hirta* on the East fenceline. Weed control along the fence assists in keeping the fenceline corridor unobstructed for ease of walking and maintenance checks. NRS is planning weed control for the entire fence perimeter.

Mākaha-10; Cya Lon

In the next two years, visit the half acre fence area quarterly and

1) Continue treating all weeds in a two meter radius around all *C. longiflora* plants,
2) Treating all mature habitat modifying understory weeds (especially *Clidemia hirta*), and
3) Reducing *P. cattleianum* canopy cover by no greater than 40% each year.

A total of 19 hours was spent controlling weeds in this newly established WCA inside the small *C. longiflora* PU fence. Most weed control took place around the *C. longiflora* plants and on the fenceline perimeter. A large aggregate of *P. cattleianum* will be cleared in progressive stages from in and around the fenced area.

Mākaha-11; Ner Ang (unfenced)

In the next two years, visit the 2 acre core area quarterly and:

1) Continue removing all understory weeds in a minimum two meter radius around all accessible rare plants (targeting *Rivina humilis* in particular).
2) Treat all *S. terebinthifolius* in a 10 m radius around all accessible *Abutilon sandwicensis* and *Neraudia angulata* plants to provide sufficient sunlight.
3) Assess feasibility of conducting weed control along the cliff face to facilitate *N. angulata* and *A. sandwicensis* recruitment by conducting one trial weeding effort in the next year. Trial weeding effort to focus on small ledges below mature *N. angulata* plants.

This WCA is unfenced. A total of three hours was spent in this newly established WCA. *S. terebinthifolius* removal will minimize competition for light by *Abutilon sandwicensis* and *Neraudia angulata*. NRS recommends more weed control to assist native plant recruitment and growth.

Mākaha-12; Upper makai

In the next two years, conduct quarterly trips to continue treating all *T. ciliata* tree greater than 20 cm dbh in a five acre area. If no trees found greater than 20 cm dbh after next trip, begin treatment of all trees between 5 and 20 cm dbh across same five acre area. This WCA was started to reduce *T. ciliata* seedling spread in the gulch below. Large mature trees were targeted for control to reduce the seed source. There are still some large trees to be controlled. NRS recommends continued *T. ciliata* weed efforts and control of resprouts as light gaps opens up.

Mākaha-13; *C. grimesiana*

This WCA was started to support recruitment of seedlings from the wild *C. grimesiana*. Management plans include conducting annual weeding in a 2m radius around base of the plant with minimal disturbance to the root zone. In 2008, this WCA will be in the fence boundary and weeding will be done on a larger scale. The area has mixed native canopy and understory and will be suitable for reintroduction sites.

Mākaha-No MU-01; Trail Trisem

The trail leading to the Mākaha fence passes through some weedy areas infested with *T. semitriloba*. This species is not incipient in the region, but NRS conducts periodic control of this infestation in hopes of limiting the spread of this plant into the fenced MU, where it is not well established. NRS handpulled over 100 mature *T. semitriloba* at one site, near a rain gauge. A total of 200 immature *T. semitriloba* and 120 seedlings on the trail from the parking lot up to the rain gauge site were handpulled as well. Continued weed control along this trail may help minimize the spread of *T. semitriloba* throughout the management area by hikers, hunters, and NRS. In the next two years, NRS will conduct an annual *T. semitriloba* control trip along a two mile by 20 foot corridor from the trailhead to the Kūmaipō trail juncture. During weed control visits to WCA units in the Subunit I fence, any *T. semitriloba* individuals found will be controlled and the results reported in the appropriate WCA discussion.

IP MU: Kamaile‘unu

NRS efforts in this area have been to collect seed and monitor *Sanicula mariversa*. The area is steep and only accessed by helicopter. Invasive plant species and goats are immediate threats. No weeding has been done here yet but may include controlling *Schinus terebinthifolius*. The construction of the Kamaile‘unu fence to protect *S. mariversa* will be started in October 2007.

The short-term objectives for this MU are:

1) Build remaining fence for *S. mariversa*.
2) Assess weed control needs of both populations of *S. mariversa* and implement weed management plan.

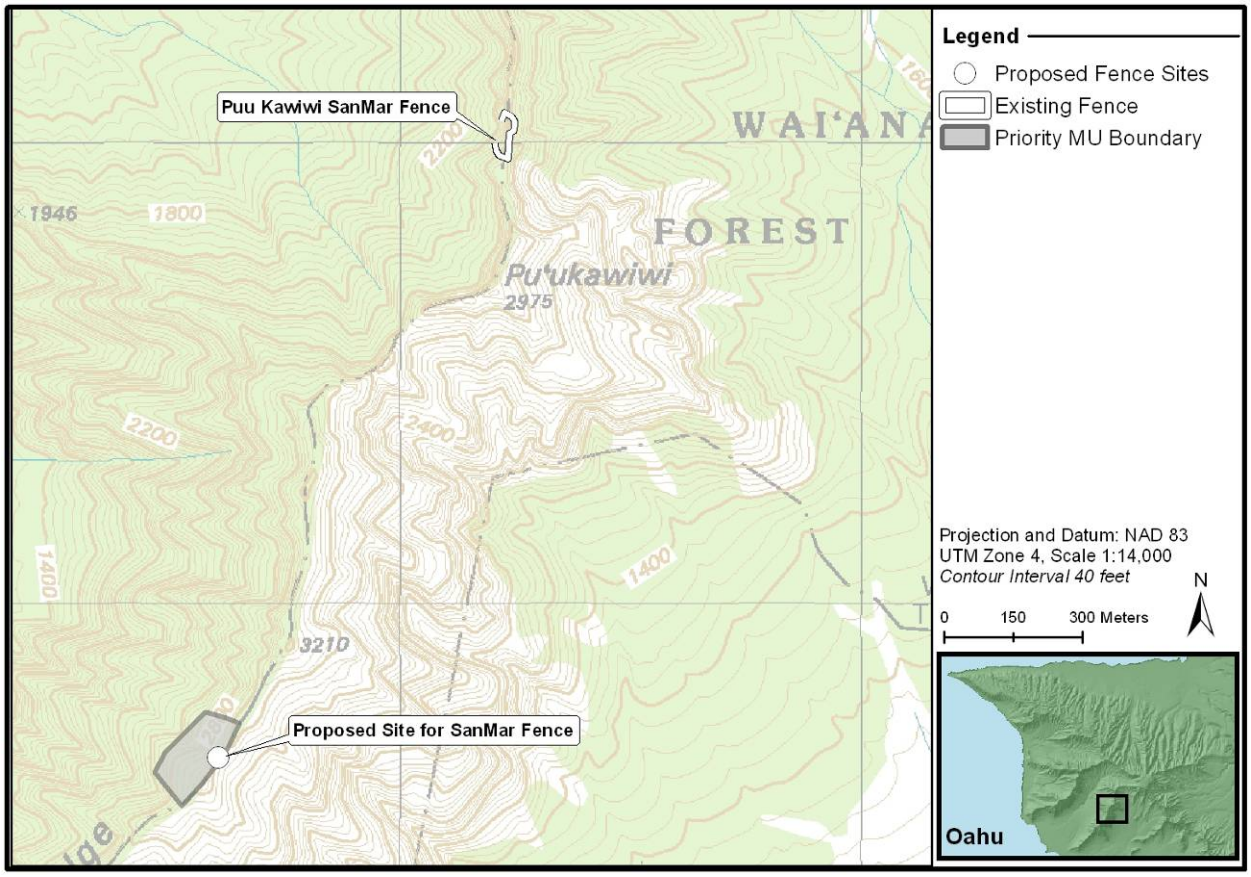

Figure 1.4.3 Ecosystem Management in Kamaile'unu

Ungulate Control Efforts

One of two small-scale fences has been built to protect *S. mariversa* (Figure 1.4.3). The fence near Pu'u Kawiwi is roughly a half an acre in size. The other proposed PU fence, near Pu'u Kēpau'ula, is about 4.5 acres in size. Construction of this fence is planned for October 2007. NRS have been awaiting the arrival of materials and tools to complete the job. The scale of the proposed fences for these MUs has been reduced significantly from what was proposed in the MIP because the surrounding habitat is heavily degraded by feral goats, considerably impacted by introduced weeds, and would take an unreasonable amount of effort, money, and time to rehabilitate. At this time, it is unclear whether the proposed PU fences will be large enough to ensure that adequate habitat is managed for the various species to remain viable and reach stability.

Region: *Ka'ena Point*

This region includes two IP MUs Ka'ena and East of Alau which are both within the State's Ka'ena Point NAR (see Figure 1.4.4). NRS focuses management around the rare plant species *Chamaesyce celastroides* var. *kaenana*. Ungulates are generally not a problem in this area so NRS do not have any fenced units proposed. However, the State is currently working with the Xcluder fence company to build a rodent proof exclosure at the point to protect native seabird populations. The actual fence route is not final and may not include the portion of the NAR that is actively weeded by NRS. Monitoring transects will be installed both inside and outside of the

proposed fence by U.H. to determine the effect of removing rodents from this dry costal habitat. A wildland fire consumed approximately 74 acres near the East of Alau MU. The fire burned within the boundaries of this MU and approximately 35m from the WCA. See Appendix III, Ka‘ena Fire Report.

IP MU: Ka‘ena

NRS coordinate with state NARS staff on management of the KAE-B *C. celastroides* var. *kaenana* population located within the MU. This population is designated as MFS. Weed control efforts are focused around the *C. celastroides* var. *kaenana* population, and there is one WCA defined in this MU, Ka‘ena-01 (see Figure). If the predator proof fence is built to include this WCA, access issues will have to be worked out with the state. The population is surrounded by grassy slopes, which is comprised predominantly of *Chloris barbata*. NRS is working towards increasing the native vegetation population by outplanting Kawelu (*Eragrostis variables*) and ‘Aweoweo (*Chenopodium oahuensis*).

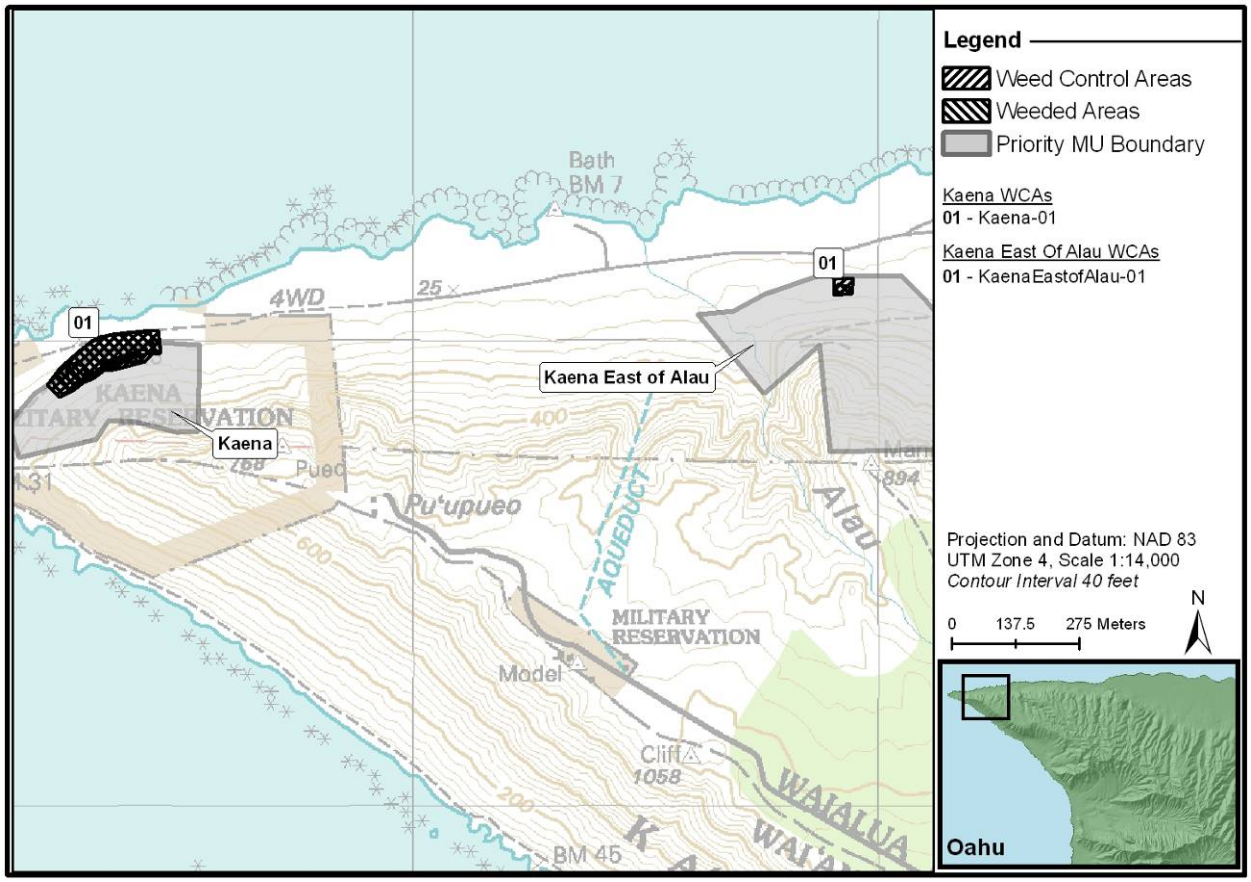

Figure 1.4.4 Ecosystem Management in Ka’ena Point

Canine Control Efforts

In early November dogs were found to have killed 700 shearwater chicks. DLNR staff quickly responded by hunting the dogs. NRS will continue to monitor the area for any dog sign when they work at this site, and will report their findings to DLNR staff. Currently, the state is developing a plan to install an excluder fence that will keep out all terrestrial animals.

Table 1.4.2 Summary of Ka'ena Weed Control Efforts

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
IP MU: Kaena						
Kaena-01	Habitat	1.60	1.40	87.54%		ChaCelKae

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	5	64.50	AcaFar, AchAsp, AgaSis, AtrSem, ChlSp., DesVir, Ipoind, LanCam, LeuLeu, MacLat, PanMax, PluInd, PluSp., PluSym, SchTer, SolSp., SyzCum
Totals	5	64.50	

Total IPMU: Kaena					
	1.60	1.40	87.54%	5	64.50

WCA Discussion

Kaena-01; NAR *C. celastroides* var. *kaenana*

NRS weeded in this area six times over the past year and noticed a major decline in the weed species *Leucaena leucocephela* (see Table). In the past, this weed was widely spread throughout this WCA and weed control efforts for this species took up a majority of the time spent. Past weeding efforts required NRS staff to carry equipment such as loppers and hatchets to treat this weed throughout the WCA. Over the past year, only immature plants were found which can be treated with clippers or simply hand-pulling. This has resulted in a decline on the amount of time needed to do weed sweeps. While this weedy tree species has diminished, NRS focused more effort on the ground creeping weed *Atriplex sembicatta.* This weed has been seen to smother the endangered *C. celastroides* var. *kaenana*, especially younger, immature plants which are often hidden under this sprawling weed.

C. barbata has been a troublesome weed to control; past weeding efforts included using the grass specific herbicide Fusilade® that was applied with backpack sprayers. Over the past year, NRS has begun to take a different approach for attacking this weed. NRS combined outplanting efforts with the state to help battle this weed. During an outplanting trip with state worker Greg Mansker, NRS helped outplant ʻOhai (*Sesbania tomentosa*) and *Capris sandwichiana* outside the WCA in native bird habitat. After those plants were in the ground 200 Kawelu and one ʻAweoweo was planted throughout the WCA in a trial effort to battle the *C. barbata* (see Figure). This was paired with hand-pulling *C. barbata* to create outplanting sites for the Kawelu. Last monitoring records in September showed that 45% of the outplanted Kawelu are still alive and the lone ʻAweoweo had perished. Seed sowing trials have also begun in this area but it is too early to report any results.

Figure 1.4.5 Outplanted Kawelu

NRS plan to visit this WCA quarterly over the next year and will focus on weeding efforts further upslope from the road. NRS will also continue to sweep through the area for *L. leucocephela* and *A. sembicatta*. NRS will work with NARS Specialist to develop a common reintro plan for this area that will include species such as Kawelu, Naio, and ‘Aweoweo.

IP MU: Ka‘ena East of Alau

NRS work with NARS staff to protect the *C. celastroides* var. *kaenana* population found within this MU (see Figure). There is one WCA found in this MU that includes the *C. celastroides* var. *kaenana* population and the area directly surrounding it. This WCA is found in a rocky area that is mainly made up of *L. leucocephela*.

Table 1.4.3 Summary of Kaena East of Alau Weed Control Efforts

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
IP MU: Kaena East of Alau						
KaenaEastofAlau-01	Habitat	0.14	0.05	38.68%		ChaCelKae

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	1	5.00	AcaFar, LanCam, LeuLeu, PluSp.
Totals	1	5.00	

Total IPMU: Kaena East of Alau					
	0.14	0.05	38.68%	1	5.00

WCA Discussion

KaenaEastofAlau-01; East of Alau *C. celastroides* var. *kaenana*

NRS visited this WCA once last year and mainly weeded *L. leucocephela* (see Table). The area where the *C. celastroides* var. *kaenana* are growing is not that weedy, so most of NRS weeding efforts have been directed to the area bordering this plant population. NRS plan to visit this site two times next year and will work on keeping a weeded buffer zone surrounding these rare plants.

Region: *Dillingham Military Reservation, DMR*

This region covers one IP MU that is split into two units and contains a highly degraded lowland dry forest/dry shrubland community. The Western unit is on State land along the Keālia Trail and the Eastern unit occurs mainly on Dillingham Military Reservation (DMR). Fire is the primary threat to this MU because of its proximity to roads as well as being dominated by *Panicum maximum* and *Leucaena leucocephala*, two fire-adapted species. Access is granted through coordination with the Army. The Army does some training in the area and NRS works around their training schedule.

IP MU: Haili to Keālia

Two WCAs are defined for this MU (Figure 1.4.6). There are no ungulate exclosures currently planned for this MU as pig activity is generally low. This decision may be re-evaluated if pig activity increases and affects reintroduction and management efforts. NRS conducts weed control only in the Eastern unit. Without fencing, weed control objectives will continue to be moderate given the level of disturbance to this area. The irreversibly degraded state of this region also warrants a lower level of weed control. Weed control needs of the Western unit of this MU have yet to be determined.

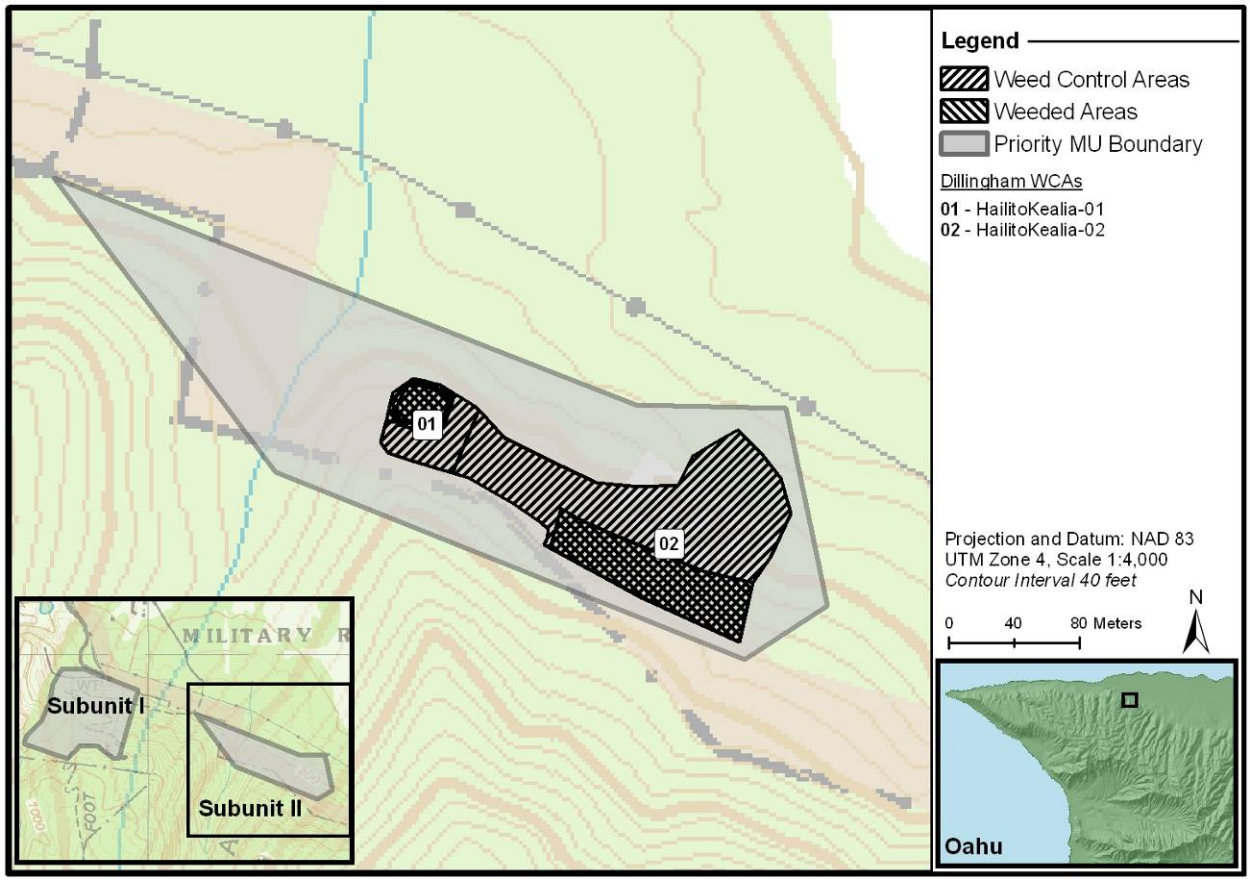

Figure 1.4.6 Ecosystem Management in Haili to Keālia, Dillingham Military Reservation

Ungulate Control Efforts

There was no NRS ungulate control efforts conducted in this area. Poaching appears sporadic. Pigs are regularly present in the area and are utilizing seeps in the *Sapindus oahuensis* stand and adjacent areas. Pigs occasionally disturb the *Hibiscus brakenridgei* reintroduction area by crossing through, but since the area is filled with talus only minimal disturbances to the outplantings have been noted.

Table 1.4.4 Summary of Haili to Kealia Weed Control Efforts

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
IP MU: Haili to Kealia						
HailitoKealia-01	Habitat	0.47	0.20	41.89%		HibBraMok

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Grass Control	2	6.50	PanMax
Ecosystem Weed Control	1	8.00	Cocgra, LeuLeu, PasEdu
Totals	3	14.50	

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
HailitoKealia-02	Habitat	1.32	0.37	28.10%	HibKokKok	

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	1	6.00	
Totals	1	6.00	

Total IPMU: Haili to Kealia						
	1.79	0.57	31.72%		4	20.50

WCA Discussion

Haili to Keālia-01; Hibiscus Outplanting

The long term objective of weed management for this area is to maintain the 0.5 acre *H. brackenridgei* reintroduction site. The short-term objectives for weed control in this WCA are:

1) Continue weed removal in a two meter area around each reintroduced plant at the 0.5 acre reintroduction site.
2) In a three-year period, create a ten meter *P. maximum* free buffer around the *H. brackenridgei* reintroduction area.
3) Control all *Syzygium cuminii* in WCA.

This area is dominated by *P. maximum* and *L. leucocephala* with some remnant *Erythrina sandwicensis* trees and other native shrubs. The reintroduction site is currently about 900m^2. NRS make roughly four trips a year to prepare for more outplantings of *H. brackenridgei* and to conduct follow-up maintenance. *Panicum maximum* was controlled by spray and hand-pulling around *H. brackenridgei*. NRS will continue fire threat management by limiting *L. leucocephala* and *P. maximum.* NRS observed native regeneration of *Psydrax odorata*, *Dodanaea viscosa,* and *E. sandwicensis* in this WCA. Continued weed control will allow more native recruitment. NRS may consider some level of habitat restoration via common outplantings to re-establish an appropriate native component that can help keep weed levels down.

Haili to Keālia-02; Sapoah forest along transect

This WCA encompasses a fairly intact *S. oahuensis* dominated forest. The long-term objective of weed management in this WCA is to maintain native forest cover in this two acre remnant *S. oahuensis* stand. The short term objectives are:

1) Control all non-native canopy tree species larger than two meters in the two acre *S. oahuensis* stand.
2) Control incipient understory weed species.

A total of six hours was spent in the upper east end of this WCA, focusing on incipient weed species and *Schinus terebinthifolius*. Work in this area requires difficult talus and boulder walking. In the past, NRS made use of volunteers to conduct weed control in this area. NRS would like to continue community stewardship of this area with experienced volunteers capable of working in difficult terrain.

Region: *Mākua Military Reservation, MMR*

This region covers the entire Mākua Valley and is leased by the Army. There are four major MUs within the valley where NRS conduct management: Kaluakauila, Kahanahāʻiki, ʻŌhikilolo, and Lower ʻŌhikilolo. Of these, Kaluakauila and Kahanahāiki are fenced, while ʻŌhikilolo and Lower ʻŌhikilolo are partially fenced. These MUS effectively identify the areas of the valley containing the highest numbers of IP taxa, highest species diversity and largest sections of native forest. NRS conduct weed control across these MUs and have some ungulate control in the unfenced portions of the valley. Most of the valley perimeter is surrounded by ungulate fencing however there is approximately 3,200 m along the northern end that is not fenced. If fenced completely, this would be the largest fenced area and first ungulate-free valley on Oʻahu. Such a project would provide many interesting research opportunities. NRS are excited about the possibility of removing ungulates from such a large area while acknowledging that removing animals from such a large area will be extremely challenging.

A wild fire occurred on the northern end of the valley this year at Puaʻakanoa (see MMR fire report in Appendix). This fire was started along the public road and spread onto the military reservation. Fire will always be a threat in Puaʻakanoa, given its proximity to Mākua training and to the public road.

IP MU: Kaluakauila

A 110 acre pig-free exclosure was completed in June 2002 protecting rare plant species and native dry forest (Figure 1.4.7). Kaluakauila MU is one of the most highly fire-threatened units in all of Mākua, surpassed only by Lower ʻŌhikilolo. The area is vulnerable to fires from nearly all directions, with steep fuel-laden slopes which make fire suppression a difficult task.

There are three WCAs drawn in Kaluakauila (Figure1.4.7). Two are around concentrations of rare taxa and native dry forest remnants. The third, Kaluakauila-03, encompasses a grassy ridgeline separating Kaluakauila from the greater part of MMR. This WCA is a fuel reduction area; no work has been done here for the past year. The Army Wildfire Crew will assist with work in this WCA over the next year. Kaluakauila-03 is not discussed below.

NRS current weed control strategies include weeding areas around rare plants to reduce competition for resources. Oftentimes, the results are large light gaps where other opportunistic weedy species can quickly germinate and occupy. NRS will attempt to utilize this available

sunlight by translocating seedlings of common native species from surrounding areas into these light gaps. Successful plantings will be able to compete for light and shade out weeds. This strategy could also be used near the forest edges to essentially expand native forest cover.

The objectives for this MU for the next two years are:

1) Continue treating all weeds in a two meter radius around the base of all rare plants (five meter radius for large, mature female *Euphorbia haeleeleana* trees)
2) Conduct quarterly control trips of *Panicum maximum* and *Leucaena leucocephala* across the six acre core native areas.
3) Conduct biannual removals of other canopy weed trees in 50 x 50 m plots (one plot each in Upper and Lower patches).
4) Conduct trial outplantings of transplanted native seedlings as well as nursery stock in same 50 x 50 m plots located around reintroductions.

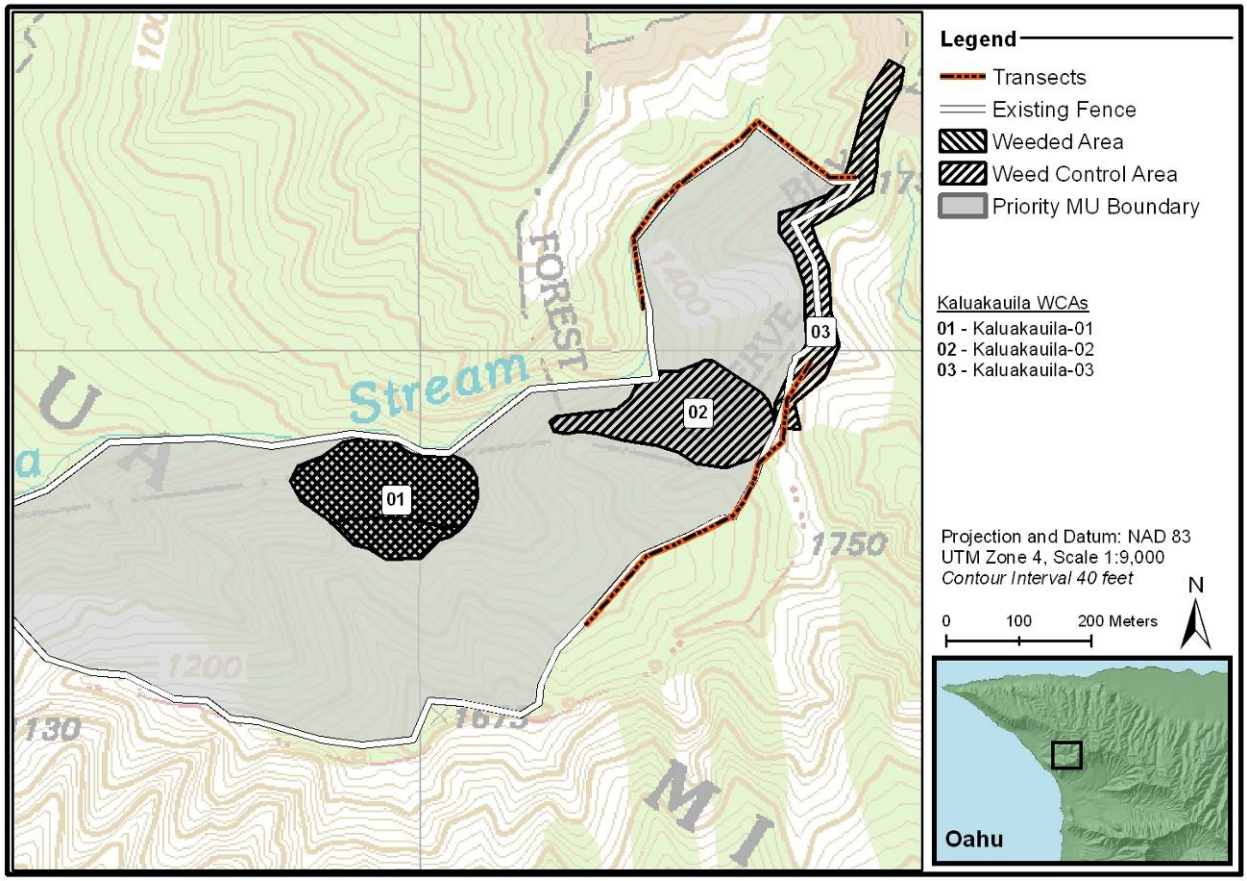

Figure 1.4.7 Ecosystem Management in Kaluakauila

Ungulate Control Efforts

Monitoring for ungulate activity takes place quarterly along two permanent ungulate transects which run alongside the fence. There appears to be a frequent influx of animals to the area which puts recurring pressure on the fence. This is probably due to a natural seep that occurs in the gulch and in association with the fruiting season of *Psidium cattleianum*.

NRS conducted periodic fence checks to monitor ungulate activity and fence integrity. The results of recent visits found the fence to be structurally intact, functional as an ungulate barrier, and still ungulate-free.

Transect discussion

There are two vegetation transects in this MU. No transect readings were done this year.

Table 1.4.5 Summary of Kaluakauila Weed Control Efforts

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
IP MU: Kaluakauila						
Kaluakauila-01	Habitat	2.94	2.94	100.00%	BobSan, BonMen, EupHae	AbuSan, HibBraMok, NerAng, NotHum

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Grass Control	2	25.00	PanMax
Totals	2	25.00	

Total IPMU: Kaluakauila					
2.94	2.94	100.00%	2	25.00	

WCA Discussion

Kaluakauila-01; Lower Patch

For a number of years, NRS has been working in the Kaluakauila-01 WCA to restore native habitat for protected species by focusing mainly on *P. maximum* and *L. leucocephala* removal. The Kaluakauila-01 WCA contains seven populations of rare plants, four wild and three reintroductions. To encourage the survival and enhancement of these rare and protected species, it is imperative to keep *P. maximum* and *L. leucocephala* under control.

To ensure that *P. maximum* is sufficiently suppressed to allow native plant regeneration, NRS will continue monitoring and grass spraying if necessary throughout the Kaluakauila-01 WCA every quarter for the 2007-2008 year. If done at this frequency, grass levels should be kept low enough so that grass control does not require much time or herbicide on any given trip.

During the coming year, NRS will continue *L. leucocephala* removal throughout the patch, once a quarter as well. Monitoring of formerly weeded areas will show if re-weeding will be necessary. NRS will also begin to evaluate the possibility of removing other canopy weeds, including *P. cattleianum, Schinus terebinthifolius,* and *Grevillea robusta* in higher priority areas.

As mentioned above, it may be feasible to expand the native forest boundary by coordinating grass removal and common native canopy species outplanting at the WCA boundaries. This would increase potential habitat for protected species as well as decrease the effects of wildfires on core protected species populations such as *E. haeleeleana* and outplanted populations. This year NRS will experiment with translocation of common native seedlings from overcrowded nearby areas to places recently cleared of weeds. It is important to combine weeding with native outplanting to discourage alien plant re-growth into the weeded area. Also, by transplanting seedlings from dense patches to open areas, we may be utilizing many plants that might not do as

well because of competition with cohorts. Using wild germinated seedlings may increase survival rates by using plants adapted to that specific microclimate.

A total of nine hours was spent surveying grass. Previous grass control with Roundup® seems to have been successful because there were only sparse populations of waist high *P. maximum* in the WCA. NRS suggests spraying in January or February to keep re-growth down.

NRS did *P. maximum* trials with Oust® XP herbicide in heavily infested areas. Oust® XP is a broad spectrum herbicide that works through preemergence and postemergence activity. The results of the trials showed that Oust® XP was not effective. NRS will continue control using Roundup® in strategic spots.

Kaluakauila-02; Upper Patch

The Kaluakauila-02 WCA is more uniform than the Kaluakauila-01 WCA, and has a larger area of 75% or more native canopy. Weeding effort in the Kaluakauila-02 WCA has focused mainly on grass and broadleaf canopy control around the three reintroduced and four wild populations of rare plant species. Grass control throughout the area occurred in 2005-2006. As NRS was short staffed this year efforts were focused on grass control in the Kaluakauila-01 WCA and did not conduct weed control in this WCA. NRS will visit the WCA at least twice in the next year for weed control. NRS will focus efforts on removing grass and reducing *G. robusta* and *L. leucocephala* in this WCA. Habitat restoration techniques discussed above will be implemented in the Kaluakauila-02 WCA if found to be successful and feasible in the Kaluakauila-01 WCA.

IP MU: Kahanahāiki

This MU was fence in 1996 and is currently ungulate free. Numerous WCAs were established in this MU because there are multiple MFS taxa and many areas of 75% native forest. WCAs were also mapped out to include existing weeding areas. All WCAs fall within the fence, however, weed control is not conducted throughout the entire fenced area as much of the south-facing fenceline is very weedy both in the understory and overstory and not worth weeding. Over the years, NRS spent much time documenting vegetation types and prioritizing MU level weed areas based on high levels of native components and proximity to endangered species.

Ungulate Control Efforts

Subunit I has been ungulate free since 1998 (Figure 1.6). Ungulate sign is closely monitored along two permanent ungulate transects which run alongside the fence. Subunit II will be constructed by Year 4 of the MIP. NRS has scoped out the route and have determined the best route of the fence line that will best enclose the associated MIP PUs for *Alectryon macrococcus* var. *macrococcus*, *Cenchrus agrimoniodes* var. *agrimoniodes*, *Flueggea neowawraea*, and *Hedyotis degeneri* var. *degeneri*. In order to protect the resources within Subunit II and alleviate ungulate pressure along the fence of Subunit I, a total of four snare groups have been operational since 1999. These groups have been very effective, removing 210 pigs since August 1998. There is also an ungulate control area that is adjacent to the Kahanahāiki MU where snares and aerial hunting have been successful at removing 202 animals (120 goats and 82 pigs).

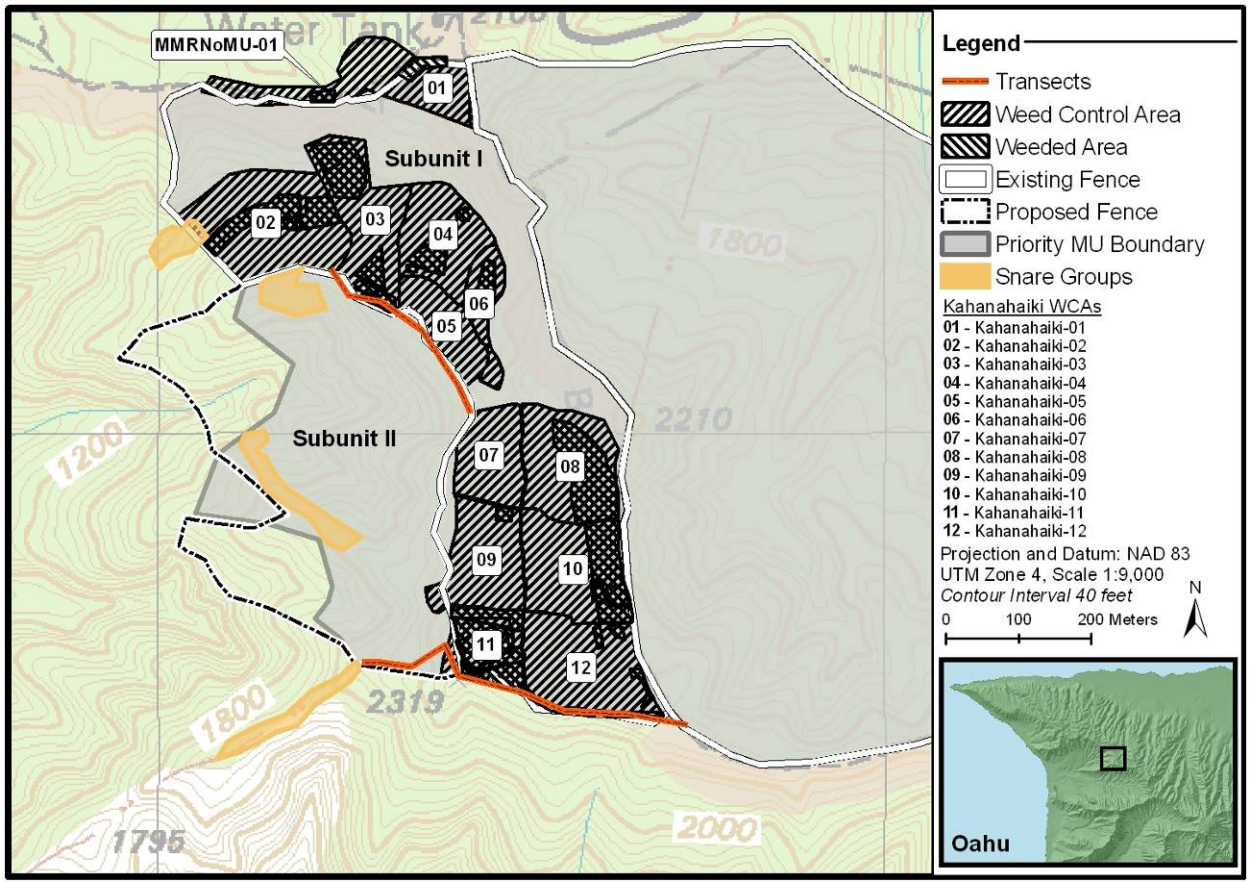

Figure 1.4.8 Ecosystem Management in Kahanahāiki, Makua Military Reservation

Transect Discussion

There are two weed transects read in Kahanahāiki. Both run alongside the fence. No new significant weeds were found along either this year.

WCA Discussion

Kahanahāiki-01; Black Wattle

This WCA is easily accessible to NRS because it is near the trail head. Last year, NRS weeded this area targeting Molasses grass (*Melinis minutiflora*) that has been trying to outcompete the native seedlings and outplanted Koa in the area. Volunteer groups help with the outplanting of 50 Palapalai (*Microlepia strigosa*) in this area to compliment NRS weeding efforts. Ninety-two percent of the outplanted native ferns have survived and are looking healthy. NRS plan on revisiting this area two times next year to continue efforts of killing the invasive grasses and continue common reintros.

Kahanahāiki-02; Ptemac/Generals

For fiscal year 2007, NRS conducted weed sweeps through 0.59ha or 22.5% of this WCA (Table 1.4.6). There are two important outplanting sites in this area, one for *Cyanea superba* subsp. *superba* and *Delissea subcordata* and the other for *F. neowawraea* and *A. macrococcus* var. *macrococcus.* Most of the weed control effort this year was focused on outplanting site maintenance and weeding surrounding areas to increase the buffer zone. Any additional time

was spent weeding forest with fairly intact native canopy on the western portion of the WCA. Next year, NRS will continue to hit the priority sites first and if there is time, expand weed sweeps in the northern portion of the WCA.

Table 1.4.6 Summary of Kahanahāiki Weed Control Efforts

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
IP MU: Kahanahaiki						
Kahanahaiki-01	Habitat	0.68	0.11	16.08%		
				Treatment Type	**# of Visits**	**Effort (Person Hrs)**	**Species Controlled**
				Grass Control	1	1.00	MelMin
				Totals	1	1.00	
Kahanahaiki-02	Habitat	2.63	0.59	22.50%	LepArb, PteMac	AleMacMac, CyaSupSup, DelSub, FluNeo, SchObo
				Treatment Type	**# of Visits**	**Effort (Person Hrs)**	**Species Controlled**
				Ecosystem Weed Control	3	37.75	AgeRip, BudAsi, ChrPar, CliHir, CorFru, GreRob, LanCam, PsiCat, PsiGua, RubRos, SchTer, SyzJam
				Totals	3	37.75	
Kahanahaiki-03	Habitat	3.65	1.46	39.88%	AlpPon	CyaSupSup, DelSub, FluNeo, SchObo
				Treatment Type	**# of Visits**	**Effort (Person Hrs)**	**Species Controlled**
				Grass Control	2	5.00	MelMin, OplHir
				Ecosystem Weed Control	4	40.00	BudAsi, CliHir, PsiCat, RubRos, SchTer
				Totals	6	45.00	
Kahanahaiki-04	Habitat	1.40	0.19	13.59%	DieFal	CenAgrAgr, CyrDen, FluNeo, SchNut
				Treatment Type	**# of Visits**	**Effort (Person Hrs)**	**Species Controlled**
				Grass Control	1	0.50	MelMin
				Totals	1	0.50	
Kahanahaiki-06	Habitat	0.58	0.14	24.96%		CyaSupSup, CyrDen
				Treatment Type	**# of Visits**	**Effort (Person Hrs)**	**Species Controlled**
				Ecosystem Weed Control	1	6.00	BudAsi, CliHir, PsiCat, RubArg
				Totals	1	6.00	
Kahanahaiki-08	Habitat	1.86	0.76	40.83%		CenAgrAgr, SchNut, SchObo
				Treatment Type	**# of Visits**	**Effort (Person Hrs)**	**Species Controlled**
				Ecosystem Weed Control	1	6.00	GreRob
				Totals	1	6.00	

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
Kahanahaiki-09	Habitat	1.41	0.27	19.50%		CenAgrAgr

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	3	32.00	PsiCat, PsiGua, SchTer
Totals	3	32.00	

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
Kahanahaiki-10	Habitat	1.90	0.86	45.28%		

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	3	31.00	BudAsi, CliHir, GreRob, PsiCat, RubRos
Totals	3	31.00	

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
Kahanahaiki-11	Habitat	1.04	0.97	93.50%		CenAgrAgr

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	5	103.00	BudMad, ChrPar, CliHir, GreRob, LanCam, PsiCat, RubRos, SchTer, StaDic
Totals	5	103.00	

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
Kahanahaiki-12	Habitat	2.12	0.22	10.50%		CenAgrAgr

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	4	85.50	BudAsi, CliHir, LanCam, PsiCat, RubRos, SchTer, SpaCam, StaDic, SyzCum
Totals	4	85.50	

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
MMRNoMU-01	Habitat	2.15	0.59	51.19%		

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Grass Control	2	3.00	MelMin, PanMax, PasCon
Ecosystem Weed Control	1	2.00	AcaMea
Totals	3	5.00	

Total IPMU: Kahanahaiki						
		19.41	6.16	31.74%	31	352.75

Kahanahāiki-03; Ethans Gulch

NRS weeded this WCA seven times this past year; on three of those visits they focused their efforts on spraying the invasive grasses. One volunteer group assisted in the weeding efforts of this area which contains a wide diversity of outplanted native plants. NRS plan on weeding this area quarterly next year and hope to compliment their weeding efforts with the outplanting of more common native plants.

Kahanahāiki-04; Aunty Barbs

This WCA contains a variety of endangered species and all weeding efforts are performed in close proximity to these plants. NRS visited this area two times last year; one of those visits was to spray *M. minutiflora*. Two volunteer groups assisted in the outplanting of *M. strigosa* in this

WCA last year. Ninety-eight percent of those plants have survived this past year and appear healthy. NRS plan on weeding this WCA quarterly next year. NRS will focus their efforts on controlling the weeds that have become established in the light gaps. This is mainly the result of killing the weedy tree canopy species in the past.

Kahanahāiki-05; Schwepps/Pink Trail

NRS visited this site once last year which coincides with the prior years weeding efforts. The prior years weeding efforts focused on spraying Molasses grass while this past year's efforts focused on weeding mainly weedy tree canopy species. NRS will visit this WCA two times next year and will focus their efforts on the weedy grasses and shrubs in close vicinity to the outplanted endangered plants.

Kahanahāiki-06; Upper Gulch

This WCA was visited once last year and focused mainly along the gulch bottom where a majority of the Ha'iwale (*Cyrtandra dentata*) is located. NRS plan on revisiting this WCA two times next year. They will focus their efforts in the gulch bottom in efforts to increase *C. dentata* habitat.

Kahanahāiki-07; North Western Quadrant

This WCA was not visited this past year but NRS plan on revisiting this WCA quarterly next year. NRS will mainly be targeting the weeds in the gulch where most of the native vegetation is found.

Kahanahāiki-08; North Eastern Quadrant

The eastern side of the Kahanahāiki exclosure is dominated by introduced weeds. NRS weed control efforts are focused on the remnant patches of native forest found in the central portion of the WCA and around the wild *C. agrimonioides* var. *agrimonioides* population. This year the only activity that occurred in this WCA was a *Grevillea robusta* sweep over 40% of the total area (Table 1.4.6). Next year, NRS plans to continue sweeping the area for *G. robusta* and to maintain priority areas if needed.

Kahanahāiki-09; Middle Western Quadrant

This site was weeded three times last year and volunteers were involved in all of those trips. There is a noticeable increase in the native understory such as Maile (*Alyxia olivaformis*). NRS has refined it's techniques by sparing the larger trees and concentrating weeding effort on the understory, which consist of immature *Psidium cattleianum* and *Clidemia Hirta*. This technique is done to minimize large scale disturbance in the form of light gaps which in the past has led to insurmountable *P. cattleianum* resprouts. Within the past year, NRS has attempted to fly in a chipper to facilitate slash disposal. Unfortunately, there were load complications and the helicopter was unable to fly in the chipper. Additionally, *M. strigosa* was later outplanted in these areas to aid in the reestablishment of native groundcover. To date, 80% of the ferns outplanted are still alive and slowly beginning to spread. NRS will visit this site quarterly next year to continue their efforts in clearing invasive understory and out-planting more common native flora.

Kahanahāiki-10; Middle Eastern Quadrant

This WCA is primarily dominated by introduced weeds. Though there are a few patches of native forest along the one gulch that runs down the eastern portion of the WCA, there are many thick stands of *P. cattleianum*. In recent years, volunteer groups were utilized in an effort to remove these stands of *P. cattleianum*. This year, most of NRS effort was spent retreating some of these *P. cattleianum* removal areas, and conducting a *G. robusta* sweep down the eastern side of the WCA (Table 1.4.6). Next year, NRS plans to conduct weed sweeps in the more native areas, hopefully with the help of volunteer groups. NRS will also be exploring the possibility of outplanting native canopy species to rehabilitate the area and reduce weed recruitment.

Kahanahāiki-11; South Western Quadrant

This area was swept five times within the last year. Additionally, *Triumfetta semitriloba* was found in this WCA in the past and monitoring for germination has been conducted with each weed sweep. Only two plants were found in the past year and NRS will continue to monitor the WCA for any other seedlings. Spreading native seeds from common native plants such as, *Diospyros sandwichensis*, and *Hedyotis terminalis* was also implemented to supplement weeding sweeps. The results have been moderate to successful with once monotypic stands of *P. cattleianum* giving way to native recruitment of *A. olivaformous* and *M. strigosa*. NRS will visit this site quarterly next year in efforts of increasing native plant diversity.

Kahanahāiki-12; South Eastern Quadrant

While this WCA has some very nice forest patches as well as surprisingly high levels of hapu‘u ferns (*Cibotium chamisoi*), there are weedy patches throughout. Many of these weedy areas are monotypic *P. cattleianum* stands; however there are also several light gaps in the WCA, such as one resulting from the dieback of *Pisonia umbellifera,* that foster the invasion of sun-loving weeds. This WCA was weeded four times this year (Table 1.4.6). During one trip, the south fence line was cleared of weeds by a big volunteer group. The rest of NRS activities focused mainly on weeding the nice forest patches. The entire WCA was swept for all weeds in March 2005, and is scheduled for retreatment again in the coming reporting year.

MMRNoMU-01; Black Wattle Outside the MU

This WCA was weeded three times last year and efforts focused on spraying the grass along the fence (Table 1.4.6). The fence was not visible and vehicles were hitting it. This WCA will be visited quarterly next year to keep the grass from covering up the fence again.

IP MU ‘Ōhikilolo

The **‘**Ōhikilolo MU lies between Mākua and Mākaha valleys (Figures 1.4.8-12). There are a total of 19 WCAs within this MU, most of which are established around wild and outplanted populations of *Pritchardia kaalae*, wild populations of a number of other rare and protected plant species, and also a large number of *A. mustelina*. The entire MU is threatened by fire originating from live firing training within MMR as well as from roadside fires started on Farrington Highway.

This MU is divided into two separate regions, ‘Ōhikilolo Ridge and Lower Mākua. Most of the ‘Ōhikilolo Ridge WCAs (Ohikilolo-3, 4, 6, 8, 9, 10, 11, 13, 14, 17 and 19,) are centered around

IP taxa and native forest patches. Figure 1.4.11 is a close up of several of these WCAs. On ʻŌhikilolo Ridge there is much variation among WCAs in the level of weeding effort they receive. Some WCAs, like ʻŌhikilolo-10, are predominantly native and require only occasional understory weeding, while others are alien dominated, and will require long-term plans if native-dominance is to be achieved. The Lower Mākua WCAs (ʻŌhikilolo-05, 07, 12, 15, 16 and 18) are comprised of a montage of predominantly native to weedy patches of forest (Figures 1.4.9 and 1.4.10). NRS felt that the best approach was to begin weeding operations in the native patches first, then spread out to the more weedy areas. This method of landscape level weeding should allow the native patches time to regenerate and spread. NRS believe that a two year re-visitation frequency should be appropriate for this but also realize that it is a very long process.

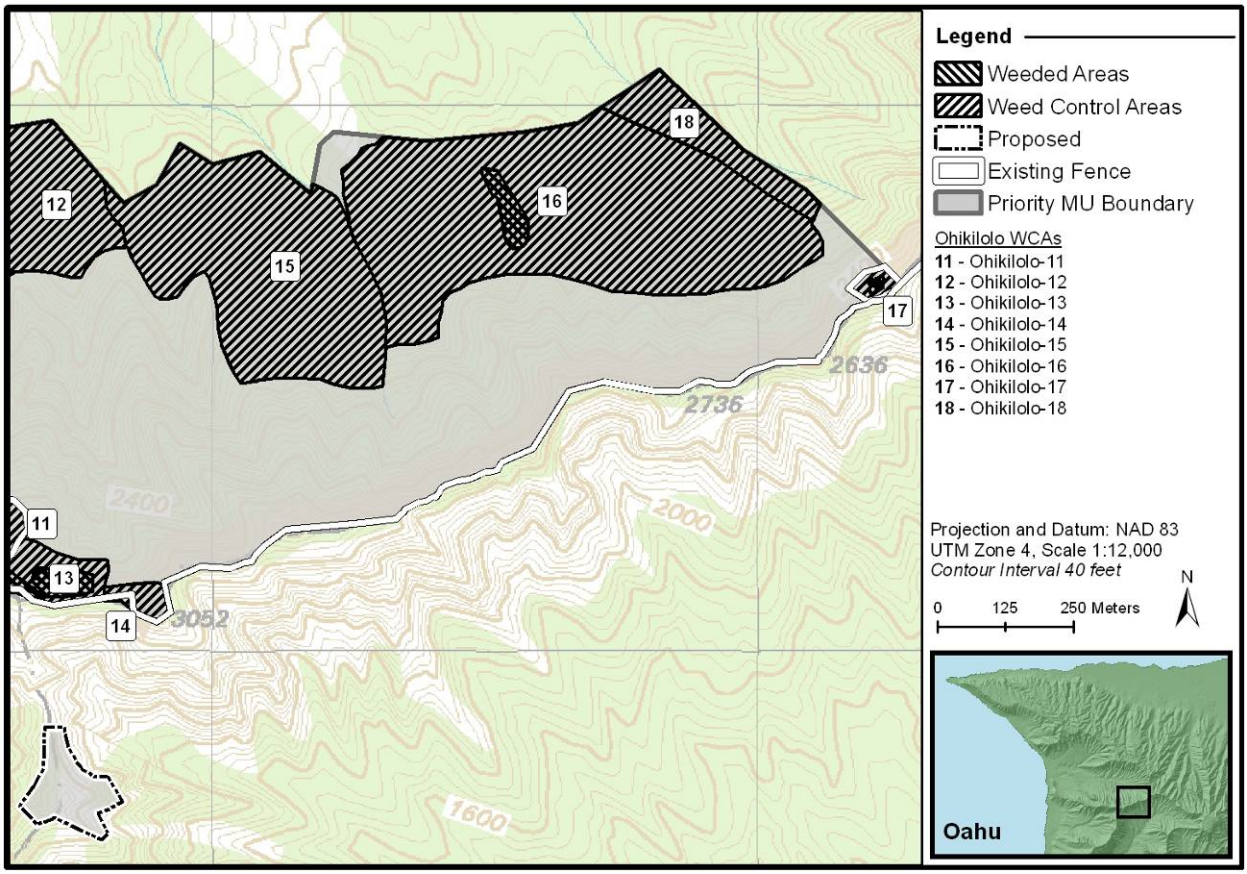

Figure 1.4.9 Ecosystem Management in ʻŌhikilolo – Eastern Section, MMR

A perimeter fence was completed in 2000 that separates the MU from the adjoining ʻŌhikilolo Ranch and Keaʻau Game Management Area (GMA) to the south, which have large populations of feral goats (Figures 1.4.9, 10, 12). Six PU enclosures and one small ecosystem management enclosure have also been constructed within the MU. All of these enclosures have remained ungulate free and are checked quarterly. All of Mākua Valley has been free of feral goats since 2001. Breaches in the perimeter fence have been known to occur since its completion in 2000. NRS were able to repair the breaches and the goats were removed. Monitoring for ungulate activity in the ʻŌhikilolo MU coincides with quarterly inspections of the perimeter fence.

NRS was able to regain permission to camp at the Lower Mākua portions of the ʻŌhikilolo MU this year. There is a 1,200 m strategic fence is slated for construction in Year 7 of the MIP within this portion of the MU. At this time, it is getting more difficult to construct fences within impact areas due to safety issues. NRS would like to look at an alternative to building the strategic fence and see if it will still be necessary to construct. This would entail completing the perimeter fence on the North side of the valley from the Kahanahāiki MU fence to the Kaluakauila MU fence. Once this was completed, NRS would then try to eradicate all of the pigs left within using as many resources as possible. If this is successful, this would create an ungulate free valley. If this is unsuccessful, then NRS would continue with the strategic fence plan and try to work out any safety concerns.

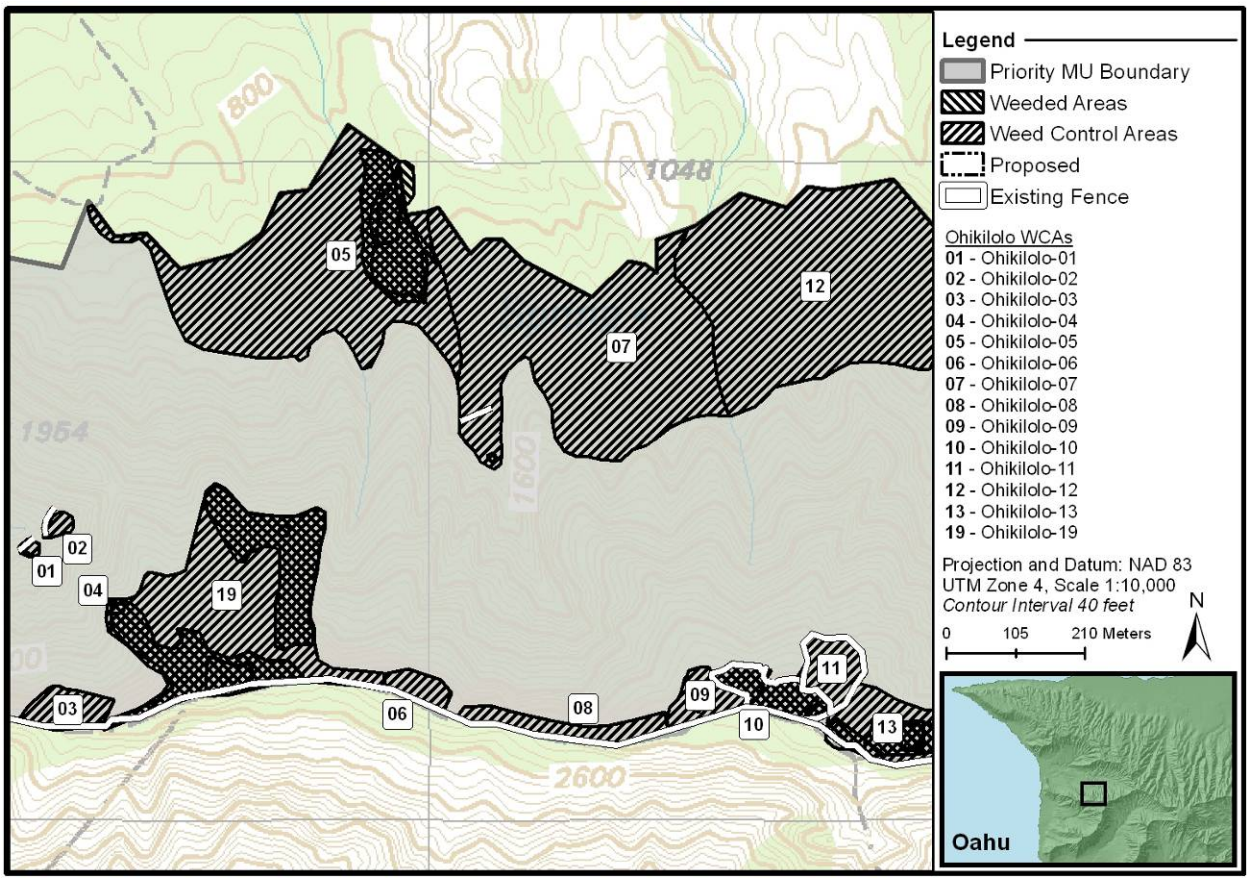

Figure 1.4.10 Ecosystem Management in ʻŌhikilolo – Western Section, MMR

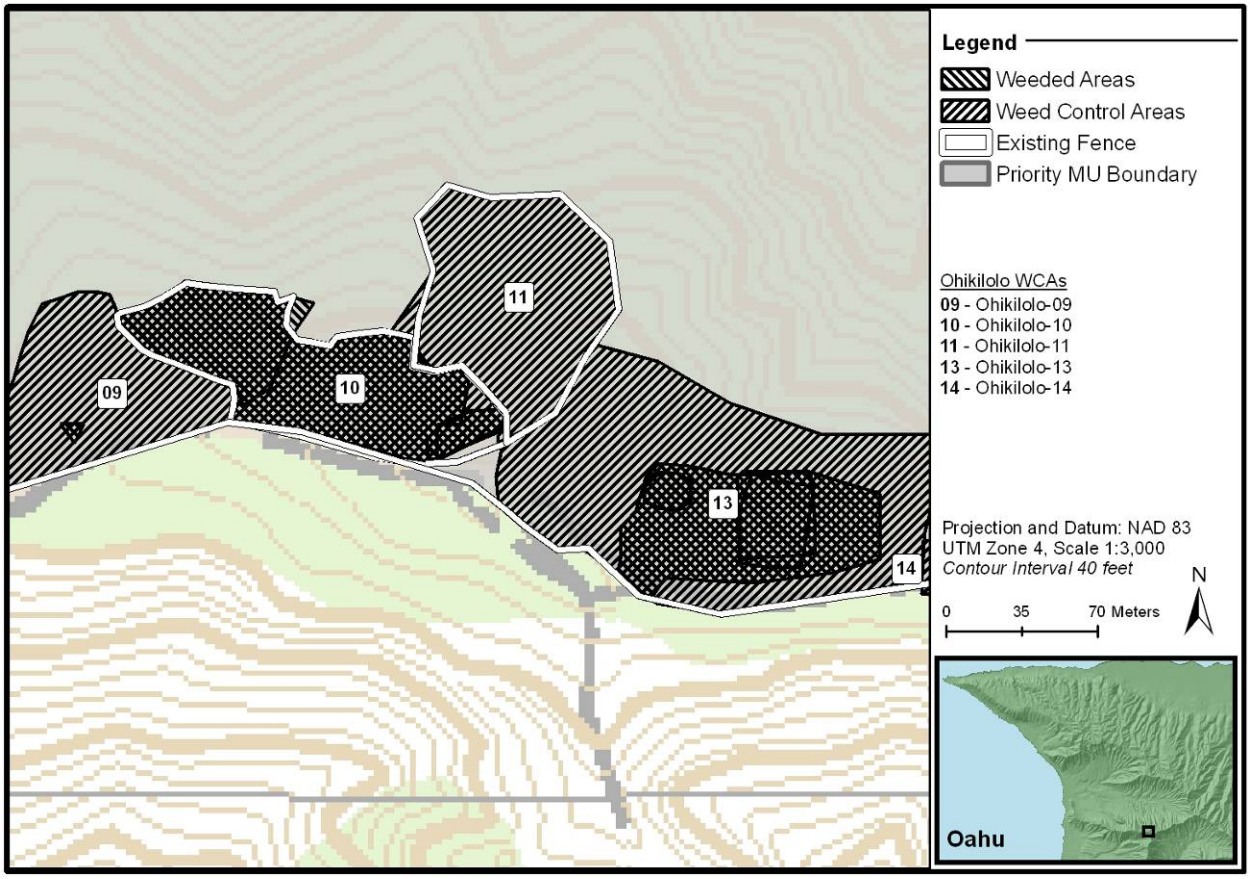

Figure 1.4.11 Ecosystem Management in ʻŌhikilolo – Fence Exclosures Section, MMR

Ungulate Control Efforts

Monitoring of ungulate activity in the ʻŌhikilolo MU coincides with quarterly inspections of the ridge fence. In September 2006, four small goats breached the ʻŌhikilolo ridge fence from Keaʻau. Fortunately, the breach was detected early enough for the goats to stay within proximity of the fence. All four goats were removed via snares. Figure 1.4.12 shows where the snares were put up (shaded area) and the goats were caught in the circled areas (goat sign). Later visits revealed an absence of goat sign. This fence will continue to be pressured by goats from the neighboring Keaʻau GMA. NRS will work this year to re-enforce the areas of the fence undermined by erosion.

The two PU fences protecting *Neraudia angulata* in ʻŌhikilolo-01 and 02 were damaged by rock-fall this year (Figure 1.4.10). NRS completed general maintenance for the damage when discovered but more comprehensive repairs are needed on the next visit. NRS will also evaluate the need to reinforce the fences.

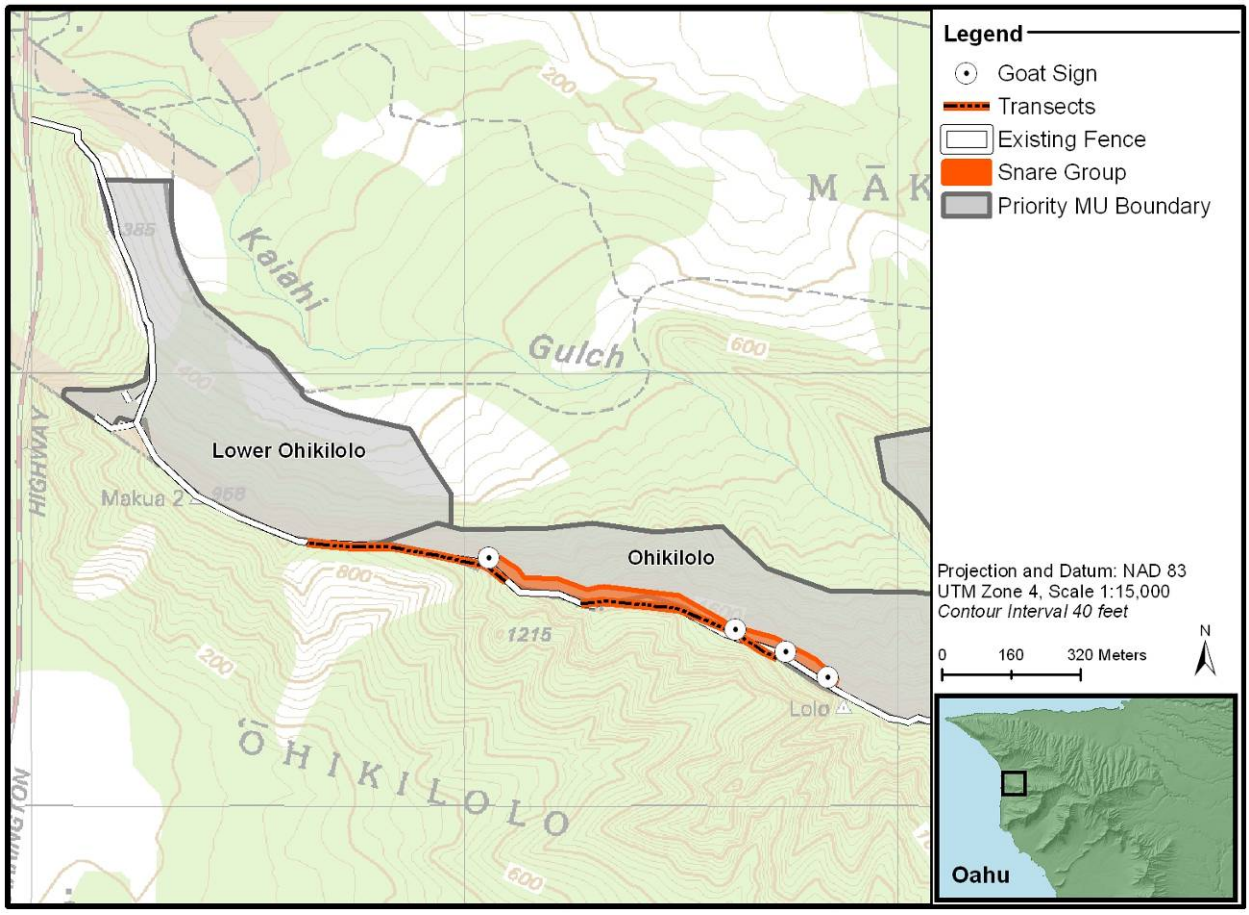

Figure 1.4.12 Ungulate Activity in Western Portion of ʻŌhikilolo

Transect Discussion

There are two transects along the ridge fence in this MU. These transects only detect the presence or absence of ungulates within the MU and serve as an instrument to detect new weed invasions. No new significant weeds were identified.

Table 1.4.7 Summary of ʻŌhikilolo Weed Control Efforts

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
IP MU: Ohikilolo						
Ohikilolo-01	Habitat	0.06	0.01	8.40%		MelTen, NerAng

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	1	3.00	AgeAde, AgeRip, BudAsi, ChrDen, SchTer, SpaCam
Totals	1	3.00	

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
Ohikilolo-05	Habitat	18.57	3.30	17.77%	BobSan	

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Grass Control	1	6.00	DigIns, PanMax, RhyRep
Ecosystem Weed Control	2	21.00	BudAsi, LeuLeu, MelAze, MonHib, PasEdu, PasSub, PluCar, PsiCat, PsiGua, SchTer, SyzCum, TooCil, TriSem
Totals	3	27.00	

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
Ohikilolo-07	Habitat	10.07	0.01	0.10%	BobSan, BonMen, LobNii, NesPol	DubHer, MelTen, NerAng, NotHum

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	1	15.00	AgeAde, AgeRip, BleApp, HelPop, KalPin, MonHib, TriSem
Totals	1	15.00	

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
Ohikilolo-09	Habitat	0.63	0.00	0.76%		AleMacMac, DubHer

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	1	1.00	GreRob, SchTer
Totals	1	1.00	

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
Ohikilolo-10	Habitat	0.75	0.74	97.86%		PriKaa, SanMar

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	2	96.00	AgeAde, AgeRip, BleApp, BudAsi, EriKar, RubRos, SchTer, StaDic
Totals	2	96.00	

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
Ohikilolo-13	Habitat	3.30	1.12	33.97%	MelMak, NotLon, PteMac	PriKaa

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Grass Control	1	1.50	MelMin, PasCon, SetGra
Ecosystem Weed Control	3	28.00	AgeAde, AgeCon, AgeRip, BleApp, BudAsi, ChrPar, KalPin, LanCam, RubRos, SchTer, StaDic
Totals	4	29.50	

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
Ohikilolo-16	Habitat	22.65	0.56	2.46%	BobSan, PteMac	AleMacMac, MelTen

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	1	28.00	CliHir, GreRob, LanCam, PsiCat, PsiGua, SchTer, SyzCum, TooCil
Totals	1	28.00	

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
Ohikilolo-17	Habitat	0.36	0.06	16.28%		PriKaa

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	2	7.00	AgeAde, AgeRip, ChrPar, GreRob, PsiCat, RubRos, SchTer
Totals	2	7.00	

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
Ohikilolo-19	Habitat	7.28	3.55	48.71%		

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	2	20.00	GreRob, SchTer
Totals	2	20.00	

Total IPMU: Ohikilolo						
		63.67	9.34	14.67%	17	226.50

WCA Discussion

‘Ōhikilolo-01; NerAng South Fork

‘Ōhikilolo-01 is located in the south fork of Ko‘iahi Gulch (Figure 1.4.10). This WCA is dominated by weeds and NRS intends to conduct weeding operations once a year to encourage *N. angulata* recruitment. NRS visited this WCA one time this year (3 person hours) to conduct weeding operations (Table 1.4.7). Two staff were able to cover about 9% of the WCA, focusing weeding efforts around the wild population of *N. angulata*. So far, it seems that the combination of ungulate removal and weeding has been beneficial to the population. There are more plants at the base of the cliff than previously known. Only a small percentage of the WCA was covered as NRS spent a majority of the time conducting fence repairs.

‘Ōhikilolo-02; NerAng North Fork

‘Ōhikilolo-02 is located in the north fork of Ko’iahi Gulch (Figure 1.4.10). NRS did not conduct any weeding operations within this WCA during the 2006-2007 reporting year but will conduct weeding when monitoring this year.

ʻŌhikilolo-03; ʻŌhikilolo Koʻiahi Prikaa-I

This WCA is home to an outplanted population of *P. kaalae* and a handful of other rare species (Figure 1.4.10). The habitat it contains is patchy, with some very nice native stands of understory species, but it is almost completely dominated by *S. terebinthifolius* in the overstory. No weed control was conducted at this site this year, but during other work, NRS noted that last year's *Grevillea robusta* treatment was very effective. Limited weed control is necessary at this time. At present, it is felt that removal of the overstory would be detrimental to shade-loving native understory plants. NRS plan to visit this site at least once in the coming year to weed the understory and to assess the feasibility of planting common canopy species in the future.

ʻŌhikilolo-04; ʻŌhikilolo Prikaa-B

This tiny WCA contains a small population of wild *P. kaalae*. The population is made up of three mature trees at the edge of a steep cliff (Figure 1.4.10). Since this PU is not designated MFS, NRS spend minimal time here. No weed control effort was conducted this year. It is unclear how NRS will manage this population in the future; the habitat surrounding the trees is not forested and is not ideal for restoration. It would require a huge investment in time and resources to try to rehabilitate this site. NRS will visit this WCA once in the coming year and target any small herbaceous plants and grass directly affecting the *P. kaalae*.

ʻŌhikilolo-05; Road to Nerang Gulch

ʻŌhikilolo-05 is located in Lower Mākua starting from the fire break road spanning across to Nerang gulch (Figure 1.4.10). NRS visited this WCA three times this year (27 person hours) to conduct weeding operations (Table 1.4.7). Nine staff were able to spend to cover about 18% of the WCA conducting ecosystem weed and grass control. Most of the area covered had been weeded prior but needed some clean-up of both new and re-sprouts and for encroaching grass. Overall, it seems that the weeding operations have been beneficial for the ecosystem. It appears that the weed populations in this area have diminished quite a bit without a great deal of re-colonization being observed.

ʻŌhikilolo-06; ʻŌhikilolo Sanmar-A

This WCA surrounds a population of *Sanicula mariversa* found on a steep cliff (Figure 1.4.10). The primary threats to this site are weedy grasses. Weeding effort this year has been minimal, and it was observed that past years weeding efforts succeeded in killing many of the grasses in the area. In the coming year, NRS will re-visit the site to monitor the *S. mariversa* and assess if more grass control is necessary. Cliff weeding of grasses and weedy trees will be considered. NRS will also monitor the possible influx of *Stachytarpheta dichotoma* to the site, and treat it and other common fenceline weeds as necessary.

ʻŌhikilolo-07; Nerang to Past Well Ridge

ʻŌhikilolo-07 is in Lower Mākua along the blue trail from the Nerang gulch to the other side of the Well Ridge (Figure 1.4.10). NRS visited this WCA once this year (15 person hours) and focused the weeding operation within a fenced site of wild and reintroduced populations of *N. angulata* and *Nototrichium humile* (Table 1.4.7). This fenced area comprises a very small percentage of the entire WCA but is to be the site for additional outplantings. Five staff were able to cover about 50% of the fenced area conducting ecosystem weed control. Anecdotally,

NRS have noticed an increase in native fern cover in the gulch bottom likely due to the removal of feral ungulates and weeds such as *Ageratina riperia, A. adenophora* and *R. rosifolius*.

‘Ōhikilolo-08; ‘Ōhikilolo Transect 9 Ridgeline

Located along the top of the ‘Ōhikilolo ridgeline, the WCA encompasses some very weedy zones, as well as some patches of native scrub (Figure 1.4.10). NRS expended no weeding effort in this WCA during the 2006-07 reporting year. In the future, NRS will seek to expand on efforts from 2004-05 and sweep any previously untouched areas in this WCA for *G. robusta* and *S. terebinthifolius*.

‘Ōhikilolo-09; ‘Ōhikilolo Makai of Exclosure

Just below the intensively managed Forest Patch Exclosure, little effort has been expended in the WCA thus far (Figure 1.4.11). It contains some lush patches of native forest and ferns. As little weeding has been conducted here, it is an ideal site to set up a monitoring plot inside to document and measure the effects of weeding on habitat structure and composition. NRS will pursue this option when the new monitoring program is initiated. Until then, very little effort will be expended in the WCA. This year, NRS treated canopy weeds *S. terebinthifolius* and *G. robusta* in a small area.

‘Ōhikilolo-10; ‘Ōhikilolo Forest Patch Exclosure

Surrounded by a fence, the Forest Patch has been goat-free and managed for weeds for almost 10 years (Figure 1.4.11). Almost 100% native, this area is thick with native ferns, *A. mustelina*, and reintroduced *P. kaalae*. The only weed-dominated portions of this WCA remaining include portions of the fenceline, a 10x10m open gap home to a *Sanicula mariversa* reintroduction, and a 30x30m slope in the far eastern corner of the exclosure.

Generally, the control strategy for this WCA is to thoroughly sweep across it once or twice a year, treating any understory weeds found. *Rubus rosifolius* is the most common understory weed; it thrives in light gaps but also can become established in semi-shade. Control efforts are summarized in Table 1.4.7. NRS swept all of the WCA except the weedy eastern corner once this year. Part of the western portion was swept twice. Sweeping the WCA more often results in less time needed per sweep, but weed control necessarily results in the trampling of some native ferns; NRS must balance these two factors in determining control frequency. NRS strive to reduce understory impacts. Weeding effort has decreased over time as natives gradually colonized open areas. Overall, this WCA is doing spectacularly. No grass control was required at all this year. NRS have noted that native ferns seem to be responding well, and are filling in understory areas.

The weedy eastern slope of the WCA was partially weeded once in the last year. Koa trees outplanted in previous years now reach five meters in height and are providing some much needed shade. *Stachytarpheta dichotoma* and *A. adenophora* were cleared from around the koa this year. NRS hope to expand on the success of these common reintroductions in the coming year by planting more koa into the area, as well as palapalai. Weed control will continue to focus around these reintroductions.

‘Ōhikilolo-11; ‘Ōhikilolo Prikaa-A Fence

Encompassing the largest wild population of *P. kaalae* on ‘Ōhikilolo ridge, this WCA is defined by a 1.9 acre fence (Figure 1.4.11). The site is dominated by *S. terebinthifolius* and a weedy understory. Previous weed control efforts focused on clearing *S. terebinthifolius* to create more light for *P. kaalae*. NRS expended no weeding effort here during the 2006-2007 reporting year. NRS plan to conduct understory and limited canopy control once in the next year.

‘Ōhikilolo-12; Rons Rock to Dividing Ridge

‘Ōhikilolo-12 is located in Lower Mākua along the blue trail from Ron’s Rock on the Well Ridge to the Dividing Ridge (Figure 1.4.9). NRS did not conduct any weeding operations within this WCA during the 2006-2007 reporting year but will do so this year.

‘Ōhikilolo 13; ‘Ōhikilolo Mauka Patch

This WCA encompasses three small gulches located just mauka of the camp LZ (Figure 1.4.11). The habitat is patchy, with some portions of the area dominated by native canopy, some by *Cibotium glaucum*, and some by weedy *S. terebinthifolius*. Understory species are similarly patchy; almost half of the area is covered by *Blechnum appendiculatum*, but some regions are thick with native ferns. Typically, weed control across this WCA has focused on grasses (*M. minutiflora*) and understory weeds, especially *Rubus rosifolius*, *S. dichotoma*, and both *Ageratina* species. Limited canopy control is conducted, since areas dominated by *S. terebinthifolius* tend to also be dominated by *B. appendiculatum*. NRS spend a significant amount of time and effort in this WCA as it includes several resources, including a large *P. kaalae* reintroduction, *Achatinella mustelina*, and *Pteralyxia macrocarpus*. Control efforts are summarized in Table 1.4.7.

Generally, weed control has focused in the middle of the three gulches, *Pteralyxia* gulch. Last year, NRS swept this area twice. *Rubus rosifolius* was much less plentiful than in previous years, suggesting past efforts are paying off. Fewer trips and less time were needed to cover the same amount of area. NRS will monitor this gulch quarterly and sweep it 2-3 times in the next year. NRS also plan to begin palapalai reintroductions to the area to jumpstart native colonization of open, weedy, eroding spots in this gulch.

The westernmost of the gulches, nicknamed Lantana gulch, is very patchy. One slope is dominated by native species, the gulch bottom is dominated by weeds, and the other slope is dominated by grasses and *S. terebinthifolius*. Koa planted into the gulch bottom in previous years are now reaching four to five meters in height. The area was treated once this year; NRS focused on clearing weeds from around the koas and from the margins of the native dominated slope. Some native ferns appear to be colonizing the gulch bottom. In the coming year, NRS plan to expand common native reintroductions and weed the area twice.

The easternmost of the gulches, *Myrsine* gulch, is almost completely covered by *B. appendiculatum*. NRS do not currently have a viable method for treating this fern, and no large scale weeding occurred in this gulch this year. Previous treatment trials of *B. appendiculatum* have been unsuccessful. This year, NRS installed a new trial, testing a technique which appeared effective in Kahanahāiki. Two plots were installed. The boundaries of the plots were dug out with a pick; all stolons and roots were cleared from the 8-10cm wide borders to a depth of 5-

8cms. Then the plots were sprayed with 5% Garlon 4 in water. The only difference between the two plots is size: Plot 1 is 4x4m, and Plot 2 is 2x2m. Results from this trial are pending. If successful, NRS will strategize how best to use this new technique.

Melinus minutiflora is found across this WCA. This grass forms dense mats which may inhibit seedling germination and growth. All three gulches were treated on one trip this year. NRS will continue grass control as needed, twice a year.

ʻŌhikilolo-14; ʻŌhikilolo Tetramolopium Peak

NRS expended no weeding effort in this WCA during the 2005-2006 reporting year. Grass is the primary threat in this WCA, which consists of a steep ridgeline and peak home to *Tetramolopium filiforme* (Figure 1.4.9). When grasses again threaten the *T. filiforme*, NRS will resume control.

ʻŌhikilolo-15; Dividing Ridge to Campsite

ʻŌhikilolo-15 is located in Lower Mākua along the blue trail going from the Dividing Ridge to the campsite (Figure 1.4.9). NRS did not conduct any weeding operations within this WCA during the 2006-2007 reporting year but will do so this year.

ʻŌhikilolo-16; Campsite to Arch Site

ʻŌhikilolo-16 is located in Lower Mākua along the blue trail going from the campsite to the archeological site in the back (Figure 1.4.9). NRS visited this WCA once this year (28 person hours) and focused the weeding operation within a large, continuous patch of predominantly native forest that had been previously weeded (Table 1.4.7). Four staff were only able to cover about 3% of the entire WCA conducting ecosystem weed control. This patch is a very small percentage of the entire WCA but NRS is considering placing MIP taxa outplantings here in the future. The most dominant weed in the area is large *P. cattleianum* trees, but individuals are few and far between. The native canopy and understory are healthy with little room left for invasive weeds. Overall, it seems that the weeding operations have been beneficial for the ecosystem. It appears that the weed populations in this area have diminished quite a bit without a great deal of re-colonization being observed.

ʻŌhikilolo-17; ʻŌhikilolo Ctesqu Ridge Prikaa-G

This WCA is defined by a small fence erected to protect a reintroduction of *P. kaalae* (Figure 1.4.9). The overstory in this steeply graded habitat is largely native-dominated with some aliens, primarily *S. terebinthifolius*. The largely open understory is dominated by herbaceous alien species such as *B. appendiculatum* and *A. adenophora*. The outplanting has been swept twice this year. Understory weeding is a priority in this WCA. Previous weeding efforts have made a significant impact on *A. adenophora*, but it remains common. NRS targeted it and other understory weeds this year (Table 1.4.7). A few canopy species, in particular *G. robusta*, were also targeted. Efforts focused on clearing around the reintroduced plants and clumps of native ferns. In the coming year, NRS plan to expand understory weed control during bi-annual sweeps through the outplanting site, possibly remove some of the non-native canopy trees to ensure optimal habitat for the outplanted *P. kaalae*, and consider common reintroduction options.

‘Ōhikilolo-18; CteSqu Ridge to FluNeo

‘Ōhikilolo-18 is located in Lower Mākua along the blue trail going from the Ctesqu ridge above the Arch site to the Fluneo ridge area (Figure 1.4.9). NRS did not conduct any weeding operations within this WCA during the 2006-2007 reporting year but will do so in the future.

‘Ōhikilolo-19; ‘Ōhikilolo Fence between Prikaa I and Sanmar A

This WCA complements ‘Ōhikilolo-08; both are defined along the fenceline, both include areas of approximately 100% alien vegetation and areas of around 75% native shrub, and the primary targets at both are *G. robusta* and *S. terebinthifolius* (Figure 1.4.10). This year, NRS expanded the boundary of this WCA to include the region between WCAs 3 and 6, reaching from the fence down several walkable ridges to a hanging gulch home to a large patch of native *Pisonia* (Figure 1.4.14). Over the course of two trips, almost half of this large WCA was swept (Table 1.4.7). In the treated areas, all *G. robusta* reachable without ropes were killed. In addition to targeting *G. robusta*, NRS also weeded directly around the *Pisonia* patch. Before goats were eradicated from the area, the hanging gulch was a popular resting spot, and thus was highly degraded. Goats have been absent from the area for several years. Encouragingly, hundreds of seedlings sprung up around the two mature *Pisonia*. See photo below. A few *S. terebinthifolius* directly around the seedlings were treated to create more favorable growing conditions for the seedlings. Next year, NRS plan to sweep the rest of the WCA for *G. robusta*. Once an initial sweep is complete, retreatment may not be necessary for several years. NRS will also monitor the *Pisonia* patch and conduct minimal weeding as needed.

Figure 1.4.13 *Pisonia* seedlings recruiting in goat-free habitat at ‘Ōhikilolo

IP MU: Lower ‘Ōhikilolo

According to the 2007 BO (USFWS 2007), OANRP is required to remove all standing live and dead grass from within two meters of all MIP stabilization plants in the MU. NRS not only maintains this two meter area, but removes all grass from with the seven hectares of the first three WCAs (Figure 1.4.15). Other contractors maintain the required, 60m strip along the south lobe of the firebreak road (grass has to be kept at a height of 30cm or less).

Maintenance weed control at Lower ‘Ōhikilolo continued this year as in previous years. There are four WCAs in the MU. Effort levels are directly tied to rainfall, as NRS must respond with spot spraying after rains. Grasses have evolved to resprout with rain after being stressed. It is notable that in the areas where the *Chamaesyce celastroidies* var *kaenana* WCAs were expanded to the road last year, grass cover was much more prevalent than in areas that have been maintained for multiple years. This indicates that the seed bank is being depleted in the retreated areas and enforces the goal of treating grass before it becomes reproductive. The additional use of a power sprayer from the road has helped speed control of grass in the lower part of the WCAs. The benefits of this technique are that no re-mixing is required as the spray reservoir is

200 gal, and spray force is greatly increasing coverage. The limitation is that a hose must be pulled from the tank in the trunk into and around the WCA. As a result, NRS found this technique effective to retreat areas with extensive grass cover. However, in areas with sparse grass, a backpack sprayer is more efficient. Across all WCAs NRS prefers to use Fusilade directly around endangered species, and Round-up in less sensitive areas. *Leucaena leucocephala* removal continues in the MU, however the effort is greatly diminished. Most of the WCAs have been completely swept at least one time and only require occasional re-treatment to remove individuals that have been missed or are new recruits.

An arson fire near Kaneana Cave threatened all three WCAs (see Appendix II). As a result of this and additional consultations with USFWS, the Army plans to expand the fire break areas around the endangered plants and expand buffers around the firebreak road. NRS strongly support this initiative.

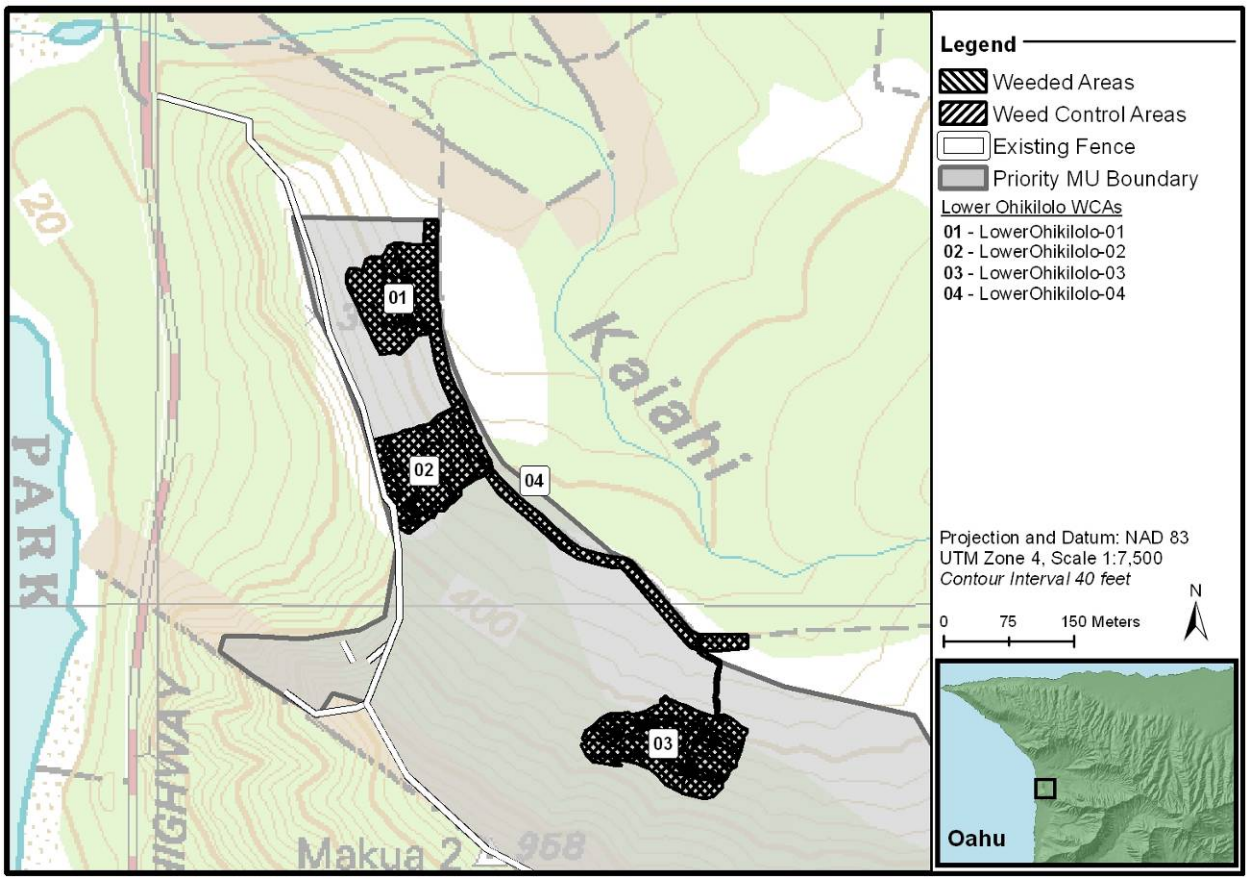

Figure 1.4.14 Ecosystem Management in Lower ʻŌhikilolo

In the next year NRS will look at developing a monitoring program to help direct control efforts. It would be ideal to maximize effect by analyzing effort expended compared to change over time. For example, it is less effective to go when grass is just starting to respond to the first rains of winter as most have not started to germinate and are not yet actively growing. However, effort required increases steeply if too much time lapses before treatment, as grass grows explosively, resulting in much more biomass to spray. Somewhere between these extremes there

is an ideal where effort is minimized and effect maximized. Perhaps this question can be answered through monitoring.
There is a perimeter fence ,completed in 1998, that separates the MU from the adjoining ʻŌhikilolo Ranch to the south, which has large populations of feral goats (Figure 1.4.15). A strategic fence protecting an endangered population of *Melanthera tenuifolia* was erected in June 2002. No breaches have been observed since 2002.

Ungulate Control Efforts

In February 2006 a small hole was discovered along the perimeter ridge fence and goat sign was reported inside the fence (Figure 1.4.15). On a subsequent scoping trip, four goats were observed uphill of the *Hibiscus brackenridgei* ssp. *mokuleianus* population. NRS has since eradicated five goats and there have been no further breaches.

Figure 1.4.15 NRS conducting grass control at Lower ʻŌhikilolo

Table 1.4.8 Summary of Lower ʻŌhikilolo Weed Control Efforts

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
IP MU: Lower Ohikilolo						
LowerOhikilolo-01	Habitat	2.01	2.01	100.00%		ChaCelKae
				Treatment Type	**# of Visits**	**Effort (Person Hrs)**	**Species Controlled**
				Grass Control	4	46.00	ChlSp., HypPec, LeoNep, LeuLeu, PanMax, RhyRep
				Ecosystem Weed Control	6	74.00	AcaFar, BidPil, ChlBar, ChlSp., HypPec, LeoNep, LeuLeu, PanMax, RhyRep
				Totals	10	120.00	
LowerOhikilolo-02	Habitat	2.39	2.39	100.00%		ChaCelKae
				Treatment Type	**# of Visits**	**Effort (Person Hrs)**	**Species Controlled**
				Grass Control	5	51.00	BraSub, ChlSp., PanMax, RhyRep
				Ecosystem Weed Control	6	86.00	AcaFar, BidAlb, HypPec, LeoNep, LeuLeu, MacLat, PanMax
				Totals	11	137.00	
LowerOhikilolo-03	Habitat	2.74	2.74	100.00%		HibBraMok
				Treatment Type	**# of Visits**	**Effort (Person Hrs)**	**Species Controlled**
				Grass Control	3	19.00	LeuLeu, PanMax, RhyRep
				Ecosystem Weed Control	9	175.50	AcaFar, BidAlb, BidPil, ChlBar, HypPec, LanCam, LeoNep, LeuLeu, PanMax, PluSym, RhyRep
				Totals	12	194.50	
LowerOhikilolo-04	Trail	0.68	0.68	100.00%		
				Treatment Type	**# of Visits**	**Effort (Person Hrs)**	**Species Controlled**
				Grass Control	1	4.00	PanMax, RhyRep
				Totals	1	4.00	
Total IPMU: Lower Ohikilolo						
		7.81	7.81	100.00%	34	455.50	

WCA Discussion

Lowerʻ Ōhikilolo-01 Lower *C. celastroides* patch

Fire is the primary threat to the *C. celastroides* patches at Lower ʻŌhikilolo. NRS has spent 120 person hours this year doing fire pre-suppression by controlling higher fuel content weed species such as introduced grasses and woody shrubs (Table 1.4.8). This included activities such as weedwhacking, *L. leucocephala* removal and grass spraying. While NRS was very successful at keeping the grass population to very low levels, and in removing the larger woody species, the broadleaf herbaceous weeds such as *Leonotis nepetifolia* and *Bidens pilosa* formed very thick monotypic patches over a good portion of the WCA. NRS tried to spray them as seedlings with Glyphosate, but at the end of the rainy season most plants had matured and seeded. These species are less of a fire hazard, but we are concerned about their affect on *C. celastroides*

seedling recruitment. Next year, we will continue grass control efforts, but we will also explore using other alternatives such as shade cloth, outplanting native species to rehabilitate the area, and we are also considering using pre-emergent herbicide on the lower roadside portions of the WCA.

Lower‘Ōhikilolo-02 Upper *C. celastroides* patch

The Upper *C. celastroides* patch is subject to all the same challenges that we are dealing with in the LowerOhikilolo-01 WCA. NRS spent 137 person hours this year (Table 1.4.8), reducing fire hazards in the upper patch by weedwhacking, removing *L. leucocephala* and by spraying the introduced grasses. Next year, we will continue with grass control efforts, but we will also explore other alternatives (listed above) to deal with the broadleaf weeds.

Lower‘Ōhikilolo-03 *H. brackenridgii*

The *H. brackenridgii* patch is subject to all the same challenges that we are dealing with in the LowerOhikilolo-01 WCA. NRS has spent 194 person hours doing fire pre-suppression activities this year (Table 1.4.8). Grass populations were kept to low levels, but for fiscal year 2008 we will explore alternatives to help control the weedy broadleaf plants that have established themselves in the three patches.

Lower‘Ōhikilolo-04; Lower ‘Ōhikilolo Roadside

Occasionally, NRS will use a power sprayer to herbicide the low portions of the three WCA at Lower ‘Ōhikilolo. At the end of the day, any excess herbicide is used to spray the road below and between the three patches. A new WCA was established to account for this roadside activity. This year, NRS spent four person hours spraying 100% of this WCA (Table 1.4.8).

Region: *Pahole Natural Area Reserve*

This region includes two IP MUs: Pahole and Upper Kapuna. These fenced and proposed fenced MUs are within the State’s Pahole NAR and access and weeding and ungulate projects here are done in coordination with the State NARS Specialist. The Pahole Gulch fence encompasses 215 acres of mixed native and alien mesic forest. Once completed, the combined Upper Kapuna subunits will encompass an additional 220 acres. Because these MUs are adjacent to the Kahanahāiki MU to the west and the proposed West Makaleha MU to the east, once all the fences are complete, this will essentially be 600 acres of mixed native and alien mesic forest in the Wai‘anae Mountains that will be ungulate free.

IP MU: Pahole Gulch

Pahole Gulch lies between Kapuna and Kahanahāiki Valleys in the Northern Wai‘anae Mountains (Figure 1.4.16). There are a total of ten WCAs within this MU, most of which are established around wild and outplanted populations of rare and protected plant species. Weed actions conducted in the gulch are based on objectives established through discussion between NRS and the NARS Specialist. These objectives include focusing weeding actions around wild and outplanted populations of rare and protected plant species, within areas that are largely native and require only occasional understory weeding, and on eradicating incipient species that are suggested by the NARS Specialist. At this time, NRS and NARS staff are still in the process

of developing an over-all weed control plan for the gulch. Goals will be established for the long-term objective for weed eradication within the MU.

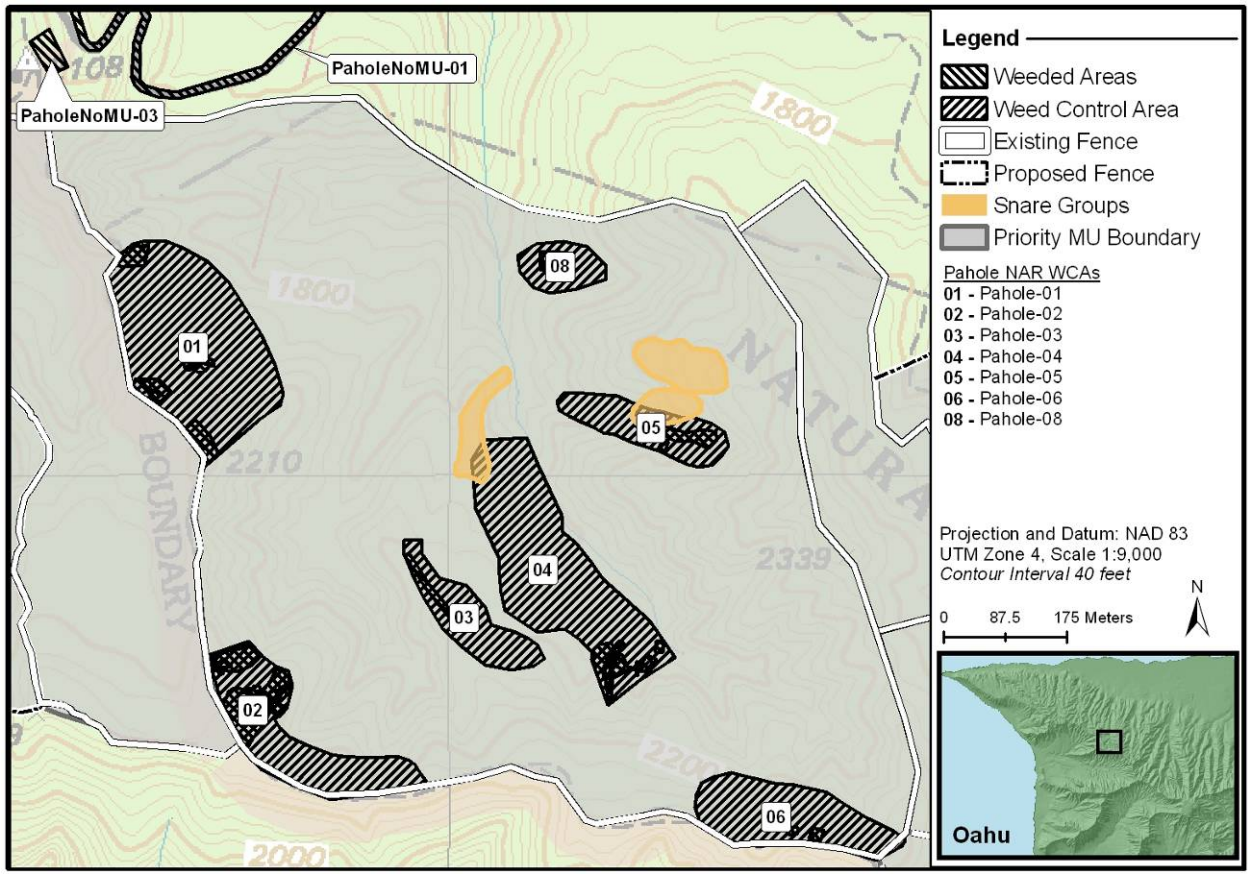

Figure 1.4.16 Ecosystem Management in Pahole

Ungulate Control Efforts

The Pahole Gulch MU has been fenced since 1997 and all of the ungulates were removed shortly after. In previous years, there have been a couple of breaches in the fence since but all animals were removed. NRS and NARS staff documented ungulate sign within the MU in February 2007. It is believed that four or five pigs breached the fence when they were very small and went undetected for several months. Action was taken by NARS staff to install a couple of snare groups to eliminate the animals (Figure 1.4.16). To date, four adults (three male and one female) and five piglets have been removed. NRS and NARS staff believe there are still a few more pigs within the fence but anticipate removing them within the next few months. It is still unclear how exactly these pigs did get in, whether they were small enough to fit through the bottom of the fence or if they were maliciously released. Inspection of the fence did not reveal any holes or damage that would allow a larger pig access.

Table 1.4.9 Summary of Pahole Weed Control Efforts

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
IP MU: Pahole						
Pahole-01	Habitat	4.90	0.42	8.49%		CenAgrAgr, CyaSupSup, SchNut, SchObo

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	3	16.50	ChrDen, ChrPar, LanCam, PsiCat, PsiGua, SchTer, SpaCam, SyzJam
Totals	3	16.50	

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
Pahole-02	Habitat	4.94	1.38	27.89%		CenAgrAgr, CyaLon, HedDegDeg, PlaPriPri

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Grass Control	3	6.00	EhrSti, MelMin, PanMax, PasCon
Ecosystem Weed Control	6	51.50	BudAsi, CliHir, FraUhd, LanCam, PluCar, PsiCat, RubRos, SchTer, StaDic
Totals	9	57.50	

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
Pahole-03	Habitat	1.23	0.08	6.24%	DieFal	CenAgrAgr

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	2	29.00	CliHir, GreRob, LanCam, MelMin, PsiCat, SchTer
Totals	2	29.00	

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
Pahole-04	Habitat	4.32	0.27	6.24%	LabKaa	AleMacMac, ChaHer, CyaSupSup, CyrDen

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	6	61.50	CliHir, GreRob, LanCam, MonHib, PsiCat, PsiGua, RubRos, SchTer, SpaCam, SyzCum
Totals	6	61.50	

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
Pahole-05	Habitat	2.52	0.38	15.19%		CyrDen, PhyKaa

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Grass Control	1	1.50	MelMin, OplHir, PasCon
Ecosystem Weed Control	1	20.00	BudAsi, ChrPar, PsiCat, RubRos, SchTer
Totals	2	21.50	

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
Pahole-06	Habitat	2.14	0.04	1.92%		CyaLon, CyrDen, SchNut, SchObo

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	1	28.00	CliHir, GreRob, PsiCat
Totals	1	28.00	

Pahole-08	Habitat	0.69	0.09	13.60%		

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	2	20.00	AleMol, CliHir, PsiCat, PsiGua, SchTer, SpaCam
Totals	2	20.00	

PaholeNoMU-01	Trail	7.76	5.18	66.77%		

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	2	12.00	LeuLeu, PanMax
Totals	2	12.00	

PaholeNoMU-02	Habitat	0.27	0.23	84.03%		

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Grass Control	1	4.00	BidAlb, ChaNic, LeuLeu, MelMin, NeoWig, PanMax, SchTer, WedTri
Totals	1	4.00	

PaholeNoMU-03	Habitat	0.26	0.18	69.00%		

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	1	1.50	LanCam, PsiCat, SchTer
Totals	1	1.50	

Total IPMU: Pahole						
		29.02	8.24	28.41%	29	251.50

WCA Discussion

Pahole-01; Switchbacks, SchNut Reintro

Pahole-01 is located on the North East facing slopes of Pahole about a third of the way out to the overlook (Figure 1.4.16). It includes the reintroduction site for *Schiedea nuttallii* at the switchback site and reintroduction sites that where established this year for *C. agrimonioides* and *S. obovatum*. The WCA also contains a mix of native dominated and alien dominated areas. NRS conducted three weeding trips (16.5 person hours) to the WCA this year. Seven staff covered about 9 % of this large WCA, weeding focused directly around the reintroductions (Table 1.4.9). Weeds do not appear to be reestablishing in large numbers and the reintroductions are doing well. Many of the reintroduced plants are producing seeds and NRS hope that intermittent weeding will be sufficient. There is much more area to cover within this WCA and NRS look forward to expanding weed control. The eastern side of the WCA (down slope away from the ridge crest) is an area of high quality native forest. NRS feel that this area is especially

important to target. Grass control also needs to be conducted in this WCA during winter months when *Melinus minutiflora* begins to invade.

Pahole-02; Cenagr PAH-A

WCA Pahole-02 spans the flat area above the Pahole snail enclosure between the Pahole and Mākua rim (Figure 1.4.16). There are nice patches of native forest separated by dense stands of *P. cattleianum*. *Dicranopteris linearis* dominates the area near the Pahole rim. There are also outplantings of *C. agrimonioides*, *Cyanea grimesiana* and *Schiedea obovata* within the WCA. NRS made nine weeding trips (57.5 person hours) to the area this year. Nine staff covered about 28% of the entire WCA (Table 1.4.9). Seven of the trips were concentrated in and around the area of the State snail exclosure and the *C. agrimonioides*. There was a lot of focus on this area in preparation for introducing a large number of common natives this outplanting season and to follow up previous weeding efforts. Some of the *P. cattleianum* that had been hit before were not killed. Two other trips concentrated weeding efforts in the *C. agrimonioides* outplanting site. NRS will continue to attempt to extend weeding operations to other areas within the WCA.

Pahole-03; Cenagr PAH-B

WCA Pahole-03 is centered upon a wild *C. agrimonioides* population (Figure 1.4.16). The highest priority action is to control *M. minituflora* that grows along the open ridge crest, in the past it smothered *C. agrimonioides*. These patches must be manually cleared away from the *C. agrimonioides*. Then once at a safe distance of at least more than 3 m, they can be sprayed. Down slope from the *C. agrimonioides*, the native forest is being invaded by *P. cattleianum*. NRS conducted weed control in the WCA twice this year (29 person hours). Five staff covered only about 7% of the WCA (Table 1.4.9). Effort was focused on opening up the *P. cattleianum* canopy in and around the *C. agrimonioides* population, hand-pulling *M. minituflora*, and eradicating the few *Grevillea robusta* in the area. NRS will continue to attempt to extend the weeding operations to other areas within the WCA.

Pahole-04; Gulch 3 Cyasup Reintro/Chaher

WCA Pahole-04 is centered upon reintroductions of *Cyanea superba* and *Chamaesyce herbstii* (Figure 1.4.16). NRS conducted weed control in the WCA six times (61.5 person hours) this year. Nine staff covered only about 7 % of this large WCA (Table 1.4.9). Effort was focused around site preparations for a *C. herbstii* augmentation and the surrounding *C. herbstii* wild populations. At this time, the area that surrounds the *C. superba* reintroduction is more problematic. This species was reintroduced along the gulch bottom which is dominated by introduced species such as *R. rosifolius, Christella parasitica* and *Paspalum conjugatum*. The presence of these species in the understory does not appear to impact the *C. superba*. The reintroduced plants do exhibit vigorous growth; however, seedling germination could possibly be inhibited by the dense cover. Unfortunately, even in a native dominated habitat, germination is unlikely because of slug predation on newly germinated seedlings. NRS will not prioritize larger scale under story weed control in this area until slug control techniques are developed.

Pahole-05; Gulch 4

WCA Pahole-05 encompasses an area where *Phyllostegia kaalaensis* was outplanted by NRS (Figure 1.4.16). Unfortunately, the outplantings have not done well. NRS has done extensive weed control in the area in the past and went to the area twice (21.5 person hours) this year. Five

staff covered about 16% of the WCA performing maintenance and preparing new areas for further reintroduction (Table 1.4.9). Over time, this weed control has changed the regime of weeds in the area. *Buddleia asiatica* replaced *Ageratum adenophora* when it was removed. The *B. asiatica* has since been removed. NRS will continue to maintain and expand efforts in this area as is needed to support continued reintroduction efforts.

Pahole-06; East Pahole Rim Schnut/Cyalon

WCA Pahole-06 is in the Southeastern corner of the fence and is one of the most intact areas remaining in Pahole (Figure 1.4.16). This WCA contains wild populations of *C. longiflora* and *S. nutallii*. The NARS Specialist has suggested that NRS pair weeding trips with collection trips to minimize impacts. NRS strongly agree with this strategy as the habitat is very sensitive to disturbance. One trip (28 person hours) was made this year. Ten staff covered about 2% of the entire WCA (Table 1.4.9). Effort was focused on *P. cattleianum* and *C. hirta* seedlings and immatures. In past years, NRS swept through this predominantly native area removing sparse canopy weeds. This site will be visited, at most, two times year and care will always be taken to minimize impacts.

Pahole-08; Gulch 5

WCA Pahole-08 encompasses an area in Gulch 5 that is being utilized as an augmentation site for *Schiedea kaalae* (Figure 1.4.16). NRS conducted weed control in the WCA two times (20 person hours) this year. Four staff covered about 14% of the entire WCA (Table 1.4.9). Weeding was conducted in the area around the last remaining wild plant in preparation for augmenting the population. NRS is optimistic that this rehabilitation of the habitat will be beneficial for the population as a whole. It is too early to make any assumptions on the success of the weeding actions.

PaholeNo MU-01; Pahole Road

WCA Pahole-No MU-01 covers roadside weed spray along the access road from the Dillingham Ranch gate to the Pahole Mid-elevation Nursery (PMEN). This WCA is partially depicted in Figure 1.4.16. NRS conducts the action in order to keep the access road open for public safety and as a means to minimize the introduction of new weeds from fallow fields below via vehicle traffic. This effort is shared with NARS staff. NRS sprayed the road two times this year and will monitor vegetation over the next year and respond accordingly (Table 1.4.9).

PaholeNoMU-02; Nike Site

WCA Pahole-No MU-02 encompasses the PMEN site upper building-helicopter LZ. This WCA is not noted on a map. NRS conducts control here in order to minimize the transport of weeds from the PMEN via slingloads and/or personnel to various MUs. This effort is shared with NARS staff. NRS sprayed the area one time this year and will monitor vegetation over the next year and respond accordingly (Table. 1.4.9).

Pahole-NoMU-03; Outside the Fence

WCA Pahole-NoMU-03 is located outside the Pahole fence near the PMEN (Figure 1.4.16). NRS weeded in this WCA prior to outplanting *S. obovata*. Two staff spent about an hour cleaning up the site. The area was weeded once this year (Table 1.4.9). The area is relatively

native and NRS feel that not much weeding will need to be done in this area. NRS will monitor the results of the weed control and conduct more control if necessary.

IP MU: Upper Kapuna

Upper Kapuna MU includes 11 WCAs, six of which were established over the last year (Figure 1.4.17). All WCAs were established with the assistance of NARS staff. Two of the WCAs are currently within small fences, while the remaining are not protected at this time. However, a system of four staggered fences is being constructed in the area. These fences will protect vital resources wild rare plant PUs, reintroduced rare plant PUs, and snail PUs. Subunit I encloses Upper Kapuna 07 and 09. Subunit III will include Upper Kapuna-03, 04, 06, and 10 and the fourth subunit will encompass Upper Kapuna-01, 02, 08, 11. No WCAs are established in Subunit II. NRS have committed to helping the State complete the units, and construction is pending initiation by the State's fencing contractor, with completion by early 2008.

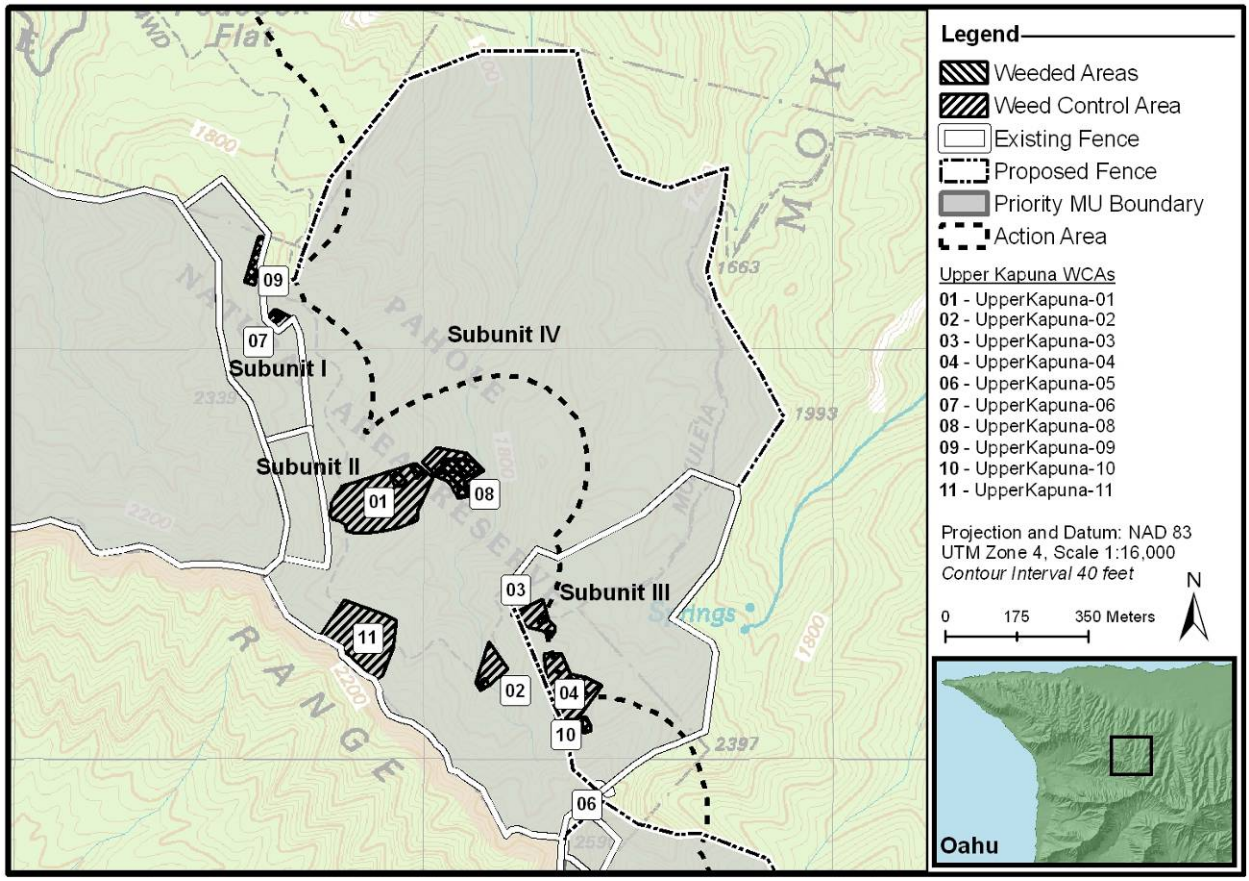

Figure 1.4.17 Ecosystem Management in Upper Kapuna

The MU is threatened by fire, from the north and the south. Fires occurring in the ranch and fallow agriculture fields below of the NAR could impact the area, though the extent of the possible burn area is unclear due to varying fuel types in the MU. Fires from MMR could impact the area as well, as part of the MU falls within the AA.

At the present time, weeding is concentrated in the direct vicinities of the rare plant populations. Control efforts are summarized in Table 1.4.10. Once the areas are fenced, NRS will intensify efforts in the MU, weed priorities will be re-evaluated and perhaps more effort will be spent improving the habitat between rare plant populations and in areas with high native composition. It is possible that future weeding could expand current WCA boundaries, leading to the merging of nearby WCA's.

Ungulate Control Efforts

Originally the Upper Kapuna MU was planned to be built as two subunits. Due to the increased cost of fencing contracts, NARS staff opted to alter the proposed subunits into four subunits (Figure 2.1.15). Subunits I, and II are complete, but have been breached by smaller pigs able to walk through small holes on the bottom of the fence. NARS staff and NRS have been addressing these weak points in the fences and these units should be ungulate free in the near future. NRS have completed their obligations for subunit III, and contractors working for NARS will complete the construction of the subunit. NARS awarded the contract for subunit IV, with construction to begin in fall 2007. NARS staff and NRS have conducted volunteer hunts using dogs within these subunits. In addition, this area remains a public hunting area to keep the pigs from further pressuring the fence.

WCA Discussion

Upper Kapuna-01; Chaher/Hesarb/Delsub Gulch

There are a number of rare plant species present in this WCA, several of which are designated MFS. There is also some native dominant habitat in the WCA, the maintenance and expansion of which being critical to the survival of the rare plant taxa found therein. Weeding effort (3 visits, 30 person hours) over the past year has been focused on areas around the rare plants, reintroductions, and in areas of healthier native forest. As stated in the introduction, the weeding effort in this WCA is focused mainly on understory weeds. The NARS specialist feels it is necessary to keep overstory control to a minimum (6% per trip) to reduce light gaps which stimulate rapid growth of pioneer weeds. However, a far amount of canopy was removed in the area where the PhyKaa.KAP-B outplanting occurred in order to provide sufficient light levels for healthy growth.

It will be necessary to continue weeding effort in this WCA on a regular basis, as there are aggressive weeds can colonize open areas quickly like *R. rosifolius* and *B. asiatica*. NRS plan to return to this site at least four times in the next year to improve the habitat for the rare plants present. Priority areas for weeding will continue to be around rare plants and reintroductions, as well as increasing the buffer of native dominated habitat around them.

Upper Kapuna-02; Kapuna Stream

This WCA is contained by a PU fence, in which are planted *Cyanea superba* and *Chamaesyce herbstii*. Weeding is focused on maintaining the health of the microclimate around the outplantings. The area is small and so not much effort is needed to keep up with weed regeneration; there was only one visit this year with 1.25 person hours of effort. The dominant weed in the area is *R. rosifolius*. In the coming year, NRS will visit the site at least once to monitor the re-growth of *R. rosifolius* and other weeds and treat them if necessary. This site is

managed for fruit production, and so not much effort is invested in weeding the surrounding habitat. The understory is primarily native, with the exception of a thick carpet of *B. appendiculatum*, and the overstory is mixed native and non-native. Weeding is focused only on understory species at this time so as not to alter the light regime for the outplanted species.

Table 1.4.10 Summary of Upper Kapuna Weed Control Efforts

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
IP MU: Upper Kapuna						
UpperKapuna-01	Habitat	2.83	0.16	5.64%		ChaHer, DelSub, HesArbu

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	3	30.00	AgeRip, BleApp, BudAsi, ChrPar, CliHir, GreRob, PsiCat, PsiGua, RubRos, SpaCam, TooCil
Totals	3	30.00	

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
UpperKapuna-02	Habitat	0.45	0.05	10.36%		ChaHer, CyaSupSup

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	1	1.25	ChrPar, CliHir, RubRos
Totals	1	1.25	

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
UpperKapuna-03	Habitat	0.47	0.02	4.22%		CyaLon, SchNut

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	2	8.50	CliHir, PsiCat, SchTer
Totals	2	8.50	

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
UpperKapuna-04	Habitat	1.32	0.04	2.79%		CyaLon, PhyKaa

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	2	28.00	CliHir, PsiCat, RubRos, SchTer
Totals	2	28.00	

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
UpperKapuna-06	Habitat	0.04	0.04	99.35%		SchObo

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	2	16.50	AndVir, CliHir, GreRob, MelMin, PasCon, PsiCat, RubRos, SchTer, StaDic
Totals	2	16.50	

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
UpperKapuna-07	Habitat	0.18	0.05	26.09%		CyaSupSup

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	1	0.75	CliHir, RubRos, SchTer
Totals	1	0.75	

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
UpperKapuna-08	Habitat	0.93	0.44	47.11%		DelSub

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	2	6.50	CliHir, GreRob, PsiGua, SchAct, SchTer
Totals	2	6.50	

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
UpperKapuna-09	Habitat	0.27	0.27	100.00%		DelSub

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	2	17.00	AgeAde, FraUhd, GreRob, LanCam, PasCon, PsiCat, PsiGua, RubRos, SchTer, SyzCum, SyzJam
Totals	2	17.00	

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
UpperKapuna-10	Habitat	0.07	0.07	100.00%		SchObo

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	1	3.75	CliHir, GreRob, PasCon, PsiCat, RubRos
Totals	1	3.75	

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
UpperKapuna-11	Trail	2.09	0.43	20.60%		

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	1	22.00	GreRob, PsiGua
Totals	1	22.00	

Total IPMU: Upper Kapuna						
	8.66	1.56	18.01%		17	134.25

Upper Kapuna-03; Keawapilau SchNut/CyaLon.

There are two protected species in this WCA, *Cyanea longiflora* and *Schidea nuttalii*, both of which are designated MFS. The area contains a fair amount of overstory weeds separating some small diverse native patches. In the past year the weeding conducted at this spot has focused on understory weeds. Two visits were made totaling 8.5 hours of effort. Weeding is concentrated mainly in the immediate vicinity of the rare taxa. It was noted that the weeding from the previous year was effective. However, the area surrounding the upper CyaLon.PIL-A population was inundated with *C. hirta*, so most of the weeding effort was focused on improving the habitat there. In the following year, NRS will visit the site quarterly to assess the re-growth of weeds, and continue to keep the areas around the protected plants free of weeds to eliminate competition and to encourage recruitment.

Upper Kapuna-04; Keawapilau CyaLon/PhyKaa

Upper Kapuna-03 and 04 are close enough together that weeding at the two sites is often tasked as one action. The areas immediately around the rare plants are particularly sensitive due to the presence of the rare taxa and the steep terrain of the site. NRS only weed directly around the

taxa to maintain their existing microclimates. In the rest of the WCA, there are patches of mostly native forest where more intense, understory weed control is conducted. NRS believe that species such as *C. longiflora* would benefit from creating more contiguous native habitat through the population. During the two visits this year (totaling 28 hours of effort) some removal of the *Psidium cattleianum* occurred, but within the NARS specialist's 6% limit per trip (see Upper Kapuna-01). NRS plan to revisit this site quarterly in the coming year.

Upper Kapuna-05; Kapuna fenceline

During the previous reporting year a fenceline was cleared in the Kapuna area in preparation for fence construction. No weeding occurred this year and NRS will not maintain this WCA in the future.

Upper Kapuna-06; SchObo PIL-C

This WCA was created this year to clear and maintain the site for the *Schiedea obovatum* PIL-C reintroduction. Currently the population is protected by a temporary plastic fence, but will soon be enclosed by the Subunit III fence. The site was visited twice for a total of 16.5 hours of effort. The habitat is of good quality with sparse understory weeds and only a few *P. cattleianum* within the fence, which were all treated during the two visits. NRS will return twice next year to monitor and maintain the site.

Upper Kapuna-07; 1-Acre Site

This WCA is defined by an old outplanting site within a PU fence, primarily *Cyanea superba*. The plants are healthy and are some of the largest outplanted specimens of their species anywhere. Weeding is focused within the fenced area on understory weeds. There remains a high number of understory weeds, the fern *C. parasitica* in particular, but the overstory is largely native-dominant (large *Metrosideros polymorpha*). Weeding efforts are focused on broadleaf weeds such as *R. rosifolius*. One trip was spent weeding in this WCA. In the coming year NRS plan to re-visit the site at least once to continue to treat understory weeds around the outplantings. The WCA is managed mainly for fruit production, so ecosystem scale weeding here is limited.

Upper Kapuna-08; Delsub KAP-C

This WCA was created this year to improve the habitat for the *Delissea subcordata* KAP-C wild population. The site was visited twice this year with a total of 6.5 hours of effort. The border of the WCA was established to include a newly found immature *D. subcordata*, but the plant has since been extirpated, most likely by a pig. However, the habitat that surrounded the extirpated immature plant is native dominant canopy (*Diospyros* and *Sapindus*) with scattered *Schinus terebinthifolius* in the overstory and minimal weeds in the understory. NRS will continue to weed within it to allow for future natural regeneration of this *D. subcordata* population.

Upper Kapuna-09; Delsub KAP-D

This WCA was established this year to clear and maintain the site for the *Delissea subcordata* KAP-D reintroduction. The site consists of a mix native and alien canopy with an open understory. The WCA was visited twice this year for a total of 17 hours of effort. The WCA is inside the Subunit I fence. Before the outplanting the area was thought to be pig free. However, on a monitoring visit NRS observed pig sign near the plants that was not there during the

planting. NRS, in coordination with NARS staff, did a thorough search of the subunit and did not find any recent pig sign. NARS patched the areas along the fence that could be compromised and NRS will monitor the site when returning to weed the site twice in the next year.

Upper Kapuna-10; SchObo PIL-B

This WCA was created this year to improve the habitat for the *Schiedea obovatum* PIL-B wild population. The site consists of a mix native and alien canopy with relatively open understory on steep terrain, surrounded by a dense *P. cattleianum* stand. The areas immediately around the rare plants are particularly sensitive due to the presence of other rare taxa (Cyalon.PIL-D) and the steep terrain of the site. NRS weed directly around the taxa to maintain their existing microclimates, and try to reduce the *P. cattleianum* canopy at the site within the limits set by the NARS staff (6% per trip). The site was weeded once this year with 3.75 hours of effort. NRS plan to return two times next year to maintain the habitat.

Upper Kapuna-11; Hunter Cabin LZ

This WCA was established to track effort used in helping the NARS staff re-open and maintain this LZ at the Hunter shelter along the Mokulēʻia Trail. The LZ will be used in emergencies only, but is needed as there are currently no LZs in the immediate area. The site was visited once this year with 22 hours of effort. NRS plan to return next year with NARS staff to remove some trees that were treated and are dead.

Region: *Lower Kaʻala Natural Area Reserve to Mokulēʻia Forest Reserve*

The landowner for this region is the State of Hawaii. There are four MUs designated in this region. Within the West Makaleha MU there are two small fences centered around rare plant populations. NRS has plans for two large scale fences in this region but is waiting on a MOU with the state of Hawaii before project plans can be finalized. Within these Units NRS is involved in ongoing vegetation management. Fire is a threat to Lower Ka'ala NAR as was illustrated by the Kaukonahua fire this year (see Appendix II)

Regional Ungulate Control Efforts

The Army's Natural Resource Staff worked with cooperators from the State of Hawaii Natural Area Reserve System and the U. S. Fish and Wildlife Service to conduct a feral goat hunt within the Lower Ka`ala NAR and East Makaleha. The hunt spanned from 24 October to 26 October 2006. Teams of two personnel were inserted by helicopter and camped on three different ridges starting from Dupont Trail and heading East to the Western ridge between Kamoku'iki and Kamokunui.

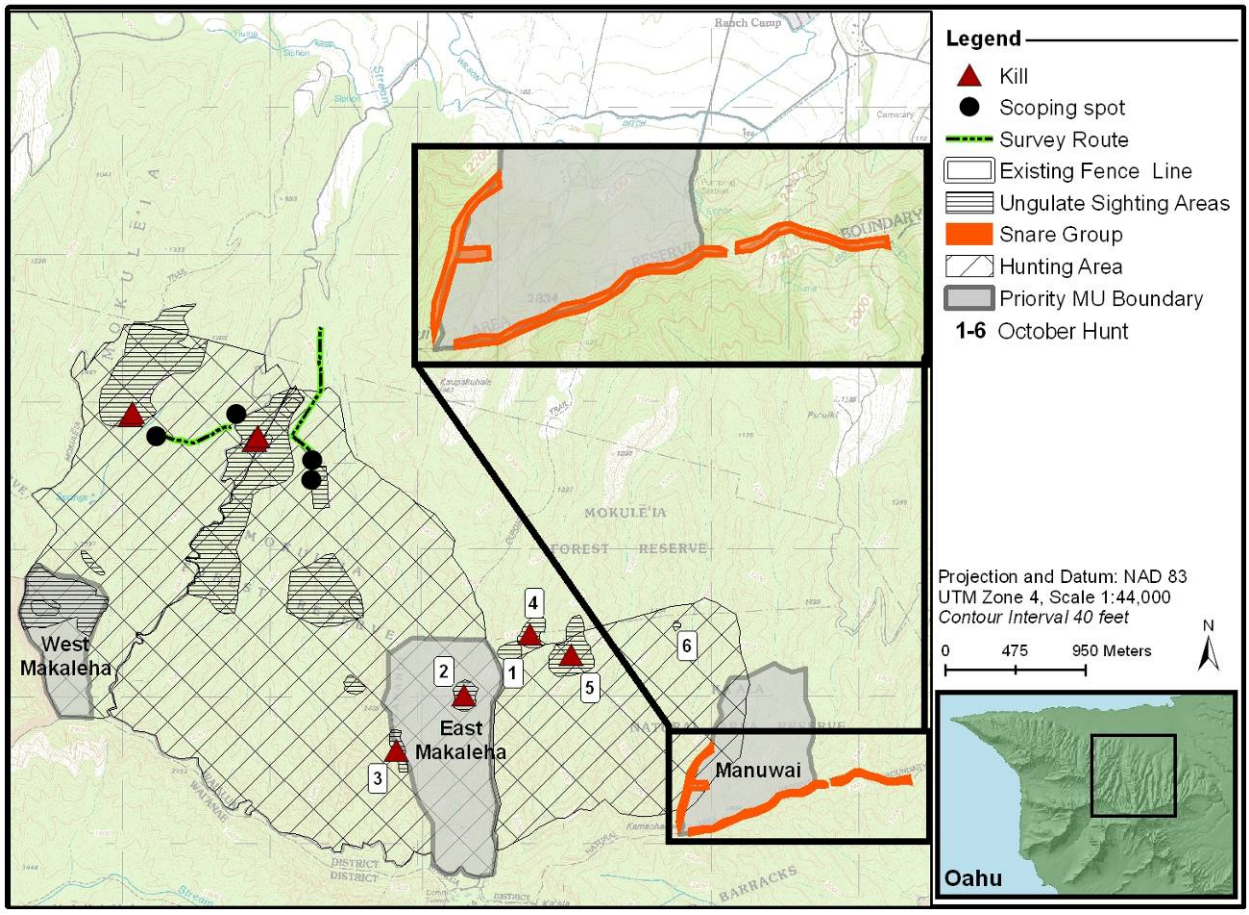

Figure 1.4.18 Goat Management Areas Across the Mokulēʻia Forest Reserve and Lower Kaʻala NAR

Table 1.4.11 Results of October 2006 Hunt

Date	Person Hours	Goats Observed	Confirmed Goats Removed	Unconfirmed Goats Removed
10/24/06	48	24	14	3
10/25/06	60	31	10	1
10/26/06	42	14	5	0

Overall the hunt was quite successful. Table 1.4.11 summarizes results of the hunt. A total of 29 goats were confirmed removed with a possible four others unconfirmed. Most of the animals are concentrated on the western boundary of the NAR and appear to travel between Makaleha and the NAR.

In order to keep the goat population at manageable numbers, future staff hunts should continue to focus efforts along the western boundary of the NAR and make the move into East and Central Makaleha. Population control efforts should also include other methods ie. aerial operations, radio telemetry, and snaring to increase success. A goat management plan needs to be drawn up with the support of all parties involved with management of ungulates in these forest reserves.

IP MU: West Makaleha

The West Makaleha MU is within Mokulēʻia Forest Reserve and borders MMR and Pahole NAR. At this time, there are two WCAs within the West Makaleha MU, West Makaleha-01 and West Makaleha-02 (Figure 1.4.19). The management actions for West Makaleha-01 revolve around maintaining the habitat for a population of *S. obovata*. The management actions for West Makaleha-02 are focused first around a population of *C. grimesiana* subsp. *obatae*. The site will also be utilized to continue habitat restoration efforts and expand outplanting sites of *C. longiflora, S. obovata,* and *Pritchardia kaalae*. Fire is a potential threat to the lower elevations of this MU. Access is coordinated with the State.

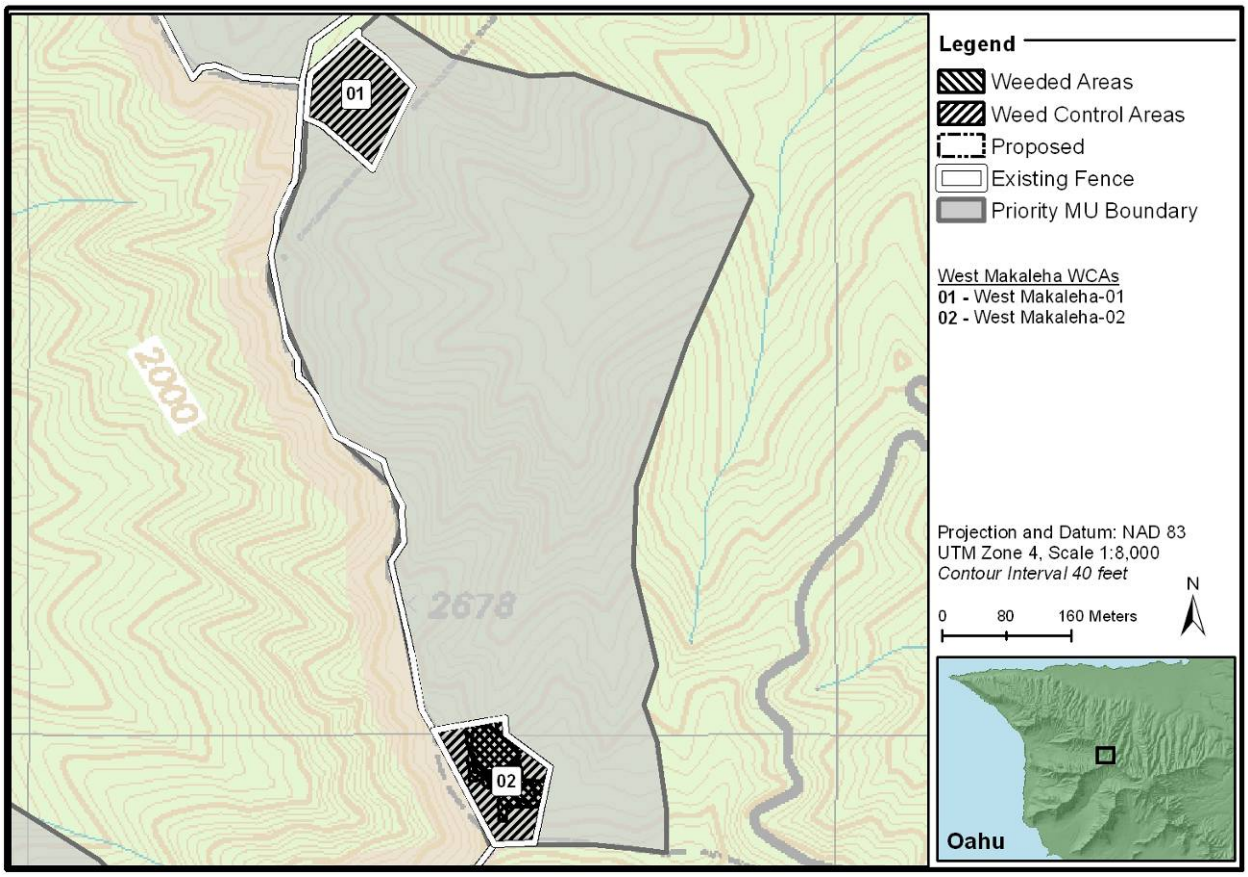

Figure 1.4.19 Ecosystem Management in West Makaleha

Ungulate Control Efforts

There are two PU fences within the MU that are both ungulate-free. Completion of the MU perimeter fence is slated for Year 4 of the MIP, pending a finalized agreement with the State. Currently, NRS and NARS staff minimizes goat damage around the MU by reducing population numbers. From September 2006 – August 2007 NRS worked closely with NARS staff to remove four feral goats from a small resident herd on the boundary ridge of the Pahole NAR (Figure 1.4.18). Close monitoring of this area will continue because the goats have been known to travel back and forth from the forest reserve to neighboring ranch land. In the past year, fewer goats have been observed with minimal NRS and NARS hunting. However, smaller herds are more difficult to track and have been known to join neighboring herds. This goat population

remains critical to eliminate as it poses a serious threat to Pahole NAR. Currently, the Upper Kapuna MU fence material that borders the West Makaleha MU is only 42" which is not tall enough to deter goats from jumping over if stressed. Taller fence materials are currently being sought.

Table 1.4.12 Summary of West Makaleha Weed Control Efforts

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
IP MU: West Makaleha						
WestMakaleha-02	Habitat	2.68	1.14	42.77%		CyaGriOba, DelSub, PriKaa, SchObo

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Grass Control	1	3.00	MelMin, PasCon
Ecosystem Weed Control	7	108.00	AgeAde, AgeRip, BudAsi, ChrPar, CliHir, LanCam, PsiCat, RubArg, RubRos, SchTer, StaDic
Totals	8	111.00	

Total IPMU: West Makaleha					
2.68	1.14	42.77%		8	111.00

WCA Discussion

West Makaleha-01; Schobo Exclosure

NRS have intentionally minimized their presence and impact in the area. Therefore, this WCA is not shown in Table 1.4.12. Management actions are scheduled with routine monitoring and collection visits because the plants grow on a steep slope, and the immediate habitat is not highly threatened by weeds. No weeding was done in 2005-2007. Follow-up weeding for past canopy removal above the slope is scheduled for next year.

West Makaleha-02; Three Points Exclosure

This WCA is defined by the fence boundary. The upper 2 acre flat area contains reintroduction sites of outplanted *C. superba*, *D. subcordata,* and *S. obovatum*. Weed control efforts focused on the grassy areas (Table 1.4.12). Herbicide spray on *Melinis minutiflora* looked promising, however; *R.argutus* is still problematic. The lower 1 acre slope area is 75% native. The current strategy in this area is to weed around and below *C. grimesiana* with hopes that seeds from fallen fruits will germinate. NRS increased weed efforts in this area focusing mostly on understory weeds including *B. appendiculatum*. NRS will monitor what regenerates from this effort.

In the next two years, NRS will conduct approximatly six visits each year to:

1) Continue weed control in a two meter radius around all rare plants.
2) Treat all mature *B. asiatica, R. argutus,* and *C. hirta* in the 3.3 acre fence area.
3) Continue 100% removal of all weeds in the 1 acre lower portion of the fence with minimal impact to native elements.
4) Continue foliar sprays of grass and other understory weeds in upper 2 acres of the fence.
5) Continue *P. cattleianum* control in upper 2 acres of fence by thinning remaining trees (no greater than 25% loss of canopy cover each year).

6) Transplant a minimum of 50 *Cibotium* sp. each year into the lower 1 acre portion for shade control of weeds.
7) Plant 250 koa saplings/acre each year into thinned *P. cattleianum* stand area in upper portion of fence (assuming 50% mortality of koa saplings planted in dibble tubes).

IP MU: East Makaleha

A 230 acre MU fence is proposed for this area but an MOU with DLNR must first be secured. In the meantime, to lessen the impacts of feral ungulates on the target species of the MU, limited hunting is underway in Central and East Makaleha and Lower Kaʻala NAR (LKN). Central Makaleha and LKN directly border on the East Makaleha MU to the West and East respectively. In the past, NARS staff and NRS have focused more effort on observing for ungulates in these areas to monitor movement and composition of the herds. As a result of this monitoring, NRS and NARS staff established proven survey routes and spots that oversee many areas where the goats frequent (Figure 1.4.18). Observations by NRS and NARS staff indicate that goat travel back and forth between these areas in fairly small discrete herds. These herds also have a tendency to spend more time down in the forest, as opposed to the more open ridge tops, which is more typical behavior.

Ungulate Control Efforts
All hunting efforts are directed by and done in cooperation with NARS staff. Since 2004, 31 goats were removed from East and the neighboring Central Makaleha gulches. NRS plan to continue working with NARS staff doing control hunts in these areas to keep populations in check. NRS has recently contacted DOFAW about the possibility of implementing alternative methods of control in this area (radio/GPS collars). The data on goat movements in these areas will help NRS plan hunt's accordingly.

IP MU: Manuwai

Spanning both the Lower Kaʻala NAR and Mokulēʻia Forest Reserve, this MU encompasses the upper elevation portion of Manuwai gulch (Figure 1.4.18). Populations of many endangered plant species are found in this MU, as well an *A. mustelina* site. Management effort thus far has focused on rare plant monitoring and ungulate control. No WCAs are yet established. While the upper section of the MU is well-forested, the lower section is patchy with the fire-carrying grass *Panicum maximum*. Below the MU boundary, Manuwai gulch is dominated by *P. maximum*. The fire threat this grass poses was realized this year when portions of the MU burned in the August 2007 fire; see Appendix II, Waialua Fire Report, for a full discussion of impacts to this MU.

Ungulate Control Efforts
A MU fence is slated for construction in Year 8 of the MIP. In the meantime, to lessen the impacts of feral ungulates on the target species of the MU, limited hunting is underway in LKN and a snare line (colored in orange) is maintained by NRS along the border with Schofield Barracks West Range (SBW). All hunting efforts are directed by and done in cooperation with NARS staff (see regional ungulate). The snares have removed a total of 74 goats total but have not caught any since September 2004. Due to recent fire events NRS believe it is necessary to

survey the area for ungulate presence once again. Since September 2005, only nine goats have been removed through hunting because NRS was waiting for an agreement with the state to continue all management actions in the NARS. Future hunts/surveys are anticipated as the agreement issues has are completed.

Region: *Schofield Barracks West and South Ranges, SBW/SBS*

This region extends from Puʻu Hāpapa, just south of Kolekole Pass, north to the major Kamaʻohanui ridgeline. The region's western boundary is the Mt. Kaʻala Summit. Currently, there is no legal pig hunting permitted within Schofield Barracks West Range (SBW) due to UXO and security issues. This restriction has allowed for proliferation of pig populations within SBW. Schofield Barracks South Range (SBS) is a GMA administered by the Provost Marshal on base.

In order to protect rare resources and specific habitats, five PU enclosures were constructed in SBW and a large-scale strategic fence was installed around the Kaʻala summit (Figure 1.4.21). There is a population of goats in Waiʻanae Valley just over the boundary line from SBW that NRS are working to address. There is one PU enclosure in SBS.

Weed issues vary dramatically across this region. The more mesic portions of the region have established forests of *Schinus terebinthifolius, Heliocarpus popayensis* and *Toona ciliata*. The wetter portions in lower Haleʻauʻau gulch are dominated by *Syzigium jambos*, *Falcataria mollucana* and *Psidium cattleianum*. Habitat conditions improve and native canopy presence increases with elevation. The summit of Mt. Kaʻala is predominately native wet forest with few canopy weeds. Weed control effort centers on rare species locations in lower elevations and intact native habitat in upper elevations along crest lines and summits.

Both SBS and SBW are threatened by fire originating from live firing training. The threat to SBS is less than in SBW due to the types of weapons used there. The Army conducts prescribed burns each year and maintains a fuel break above the impact area as a means to protect the natural resources outside.

IP MU: Kaʻala

Mt. Kaʻala is located in the northern Waiʻanae mountains above SBW, Mākaha, Makaleha, and Waiʻanae valleys (Figure 1.4.21). It is the highest point on Oʻahu at 1227 m in elevation. Natural resource management actions on the summit region of Kaʻala are shared by NRS and NARS staff. At this time, there are six WCAs designated for the MU.

For the Kaʻala MU, NRS presents a *Hedychium gardnerianum* control strategy across all WCAs. In the following WCA discussion, NRS combines the results of all the sweeps conducted throughout the WCAs this year. Figure 1.4.21 presents the WCAs and weeded areas from this reporting period. In addition, Table 1.4.15 shows the summary data for weed control efforts in Kaʻala WCAs for this reporting period. WCA-3 is not included as NRS did not conduct weed control over this year. Of note is the expansion of WCA-6 to encompass some of the Kaʻala

NAR area on the northeast side of the Mt. Ka‘ala access road. In addition, NRS presents an update on efforts to determine control mechanisms for *Sphagnum palustre*.

***Hedychium gardnerianum* Control Strategy**

In last year’s report, NRS presented a strategy for the control of this taxon at Ka‘ala. In summary, the goal for *H. gardnerianum* is to eliminate all mature plants from within the fenced MU. NRS will investigate options for knocking back the core of this taxon located in WCA-3 to reduce the seed sources immediately adjacent to the fenced area. NRS aim to re-treat WCAs on a two-year cycle because it takes just over two years for ginger plants to mature.

In order to more effectively achieve the above goals, NRS conducted an aerial survey of all WCAs within the fence and adjacent NARS and Board of Water Supply lands for mature plants. Figure 1.4.20 displays observations of ginger and other incidental weeds from this survey. These will be discussed in the *Other Survey Observations* section. Of the sites identified, the highest priority for control is the mature plant clusters furthest from the core area in WCA-3. The aerial survey approach to identifying mature plants was very effective and should be employed yearly.

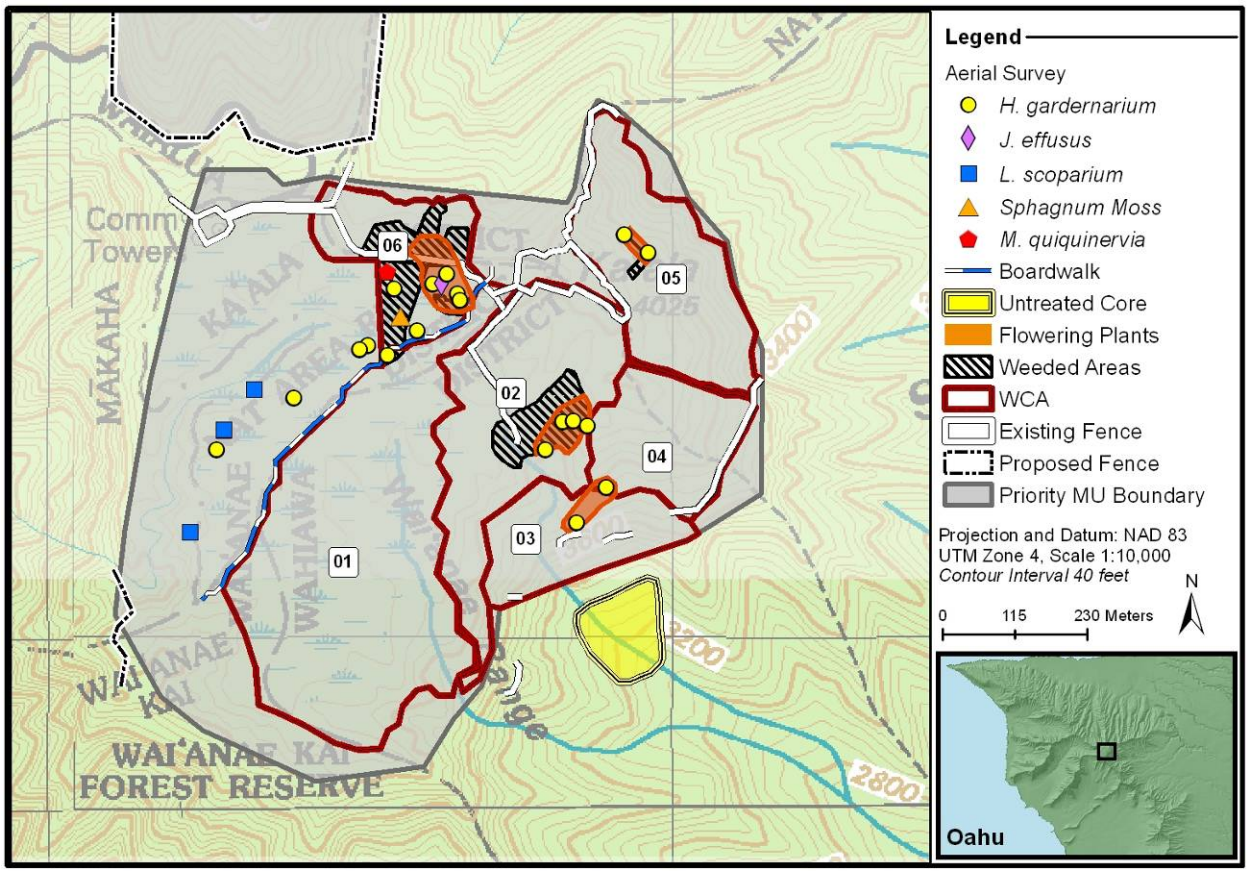

Figure 1.4.20 Aerial *Hedychium gardnerianum* Survey

Other Survey Observations

Other incipient weeds observed while conducting the aerial ginger survey are shown in Figure 1.4.20. NRS will request permission from the NARS Specialist to kill the few *Leptospermum scoparium* and the lone *Melaleuca quinquenervia* observed. NRS have establish a no tolerance policy for both of these taxa atop Ka‘ala. Control of these weeds will be discussed in the ICA section next year. In addition, this survey identified the far western location of *Juncus effusus* which revealed to NRS the true extent of this ICA. One satellite location of *Sphagnum* moss was observed from the air. NRS will follow up with NARS staff to conduct a survey of the location.

***Sphagnum palustre* Control Research**

Sphagnum palustre was introduced to Mt. Ka‘ala from the Kohala Mountains, Hawai‘i Island. It is native to the Kohala Mountains but was never native to the Wai’anae Mountains. *Sphagnum palustre* is abundant along the boardwalk corridor and along the upper reach of the Mākaha stream drainage. In addition, NRS have identified some small satellite populations. *Sphagnum palustre* is easily spread vegetatively; therefore, strict protocols must be employed to eliminate spread.

Table 1.4.13 List of Proposed Mossicides

Trade Name and Synonyms	Chemical Name and Synonyms	Proposed application rate	EPA Reg. No.
Ash Grove Kemilime; Graymont Hydrated Lime	Calcium hydroxide 97.0%	Applied as a 3% solution (see soil drench application on Coqui label)	None
Safer® Brand Moss and Algae Killer; DE-MOSS Concentrate	Potassium Salts of Fatty Acids, Ethyl alcohol, Methyl alcohol	Label specifications	42697-7
St. Gabriel Moss Killer	Clove Oil 12%, Sodium Laurly Sulfate 8%	Label specifications	None
ZeroTol	Hydrogen Dioxide: 27%	Label specifications	None

Since this taxon is impacting the native habitat atop Ka‘ala, it is a high priority to develop a control technique for it. NRS have experimented with hydrated lime as a control agent for *S. palustre*. Based on preliminary observation, the lime appears to affect good control of the moss but it is not registered by the EPA for use in this manner. In the last year, the NRS Research Specialist investigated available registered mossicides via the Hawaii Department of Agriculture (HDOA). Table 1.4.13 is a tentative list of products under consideration for control of *S. palustre* on Army lands at Mount Ka‘ala. Products listed have been tentatively approved by HDOA for inclusion in an Experimental Use Permit (EUP) application. St. Gabriel Moss Killer is currently legal to use at Mt. Ka‘ala as the product contains natural ingredients not regulated by the EPA. All other products would be illegal to use as a mossicide in the bog unless covered under a EUP. Among these, both Safer Moss Killer and ZeroTol would require a label change if used outside of a EUP. Most difficult to register would be lime. This product would require a new registration and label with the EPA. It is included in the EUP for comparison only, not

because it is likely to be approved for general application. The EUP is under preparation and when complete will be submitted to HDOA for approval.

One other subject related to *S. palustre* at Ka'ala is the planning for the reconstruction of the boardwalk. The boardwalk will be designed considering the need for future access to the moss for control. When a viable control method is available, control may be conducted in the area of the boardwalk in order to reduce inadvertent spread. The re-design of the boardwalk to an elevated design would greatly reduce the spread of *S. palustre* by hikers.

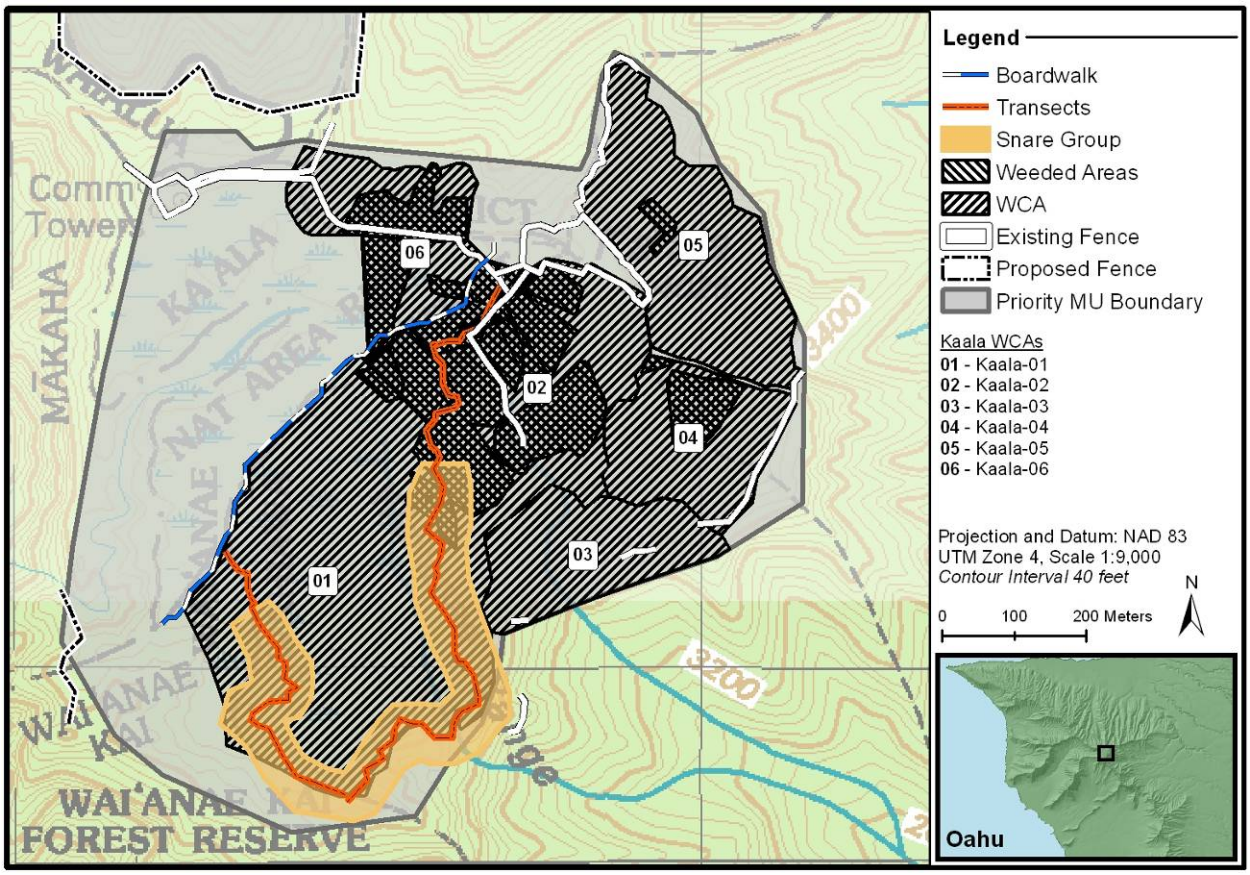

Figure 1.4.21 Ecosystem Management in Ka'ala

Objectives for Ka'ala MU

- Survey for points of ingress for pigs, construct additional fencing required to secure Ka'ala summit as pig free.
- Investigate use of telemetry studies to look at pig movement on the summit.
- Control all locations of *H. gardnerianum* where mature plants were observed during aerial survey.
- Request permission to control *L. scoparium* and *M. quinquenervia* on NARS property.
- Survey the *S. palustre* satellite location with NARS Specialist and determine a course of action.
- Conduct annual aerial surveys for mature *H. gardnerianum*.
- Research aerial control techniques for attacking the core *H. gardnerianum* site in WCA-3.
- Submit EUP application for potential *S. palustre* control products.

- Propose establishing more WCAs on the NARS side of the boardwalk to control *H. gardnerianum*.
- Complete new redesigned boardwalk.

Ungulate Discussion

With the completion of the strategic fencing on the SBW side of the summit, NRS felt that pig ingress would be eliminated. Unfortunately, there are still some pigs left within the fence. It is not entirely clear whether all of the pigs were eradicated, but NRS feel that whatever ingress there may be must be coming from other portions of the protected summit. Initially, NRS tried to use hunting as a means to eliminate the pigs from within the MU. This method has proven feasible but a lot of person hours are required to survey and run the dogs. There is also a problem with the possible increased spread of *S. palustre* throughout the summit region and the sensitivity of the area to disturbance from hunting. Because of this, NRS is looking at other methods as a way to eradicate the last of the pigs. NRS has installed snares along Transect SBW-03 where fresh sign was observed and have since caught five pigs. In the next year, NRS will install baited live traps as another means of capturing the pigs. This should limit the amount of damage that occurs while snaring and NRS would be able to us these pigs for possible telemetry studies. NRS will also run a few ground hunts if fresh sign is observed, and survey for possible pig ingress.

Transect Discussion

There is one ungulate transect at Ka‘ala which is monitored quarterly for pig sign. NRS will continue to use this monitoring as a tool to guide pig control efforts and supplemental fencing. No new weeds have been observed on Transect SBW-03.

WCA Discussion

NRS is consolidating all of the results from the weeding actions in all of the WCAs for the Ka‘ala MU. Most of the weeding consists of conducting sweeps through all of the WCAs looking for *H. gardnerianum*. *Psidium cattleianum* and *C. hirta* are patchily distributed so control of these taxa occurs in conjunction with volunteer trips usually. In the last year, NRS conducted weed control over 9.8 hectares, covering 23.5% of the 41.8 total hectares in WCAs at Ka‘ala (Table 1.4.15). NRS targeted *H. gardnerianum*, *P. cattleianum*, and *Clidemia hirta*.

Table 1.4.14 *Hedychium gardnerianum* Control Summary

Report Year	2006	2007
Mature	27	25
Immature	667	1052
Seedling	368	862
Re-treat	23	8

Table 1.4.14 summarizes the totals of the different age classes of *H. gardnerianum* controlled over the last two years. The increase in the total number of plants treated this year is directly attributed to information gained from NARS staff, the aerial surveys conducted and time spent conducting sweeps in new areas. NARS staff informed NRS about the location of some flowering mature plants on the NAR side of the summit. Upon further inspection NRS found a total of 366 plants. Of the 23 mature plants killed this year, 10 plants were identified during the

aerial reconnaissance and 13 were located within the NAR. In 2006, NRS spent 181 hours covering 7.5 ha. This year 371 hours were spent covering 9.8 ha of which roughly 3 ha had never been covered before. This increase in effort is what this project requires for success. In addition to more staff time working on *H. gardnerianum* control, NRS will engage more volunteer assistance via our expanded public outreach program.

Table 1.4.15 Summary of Ka'ala Weed Control Efforts

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	IP Taxa Present	Effort (Person Hrs)	
IP MU: Kaala							
Kaala-01	Habitat	16.84	2.09	12.40%	LabCyr, SchTri		
				Treatment Type	**# of Visits**	**Effort (Person Hrs)**	**Species Controlled**
				Ecosystem Weed Control	6	95.50	HedGar, PsiCat
				Totals	6	95.50	
Kaala-02	Habitat	9.37	4.82	51.41%	LabCyr, SchTri		
				Treatment Type	**# of Visits**	**Effort (Person Hrs)**	**Species Controlled**
				Ecosystem Weed Control	6	180.00	CliHir, CroCro, GreRob, HedGar
				Totals	6	180.00	
Kaala-04	Habitat	4.25	0.82	19.22%	CyaCal, LabCyr, SchTri		
				Treatment Type	**# of Visits**	**Effort (Person Hrs)**	**Species Controlled**
				Ecosystem Weed Control	3	32.10	BudAsi, CliHir, ElaGra, HedGar, PsiCat, RubArg
				Totals	3	32.10	
Kaala-05	Habitat	6.85	0.16	2.28%	CyaAcu, CyaCal, LabCyr, SchTri		
				Treatment Type	**# of Visits**	**Effort (Person Hrs)**	**Species Controlled**
				Ecosystem Weed Control	1	12.00	HedGar
				Totals	1	12.00	
Kaala-06	Habitat	4.44	1.93	73.70%			
				Treatment Type	**# of Visits**	**Effort (Person Hrs)**	**Species Controlled**
				Ecosystem Weed Control	2	51.25	HedGar
				Totals	2	51.25	
Total IPMU: Kaala							
		41.76	9.81	23.50%		370.85	

IP MU: South Haleauau

This MU is located in a sub-gulch on the south side of South Hale‘au‘au (Figure 1.4.23). The MU is a patchwork of mixed native to weedy mesic/wet-mesic forest. There is a large MU fence proposed for construction, however in the meantime, a small PU fence protecting *Stenogyne kanehoana* has been built.

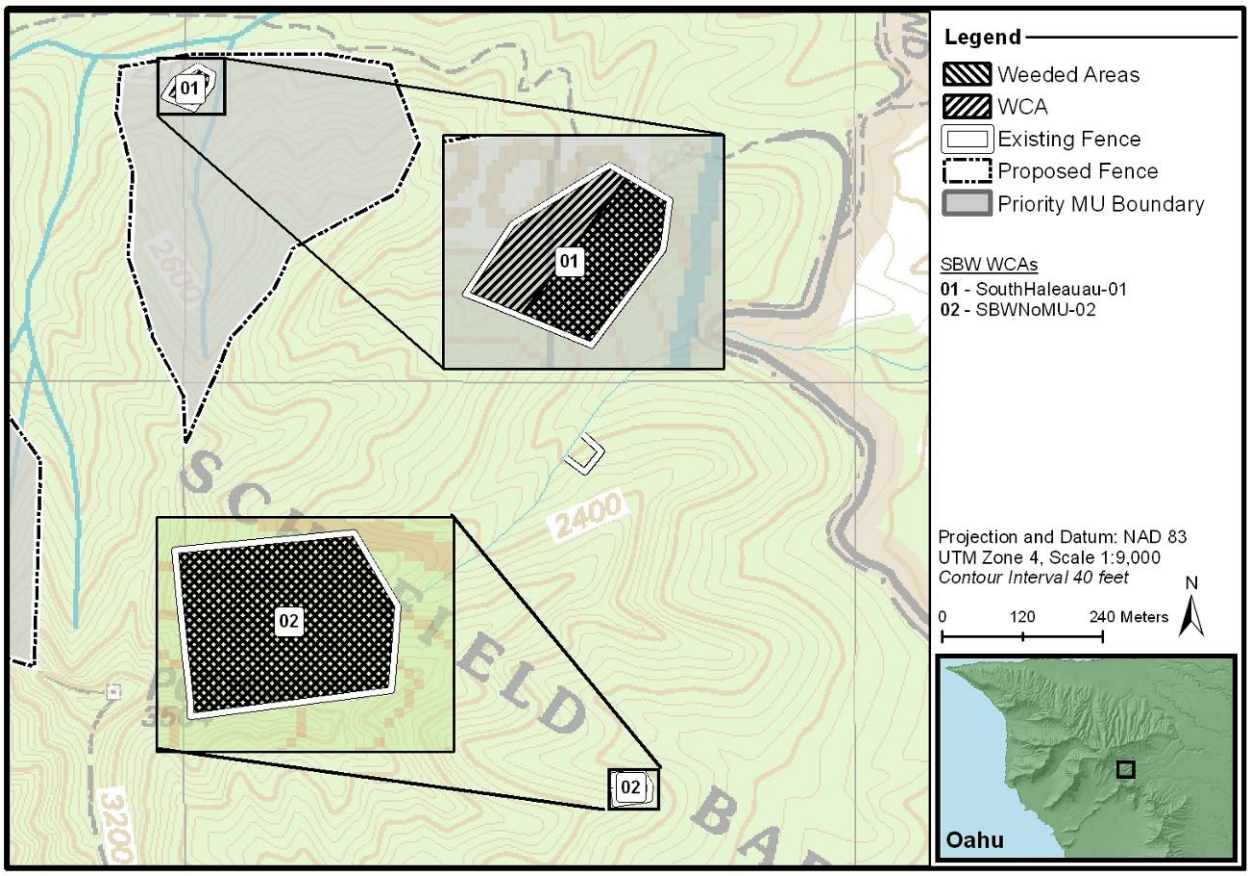

Figure 1.4.22 Weed Control Areas and Fences in SBW–South Hale‘au‘au

Ungulate Control Efforts

NRS did not conduct any ungulate control operations within this WCA during the 2006-2007 reporting year. NRS will monitor fence yearly.

WCA Discussion

South Hale‘au‘au-01; Stekan Exclosure

South Hale‘au‘au-01 is in the mid reaches on the south side of Hale‘au‘au Gulch (Figure 1.4.23). NRS tries to conduct weeding operations in this WCA one to two times a year, depending upon access. The WCA consists of a small fence surrounding a population of *S. kanehoana*. NRS visited the WCA twice this year (3 person hours) to conduct weeding operations. Three staff covered about 57% of the PU fence enclosure for both grass control and ecosystem weed control (Table 1.4.16). To date, NRS is unable to say whether the weeding is having a positive effect on

this population. The population has dwindled considerably since discovery but there may be other factors that NRS are unaware of.

Table 1.4.16 Summary of South Hale‘au‘au Weed Control Efforts

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
IP MU: South Haleauau						
SouthHaleauau-01	Habitat	0.53	0.30	56.92%		SteKan

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Grass Control	1	1.00	PasCon
Ecosystem Weed Control	1	2.00	CliHir, LanCam, PsiCat, RubArg, RubRos, TooCil
Totals	2	3.00	

Total IPMU: South Haleauau					
	0.53	0.30	56.92%	2	3.00

IP MU: SBW No MU

NRS did not conduct any ungulate control operations outside of MUs in this region during the 2006-2007 reporting year. NRS will monitor the Mohiakea fence yearly.

Table 1.4.17 Summary of SBW NoMU Weed Control Efforts

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
IP MU: SBW No MU						
SBWNoMU-02	3M	0.21	0.21	100.00%		AleMacMac, DelSub, FluNeo, PhyMol

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	1	11.00	BudAsi, CliHir, PasSub, SchTer, TreOri
Totals	1	11.00	

Total IPMU: SBW No MU					
	0.21	0.21	100.00%	1	11.00

<u>WCA Discussion</u>

<u>SBW NoMU-01; North Hale‘au‘au Garman Exclosure</u>

SBW NoMU-01 is located in the mid reaches on the south side of North Hale‘au‘au Gulch (Figure 1.4.23). NRS did not conduct any weeding operations within this WCA during the 2006-2007 reporting year. NRS will endeavor to conduct weeding operations within this PU enclosure one to two times a year, depending upon access. It is a small area and the rare plant populations contained within are all deemed ‘collect for genetic storage’.

SBW NoMU-02; Mohiākea Delsub Exclosure

SBW NoMU-02 is located in the first sub-gulch on the north side of Mohiākea Gulch (Figure 1.4.23). NRS tries to conduct weeding operations in this WCA one to two times a year, depending upon access. The WCA is a small area and the rare plant populations contained within are all deemed 'collect for genetic storage', making weed control a low priority. NRS visited the WCA once this year (11 person hours) to conduct a weeding operation (Table 1.4.17). Four staff covered the entire PU enclosure and the perimeter was cleaned up. NRS will continue status quo for upcoming year.

IP MU: Kalena – Ka'ala Ridge

Effort in this MU has centered on exploratory surveys. In the last year, substantial discoveries were made within the proposed fence unit. An endangered *Drosophila montgomeryi* fly was possibly observed (see Chapter 5.4). In addition, substantial numbers of *Achatinella mustelina* were discovered. Both observations increase the priority for management within the Kalena-Ka'ala Ridge MU. The construction of the MU fence at this site is not slated until year four of the OIP. Weed control has not been initiated within this MU. In the next year, efforts will continue to focus on rare species surveys.

Ungulate Control Efforts

While there is significant pig impact to this MU, the most critical ungulate issue is the population of feral goats just over the Kalena-Ka'ala ridge on the Waianae side. Goats observed were unafraid of humans, suggesting that the site receives very little to no hunting pressure. NRS have initiated discussions with the Division of Forestry and Wildlife staff about conducting control hunts in the area. This is the top priority action for NRS to perform over the upcoming reporting period.

IP MU: Pu'u Kūmakali'i

This MU is centered around wild and reintroduced *Tetramolopium filiforme*. NRS modified the shape of the boundary for this MU to include Navy property, see Figure 1.4.24. Initially, the wild population of *T. filiforme* had been left out of the MU because there was no signed MOU between the Army and Navy. In the last year, the MOU was signed, therefore there is now an agreement allowing Army management of rare plants in Lualualei. One WCA was designated around the *T. filiforme* reintroduction. IP taxa in this MU are primarily located on cliffs, and little weed control is needed at this time; NRS did not conduct any weed control work within the Pu'u Kūmakali'i WCA this year. NRS will work to develop a weed control plan for this MU. In the coming year, work in this MU will focus on ungulate control and limited weed control.

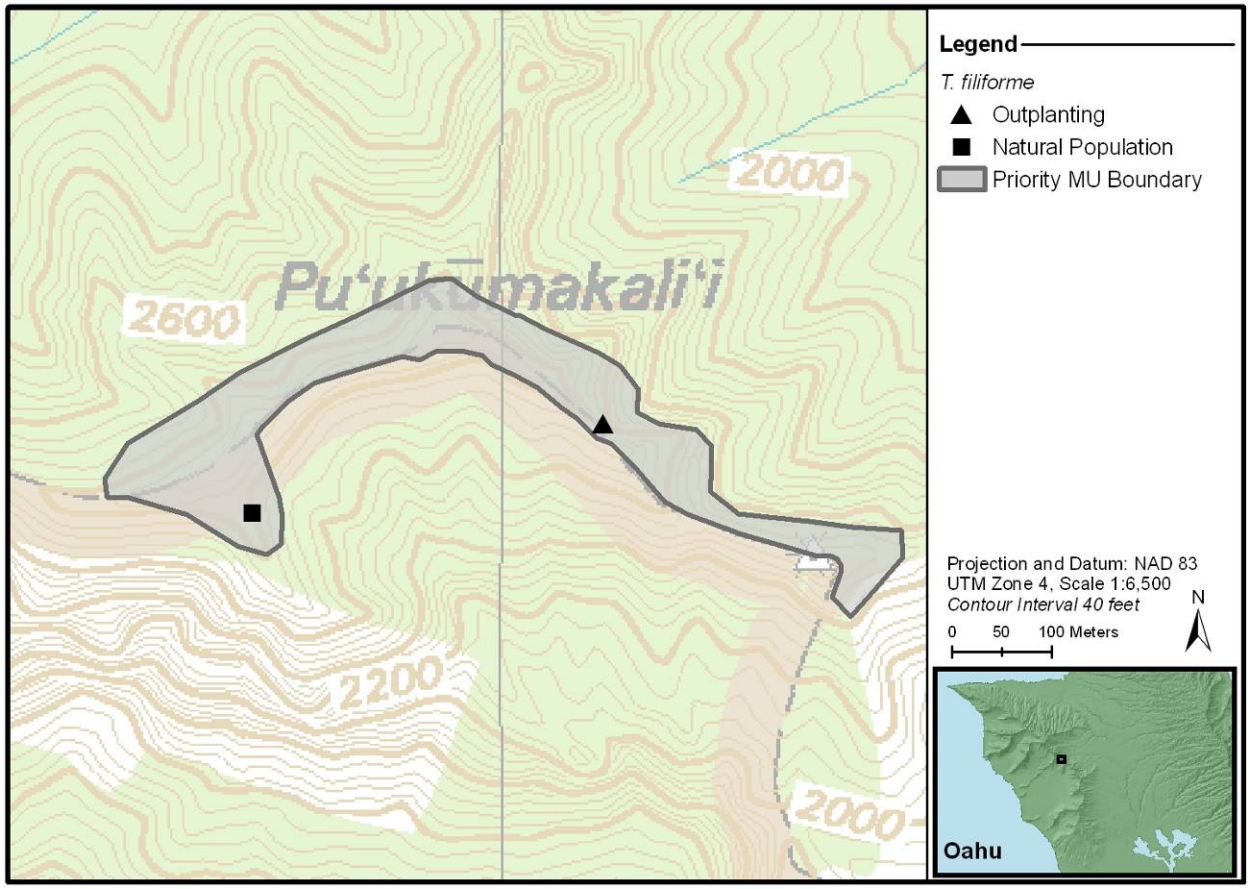

Figure 1.4.23 Weed Control Areas in Pu'u Kūmakali'i

IP MU: SBS, No MU

One of the smaller Army training ranges, SBS is difficult to access as it is heavily used for training. Much of the region is steep, and much of it is heavily degraded. Weeds dominate much of the area, but some diverse mesic components remain in small areas in SBS. No MUs have been designated in this region. Management in SBS is focused in two locations, both designated as WCAs (Figure 1.4.25). The primary weed threats to these sites are *S. terebinthifolia*, *C. hirta*, *E. karvinskianus*, and non-native grasses. Given that regular visitation isn't possible at this time due to poor access, controlling *E. karvinskianus* and weedy grasses is difficult, as both require dependable follow-up. Weed control efforts are summarized in Table 1.4.25. This year, management focused on conducting native *Drosophila* surveys.

The short-term objectives for this MU are:

1) Continue baiting grids for rat control around snail habitats.
2) Weed around rare native plants and in preferred *Drosophila* habitat

Ungulate Control Efforts

A 1.6 acre fence exclosure was constructed to protect reintroduced *Urera kaalae*, habitat of the endangered tree snail *Achatinella mustelina*, and two very rare ground snails, *Laminella*

sanguinea and *Amastra micans*. These snails have not been seen on recent surveys, and may no longer be present. The fenced area was checked and appeared to be ungulate-free.

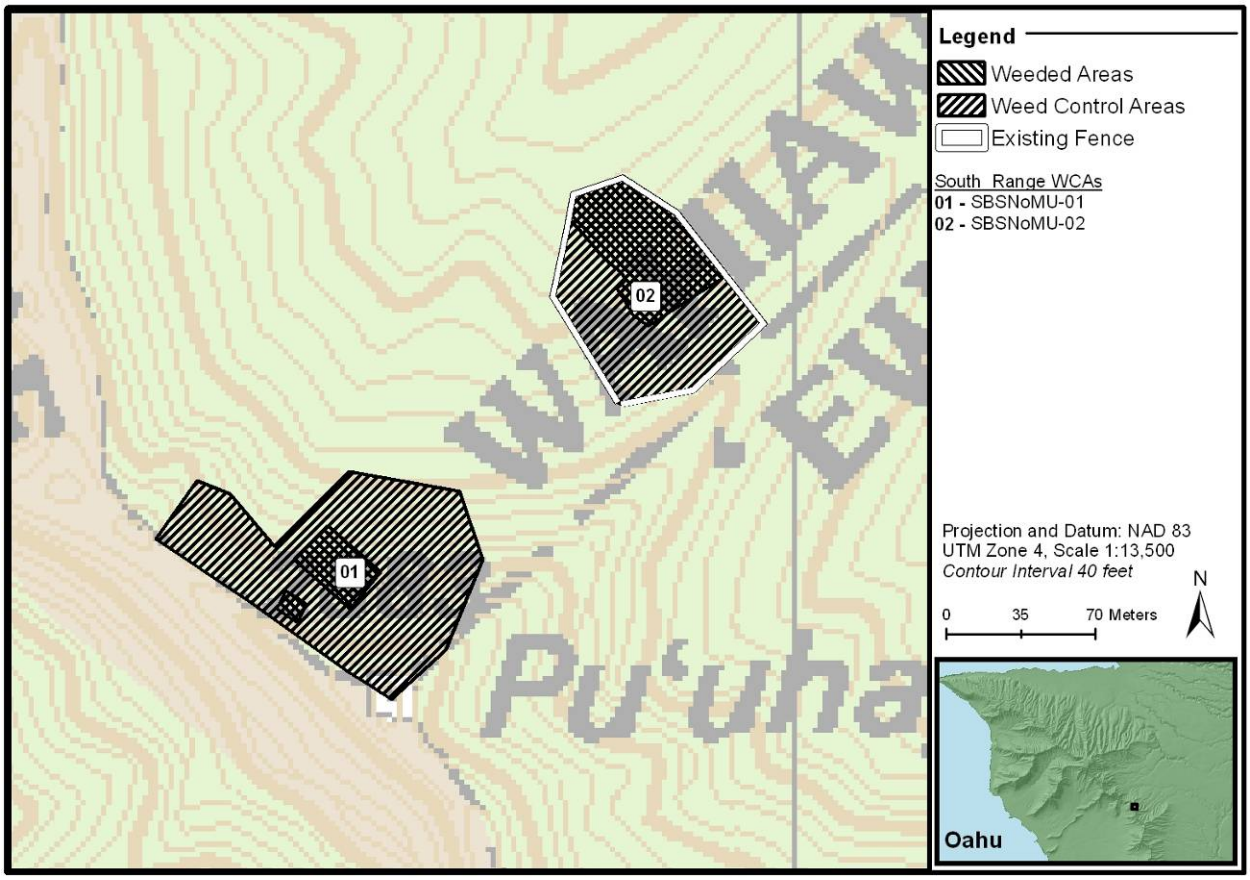

Figure 1.4.24 Ecosystem Management in SBS

WCA Discussion

SBSNoMU-01; Puu Hapapa Snail Zone

This area has a lot of Campanulacea and *Cibotium glaucum* habitat and contains good habitat for *Drosophila* species. Not much weed control has been done since the area is not fenced and pigs may invade open areas. NRS did weed canopy and understory in a small area (Table 1.4.18). NRS noted that weeding in the steep sections seems to help native recruitment but weeds came back after a year. Grass and *E. karvinskianus* need to be controlled, especially if more canopy is removed. *Toona ciliata* and *H. popayanensis* were killed near the bottom of this WCA. NRS is considering construction of strategic fencing to protect this site from pigs.

SBSNoMU-02; Moho Gulch

NRS initially managed this area for *A. micans* and *L. sanguinea*, which are no longer abundant in the area. This WCA contains a unique grouping of native plant species, including *U. kaalae*, *N. latifolium* and *Phyllostegia hirsuta*. NRS monitored this area for *Drosophila* species, but only common taxa were found. Weed control was conducted around *U. kaalae* and *U. glabra* reintroductions, as both are preferred *Dropsophila* habita (Table 1.4.25). If future surveys

reveal endangered *Drosophila* in the area, NRS will conduct more aggressive management. For now, NRS management will be minimized.

Table 1.4.18 Summary of SBS Weed Control Efforts

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
IP MU: SBS No MU						
SBSNoMU-01	Habitat	0.91	0.09	9.58%		

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	2	14.00	BudAsi, CliHir, EriKar, HelPop, LanCam, PasSub, RubRos, SchTer, TooCil
Totals	2	14.00	

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
SBSNoMU-02	Habitat	0.66	0.27	40.82%	NotLon, UreKaa	

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	1	16.00	BudAsi, CliHir, HelPop, PasSub, RubRos, SchTer
Totals	1	16.00	

Total IPMU: SBS No MU						
		1.57	0.35	22.63%	3	30.00

Region: *Honouliuli*

Honouliuli is currently owned by Campbell Estate with a conservation easement held by TNCH. However, Campbell Estate is subdividing and selling the area and the TNCH is phasing out management of the Preserve. NRS continues to be actively involved in management in the area and is also working to secure the land for future management. The region may be purchased in part with Army funds via Army Compatible Use Buffer (ACUB) funds through Trust for Public Lands (TPL) and other partners. Regardless of the land transfer, NRS is vested in the management of the resources of this region. There are four MUs where NRS conduct active management. This includes fenced MUs where NRS is involved with ongoing ungulate management. The ʻĒkahanui fence is being extended by 120 acres. A larger MU fence is being constructed at Palikea. Within these MUs, NRS is involved in ongoing vegetation management. Access to this region has become more difficult over the past year, as the agriculture fields below the preserve are fallow and for sale.

IP MU: Kaluaʻā and Waiʻeli

Within this MU are two fences, SubUnit I, a larger 107 acre fence built in 2001 by TNCH and SubUnit II, a 24 acre fence completed in 2005 by TNCH with the help of NRS. NRS and TNCH collaborate on management of these areas. There are a total of 12 WCAs in this MU, incorporating past TNCH weed control areas into current NRS WCAs (Figure 1.4.26). Weed control efforts for this year are summarized in Table 1.4.19.

The short term goals for this MU are as follows:

1) Maintain pig free fenced areas.
2) Weed two meters around rare plants and re-introduced plants.
3) Reduce large canopy alien species such as *T. ciliata* and *S. terebinthifolius* in areas surrounding re-introduction sites.
4) Survey and control all *T. ciliata* and *S. campanulata* in the central gulch with trees greater than 50 cm diameter at breast height (dbh).
5) Reduce the spread of incipient weeds such as *T. semitriloba* , *P. maximum*, *E. karvinskianus*, and *A. evecta.*
6) Possibly create field nurseries in some of these areas to reintroduce common native canopy and understory species.

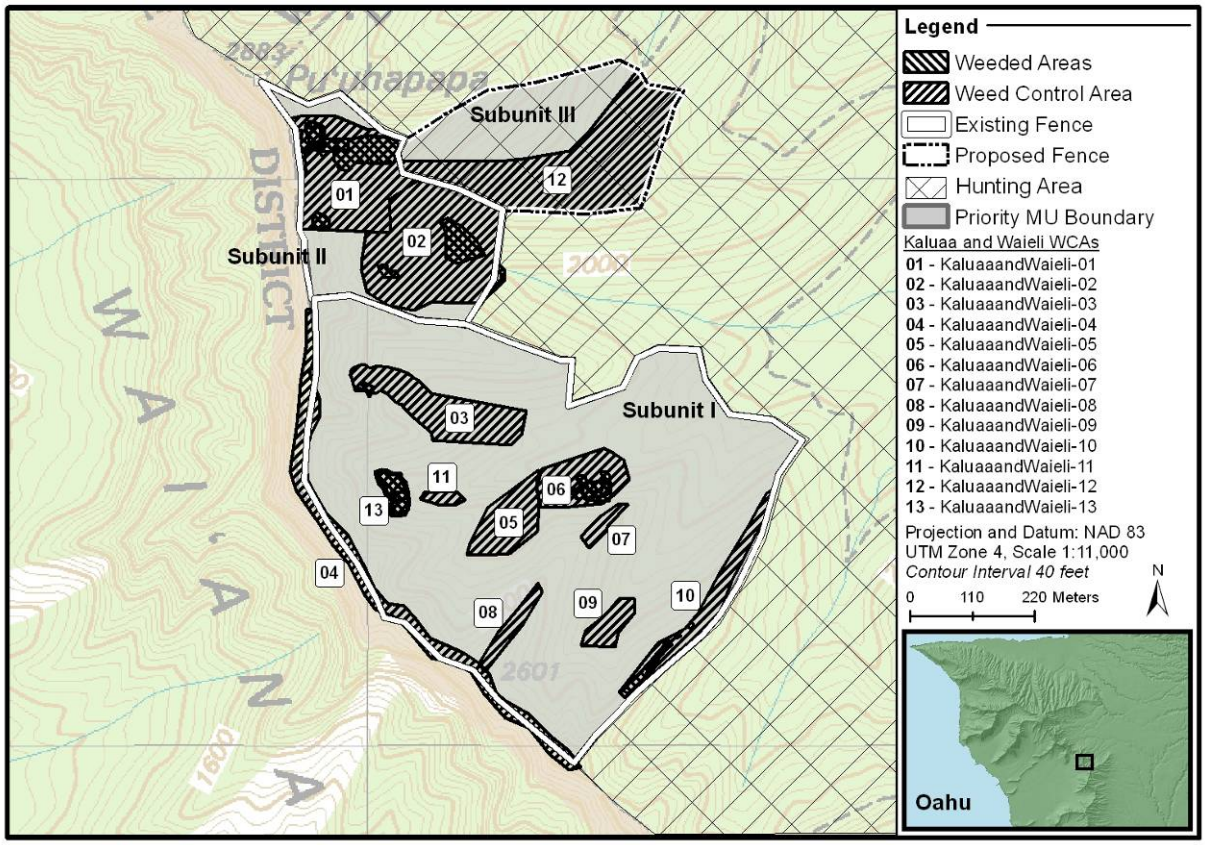

Figure 1.4.25 Ecosystem Management in Kalua‘ā and Wai‘eli MU

Ungulate Control Efforts

Subunit III (107 acre) was completely fenced by TNC in 2001 (Figure 1.4.26). In May 2004, a small PU fence was constructed around a single *Cyanea grimesiana* subsp. *obatae* along the stream bank of South Kalua‘ā gulch. Subunits II A and C were completed in December 2005 as a combined unit and are ungulate-free. Subunit II B is slated for construction for Year 10.

In October 2006, researchers working in the Kalua‘ā Subunit III fence reported seeing piglets running through the area. TNC staff did a fence check of the entire Subunit III fence and did not find any openings where ungulates might enter. As a precaution, snares were set in areas where

pigs frequent, mainly at the back of all the major gulches and along fencelines. NRS and TNC staff spent 80+ hours snaring, deploying 51 snares, and removing 11 ungulates. Fence improvements were also made to reinforce areas where the fence height may have been inadequate. On recent visits to Kalua‘ā Subunit III, no new ungulate sign or activity was observed.

Table 1.4.19 Summary of Kalua‘ā and Wai‘eli Weed Control Efforts

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
IP MU: Kaluaa and Waieli						
KaluaaandWaieli-01	Habitat	6.70	1.73	25.77%	LamSan, MelChr	AchMus, PlaPriPri

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Grass Control	1	2.00	MelMin
Ecosystem Weed Control	6	22.00	EriKar, PsiCat, SchTer, TooCil
Totals	7	24.00	

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
KaluaaandWaieli-02	Habitat	4.38	0.41	9.37%	DieFal, UreKaa	AleMacMac, SchKaa

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	2	12.50	BudAsi, CliHir, PasEdu, RubRos, SchTer, TooCil
Totals	2	12.50	

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
KaluaaandWaieli-03	Habitat	1.83	0.44	24.01%		AleMacMac

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	8	52.00	BudAsi, ChrPar, CliHir, EriKar, HypPec, LanCam, PanMax, PasCon, PasEdu, PasSub, PsiCat, RubRos, SchTer, TooCil, TriSem
Totals	8	52.00	

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
KaluaaandWaieli-06	Habitat	1.22	0.23	18.62%	UreKaa	AleMacMac, CyaGriOba, DelSub, PhyMol, SchKaa

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	2	16.00	CliHir, PasSub, PsiCat, RubRos, TooCil
Totals	2	16.00	

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
KaluaaandWaieli-10	Habitat	1.10	0.13	11.67%		CenAgrAgr, SteKan

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	4	13.00	CliHir, GreRob, LanCam, PasSub, PsiCat
Totals	4	13.00	

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
KaluaaandWaieli-13	Habitat	0.00	0.22			AleMacMac

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	2	11.00	CliHir, LanCam, PasCon, PasEdu, PsiCat, PsiGua, SchTer, TooCil
Totals	2	11.00	

Total IPMU: Kaluaa and Waieli						
	15.24	3.16	20.72%		25	128.50

WCA Discussion

Kalua‘ā and Wai‘eli-01; Hapapa bench

In the next two years, visit quarterly to:

1) Conduct follow up treatments of canopy weed trees in the 2 acre bench area as needed.
2) Continue weed control in a two meter radius around all NRS reintroductions and assist TNC with maintenance of their reintroductions as time permits.
3) Begin selective control of canopy weed trees upslope toward the crestline (avoiding weed trees populated by tree snails and targeting *S. terebinthifolius* trees that are likely to rip out the cliff side as they become too top heavy).
4) Conduct grass and other understory weed control (especially *B. asiatica*) as light levels increase across 2 acre bench area.
5) Treat all accessible *E. karvinskianus* patches within 50 m of current or planned NRS reintroduction areas. Some patches are on steep, fragile cliffs and control is not feasible without considerable effort and significant damage to cliff sides.

NRS continued large canopy control as well as *E. karvinskianus* and grass control. So far response to large canopy control has been good with no alien weed regeneration. NRS will continue to monitor what appears in the understory of these weeded areas. More *E. karvinskianus* and grass control is needed.

Kalua‘ā and Wai‘eli-02; Kalua´ā North

In the next two years, conduct quarterly visits to:

1) Treat all *T. ciliata* trees greater than 10 cm dbh and all *H. popoyanensis* and *S. campanulata* trees and saplings in the 10 acre area below and above the large cliff in the fenced area.
2) Continue weeding two meters around base of all NRS reintroductions and *A. macrococcus* trees as needed. Assist with maintenance of TNC reintroductions as time permits.

Large canopy control of *T. ciliata* was a priority. Some understory control of *Rubus rosifolia* and *C. hirta* was conducted.

Kalua‘ā and Wai‘eli-03; Kalua´ā Central Gulch

In the next two years, conduct quarterly visits to this 8 acre area to:

1) Treat all *T. ciliata* trees greater than 10 cm dbh.
2) Continue weeding two meters around base of all NRS reintroductions and *A. macrococcus* trees as needed.
3) Continue treating large, mature *S. terebinthifolius* in and near native dominated patches.
4) Continue treating aggressive understory weeds as light levels increase primarily within 50 m of reintroduction areas.
5) Continue treating incipient populations of *P. maximum, E. karvinskianus,* and *T. semitriloba* along adjacent ridgelines.
6) Assist with maintenance of TNC reintroductions as time permits.

Weeding is done in this WCA to maintain and expand outplanting sites. Lots of *P. suberosa* was removed, and without this invasive component, the area is left with high levels of native canopy. A total of 25 hours of weed control was near the outplantings. NRS has observed native regeneration of ferns *M. strigosa* and canopy *P. albidus* with removal of *S . terebinthifolius.* A total of five hours of weed control was done on the ridge above the outplantings. Grass control was conducted on *P. maximum* and *P. conjugatum.* Herbicide control was conducted on *T. semitriloba and E. karvinskianus.* There still are some *T. semitriloba* populations midslope south of the ridge under *L. camara.* The main goal was to reduce spread of these invasive species from the ridgeline.

Kalua‘ā and Wai‘eli-06; Kalua´ā Central Gulch 1A

In the next two years, conduct quarterly visits to this 3 acre area to:

1) Treat all *T. ciliata* trees greater than 10 cm dbh in and adjacent to core 3 acre area.
2) Continue weeding two meters around base of all NRS reintroductions and *A. macrococcus* trees as needed.
3) Continue treating large, mature *P. cattleianum, P. guajava* and *S. terebinthifolius* in and near core area.
4) Continue treating aggressive understory weeds primarily within 50 m of NRS reintroduction areas (especially *C. hirta*).
5) Assist with maintenance of TNC reintroductions as time permits.

The focus in this WCA was on *C. hirta* and *T. ciliata* control. More weed control is needed in this area. NRS should visit this site quarterly next year. The reintroduction site is predominately native except for regenerating *C. hirta*. Common native canopy outplanting may reduce repeated *C. hirta* seedling regeneration. The surrounding area has good native habitat mixed with an abundance of mid-sized *T. ciliata*.

Kalua‘ā and Wai‘eli-10; South Fenceline

In the next two years, conduct annual visits to this 20 m x 250 m area to:

1) Reduce *C. hirta* cover to less than 5% within 10 m of all reintroductions with minimal damage to sprawling canes of *Stenogyne kanehoana.*

2) Continue *P. cattleianum, L. camara,* and *P. suberosa* control across WCA area.
3) Treat 15 x 15 m *C. hirta* patch at old *S. kanehoana* site to release koa saplings from competition.
4) Treat *B. appendiculatum, R. rosifolius,* and *B. asiatica, M. minutiflora* in the 10 x 10 m *Phyllostegia hirsuta* patch.

This site was weeded for the *S. kanehoana* outplanting. The area is abundant with *D. linearis* and NRS hopes that *S. kanehoana* grows well in this environment. The *D. linearis* will help to keep weed regrowth at bay. NRS will monitor the outplantings and will plant more in the future if the current outplantings continue to thrive. *C. hirta* competes for space and may reduce moisture needs for *S. kanehoana*. Weed control in this area usually happens after monitoring *S. kanehoana*. While clipping *C. hirta* , NRS is careful not to smash any *D. linearis* which seems to shelter and retain moisture for *S. kanehoana*.

Kaluaʻā and Waiʻeli-13; AleMac

A total of 11 hours on 2 trips was used to weed mostly canopy and some understory alien plants around a few *A. macrococcus macrococcus.* This site may also be used as a *P. mollis* outplanting site in the future.

IP MU: ʻĒkahanui

The ʻĒkahanui MU is comprised of two subunits, I & II. There are ten WCAs around wild and reintroduced populations of rare plants throughout both subunits, and one WCA covering the recently cut Subunit II fenceline. Weed control is focused on creating and maintaining reintroduction sites and controlling weed populations near wild rare plants. The area is officially managed by TNCH, but throughout this report year NRS has assumed the majority of the management responsibilities for the MU. The MU consists of small native dominant forest patches between large alien dominant forests. Due to the dry to mesic forest types, stands of dead *Eucalyptus* and *Grevillea* in the makai areas of the MU, and the fallow agricultural fields below, the area is highly threatened by fire. A 170 acre fire occurred in 2005, which fortunately burned only five acres of forest within the TNCHH preserve boundary. In 2004, another large fire in the adjacent Puʻu Maiʻalau Gulch to the south burned to within 300 m of the fence.

Most of the WCA's are protected in the 43 acre subunit I fence. NRS are in the process of constructing the subunit II to greatly increase the area protected from feral ungulates, and to encompass all the presently managed WCA's, their corresponding rare plant and snail populations, as well as to create new reintroduction sites.

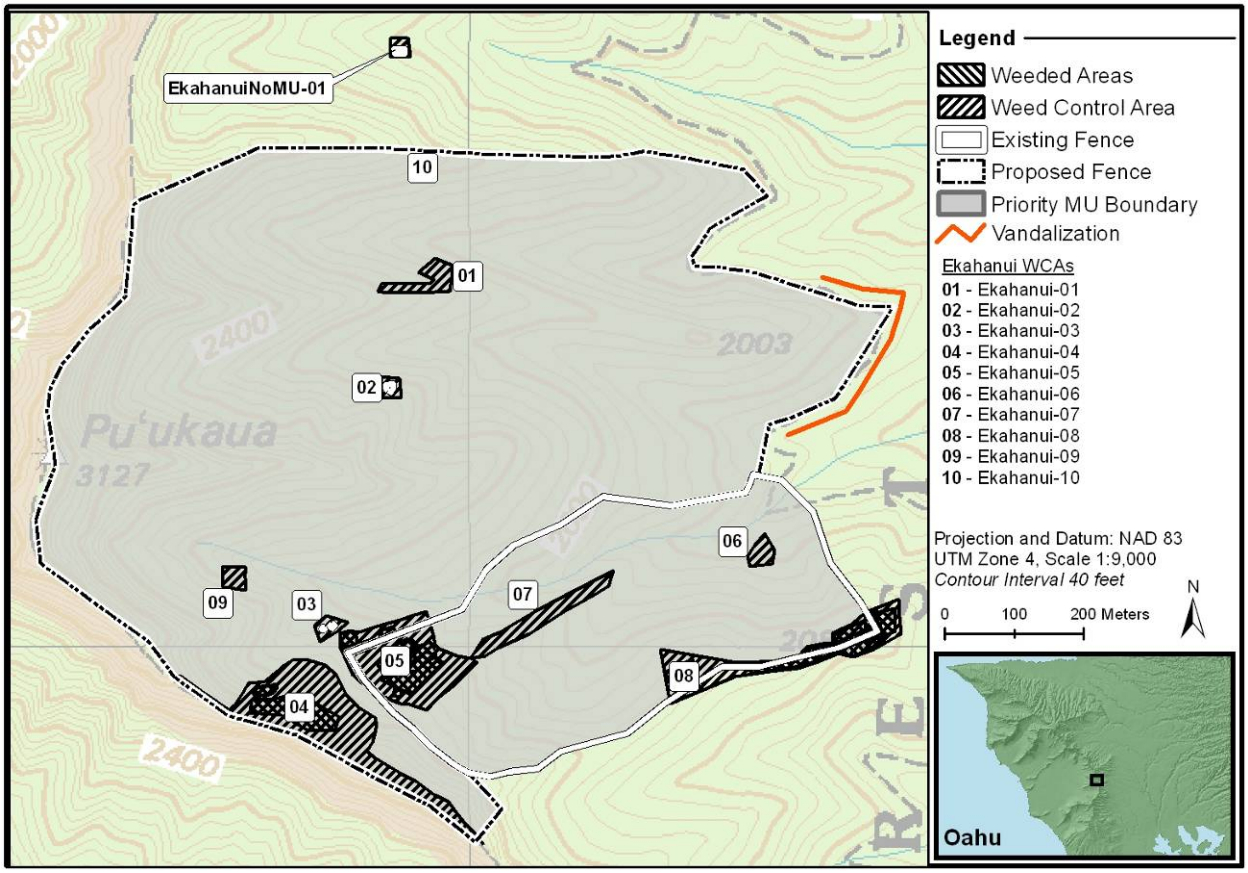

Figure 1.4.26 Ecosystem Management in ʻĒkahanui

Ungulate Control Effort

TNCH completed the Subunit I fence in 1999. Fence construction has begun on Subunit II, but vandalism has slowed its progress. Construction on the makai line will resume with livestock panels, which are harder to vandalize. This new perimeter fence will encompass about 159 acres (Figure 1.4.27), and is projected to be completed within the coming year. NRS continues to conduct fence maintenance on subunit I. In early July small breaches by immature pigs prompted NRS to conduct hunts with dogs. The piglets were found and chased out of the fence, as they were small enough to travel in and out. Later trips revealed absence of pig sign within the fence. There is some public hunting that occurs outside the fenced subunit but it is unknown how effective this is at reducing feral pig impacts on other target taxa. There is a population of goats located in the Lualualei Naval Magazine from the Puʻu Kaua area. This herd is believed to be the last population of feral goats located in the southern Waiʻanae Mountain range. NRS is currently working with the Navy on gaining permission to do a scoping/hunting trip in this area to assess the current state of the goat population at this location.

Table 1.4.20 Summary of ʻĒkahanui Weed Control Efforts

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present	Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
IP MU: Ekahanui										
Ekahanui-04	Habitat	2.17	0.42	16.01%	UreKaa	PlaPriPri, SchKaa				
							Grass Control	2	2.50	MelMin, PanMax, PasCon
							Totals	2	2.50	
Ekahanui-05	Habitat	3.17	1.02	32.23%		AleMacMac, CenAgrAgr, CyaGriOba, DelSub, SchKaa				
							Grass Control	1	1.00	MelMin, PasCon
							Ecosystem Weed Control	4	38.00	CliHir, PasEdu, PasSub, PsiCat, PsiGua, RubArg, RubRos, SchTer
							Totals	5	39.00	
Ekahanui-08	Habitat	2.49	1.43	57.55%						
							Grass Control	2	4.00	MelMin, PanMax
							Ecosystem Weed Control	1	9.00	CasEqu, PsiCat
							Totals	3	13.00	
Ekahanui-10	Fenceline Clearing	1.01	0.52	51.74%						
							Ecosystem Weed Control	2	23.00	CasEqu, CliHir, PsiCat, PsiGua, SchTer
							Totals	2	23.00	
Total IPMU: Ekahanui		8.84	3.40	38.47%				12	77.50	

WCA Discussion

ʻĒkahanui-01; Cenagragr EKA-A

The weed control objective at this WCA is to suppress weeds around the *Cenchrus agrimonioides* var. *agrimonioides* PU. The habitat around the site consists of small areas of native shrubs, underneath an alien dominant canopy, and surrounded by dense stands of *Psidium cattleianum*. No trip was deemed necessary this WCA during this year. Once the fence is completed and this WCA is protected, NRS plan to visit the site one or two times per year to weed around the *C. agrimonioides* var. *agrimonioides* and improve the habitat.

ʻĒkahanui-02; Delsub EKA-B

This WCA exists to keep understory weeds suppressed around a single *Delissea subcordata*. It covers a very small PU fence surrounded by poor quality habitat. This year it was deemed that no

weeding was needed. NRS will continue to monitor the WCA and hand weed two meters around the plant during fruit collection trips.

‘Ēkahanui-03; ‘Ēkahanui South Schkaa

No weeding effort was conducted in this WCA for this reporting year. When the entire ‘Ēkahanui MU fence is completed, this largely native site will be used for reintroductions and Weed control efforts will resume.

‘Ēkahanui -04; Upper ‘Ēkahanui

This WCA is comprised of some very steep terrain with three *Plantago princeps* var. *princeps* PUs and *Achatinella mustelina*. The majority of work is focused on grass control, particularly *M. minutiflora* and *P. maximum*. The success of the previous year’s efforts demonstrated that intensive initial investment in weeding can lead to reduced efforts in later years to maintain healthy native habitat. This year only 2.5 person hours of weeding effort were spent controlling the grass here compared to 15.5 hours the previous year. Next year, in addition to monitoring and controlling grasses, NRS plan to survey the WCA for the most intact forest patches and begin weeding selectively within them as time permits.

‘Ēkahanui -05; Reintroduction Area

This WCA is the most intensely weeded area in the entire MU. It spans a four acre area of mixed native and alien forest, and has been an important reintroduction site for many rare taxa over the years (Figure 1.4.27). Initially, a large amount of effort was spent removing *Passiflora suberosa* to establish the site as a reintroduction area. Only minor re-treatment of *Passiflora* has been needed since then. Much improvement has been seen in the reintroduction sites. During the report year, only 39.5 hours were spent weeding in this WCA, compared to 71.5 last year (see Table 1.4.20). NRS noted that most of the weeds seen within the reintroduction areas were seedlings or resprouts. Work efforts in the following year will focus on opening up corridors between reintroduction areas, creating more room for common and rare native plant regeneration as well as opening trails between reintroduction sites.

Only one sweep around the *C. agrimonioides* var. *agrimonioides* outplantings was needed this year. NRS observed increased growth of the *Cenchrus* due to the opening up the canopy through *Psidium* removal during the previous year and fruiting of the *Cenchrus* has been noted as well. Non-native grass control was also done in this area on one trip this year.

‘Ēkahanui -06; ‘Ēkahanui Palai Patch

This site is managed to promote fruit production of the *C. grimesiana* reintroduction. While there are some native canopy and fern components, NRS limit weeding effort at the site. No weed control was conducted at the site this year by NRS. TNCH staff conducted limited follow up weeding of understory weeds.

‘Ēkahanui -07; ‘Silky Oak Ridge

This site has been managed by TNCH in years past but has not seen management by NRS. However, the site has great potential for volunteer weeding trips and Koa reintroduction.

‘Ēkahanui -08; ‘Ēkahanui South Fenceline

This WCA was created to help reduce fuel loads close to the exclosure. This is one of the few places where *P. maximum* is found on the fenceline (Figure 1.4.27). With the exception of ‘Elepaio, there are no rare and few common native taxa in this WCA. The WCA was visited twice this year for a total of 13 person hours (Table 1.4.20). This year the grass was relatively under control within minimal resprouting within the sprayed patches. The majority of effort spent this year was towards opening up the camp DZ along the south fenceline and creating a new emergency LZ makai of the camp. Ironically, the LZ is now almost completed engulfed with Koa seedlings that came up after the clearing. NRS will visit this site twice in the coming year to monitor and control *P. maximum*.

‘Ēkahanui -09; AleMac EKA-D site north outside fence

This WCA was created in the previous report year. The area has a native dominant canopy with a few *A. mustelina*, as well as an *Alectryon macrococcus* var. *macrococcus* PU near by. These resources encouraged NRS to weed in the area, taking out small non-native canopy trees and understory weeds. Unfortunately NRS did not return to the WCA this year. However, NRS plan to visit the site next year to monitor and continue to improve the native habitat.

‘Ēkahanui 10; ‘Ēkahanui Fenceline Clearing

This WCA is made up of the fence line cleared in preparation for the construction of the subunit II (Figure 1.4.27). Fence line clearing is now complete after 23 hours of effort (Table 1.4.20). Unfortunately construction of the fence has been delayed by vandalism. NRS will monitor for regrowth of weeds and will assess whether or not additional treatment is necessary.

‘Ēkahanui -NoMU-01; DelSub EKA-A

This WCA exists to keep understory weeds suppressed around a *D. subcordata* population (Figure 1.4.27). It covers a very small PU fence surrounded by poor quality habitat. Although this area was received a fair amount of effort in the past, no weeding was deemed necessary in the past year. However, NRS plan to visit the site next year to monitor and weed if necessary.

IP MU: Puali‘i Portion of Palikea MU

The Puali‘i portion of the Palikea MU is comprised of three WCAs around wild and reintroduced populations of rare plants (see Figure 1.4.28). The area is managed by TNCH but during the coming year NRS will assume management responsibilities for the MU. NRS plans to reintroduce *Phyllostegia mollis x Phyllostegia parviflora* var. *lydgatei* in a site near the original population, which may establish a new WCA at that site (see chapter 2.2.12 for discussion). Weeding efforts will be focused on improving the habitat for this reintroduction. The area is threatened by fire due to large amounts of light and heavy fuel types east of the area and in the fallow agricultural fields below. However, no fires in recent years have threatened the MU. TNCH completed a fence encompassing all the presently managed WCA’s and their corresponding rare plant populations in November 2006.

The WCAs discussed below were created by TNCH staff to create and maintain sites for restoration of rare plants that occur or formerly occurred in the Honouliuli preserve. While several of these reintroductions are either MIP or OIP species, NRS will not be actively managing them. They often are of mixed plantings and not designated as Manage for Stability

(MFS) or Genetic Storage (GS) populations. However they are of interest and value to NRS as examples of areas that may or may not have worked for reintroductions due to site selection, microclimate, etc. For example, at one of the *Delissea subcordata* sites, two seedlings were found within a year of the establishment of the outplanting.

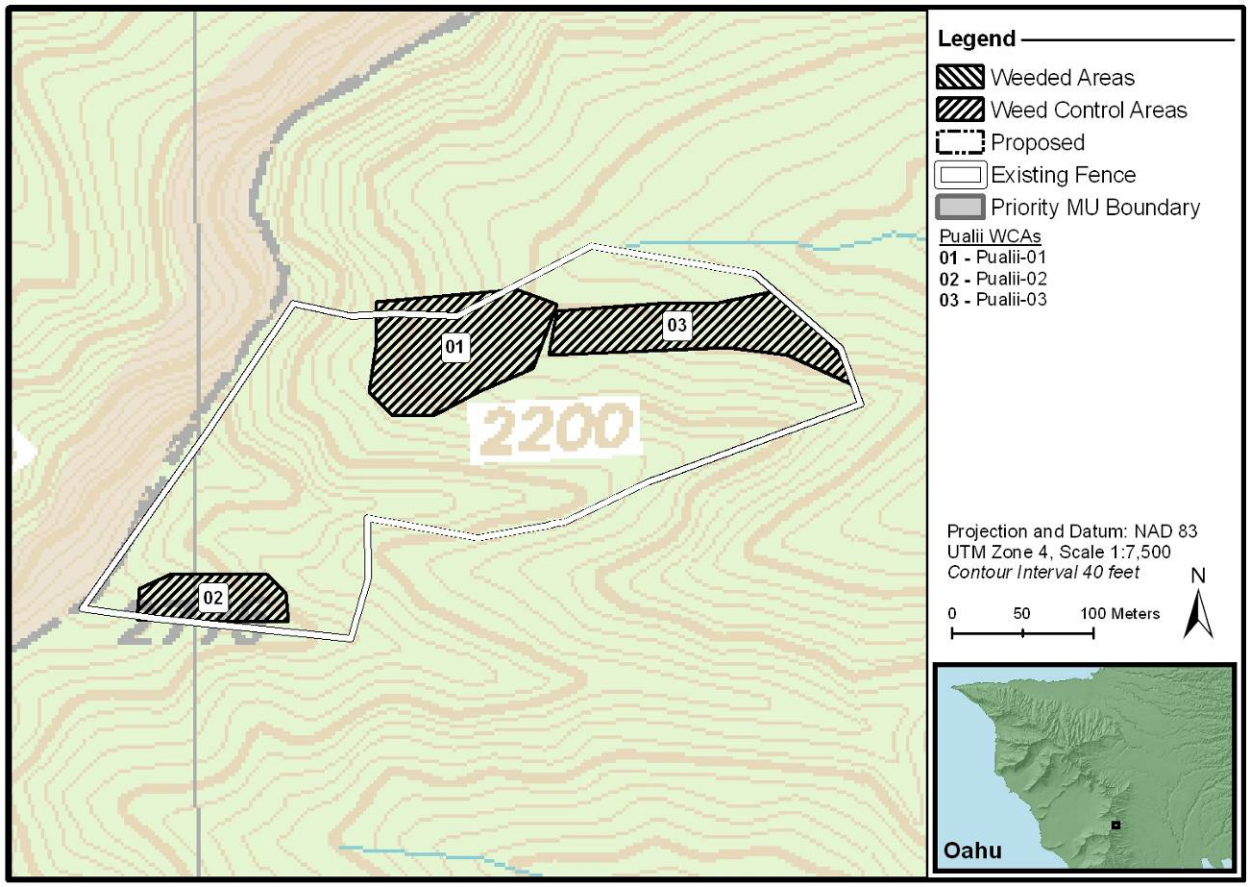

Figure 1.4.27 Ecosystem Management in Puali‘i

Ungulate Control Efforts

Since the completion of the fence by TNCH staff in November 2006, no pig sign has occurred in fenced area. NRS will monitor and maintain the fence as needed in the following year.

WCA Discussion

Puali‘i-01 Central Reintroduction Site

Puali‘i-01 contains a native dominated forest patch consisting of a *Pouteria sandwicensis* stand. This stand is near rare plant populations of *Diellia falcata, Urera kaalae*, and *Sicyos lanceoloidea*. The stand served as a reintroduction site for *Delissea subcordata*, *Urera kaalae,* and *S. lanceoloidea*, which were outplanted by TNCH staff last year. There was no weeding effort in this WCA by the NRS staff for this reporting year. However, TNCH staff weeded the area once this year.

Puali‘i-02 South Reintroduction Site

Puali‘i-02 is a native dominated area consisting of a *Metrosideros polymorpha* canopy. This area also served as a reintroduction site by TNCH for *Delissea subcordata*, *Gardenia brighamii*, and *P. mollis* last year. There was no weeding effort in this WCA by the NRS staff for this reporting year. However, TNCH staff weeded the area once this year.

Puali‘i-03 *Sapindus oahuensis* Reintroduction Site

Puali‘i-03 contains a native dominant forest of *Sapindus oahuensis*. The forest served as a reintroduction site for TNCH staff last year, where *Abutilon sandwicensis* and *Gardenia brighamii* were planted. There was no weeding effort in this WCA by the NRS staff for this reporting year. However, TNCH staff has weeded the area once this year.

IP MU: Palikea

The Palikea MU is on the southern end of the Wai‘anae Mountains (Figure 1.4.29). In the last year, NRS has collaborated with TNCH staff on weed control in this area. The area contains both relatively intact areas and completely alien dominated areas. *Schinus terebinthifolius* is particularly dominant in the areas below the MU. *Ehrharta stipoides* and *Morella faya* are also prevalent on the primary access route to part of this area. As far as NRS knows, this is the only area where these species are widespread on O‘ahu. NRS is careful to clean gear after visiting this MU.

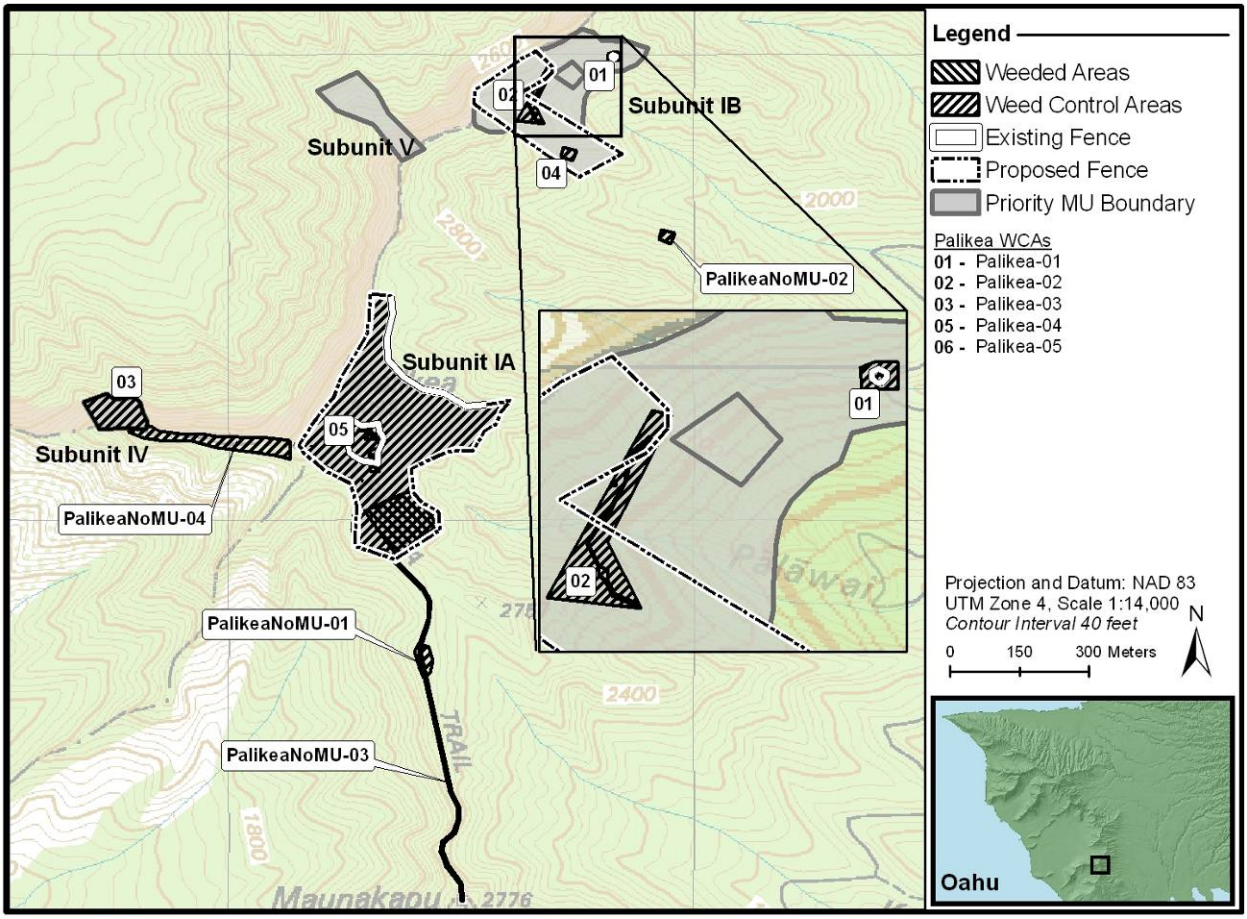

Figure 1.4.28 Weed Control and Ungulate Management Areas in Palikea

A small PU fence has been completed around a population of *Cyanea grimesiana* subsp. *obatae* within Subunit IA. Several PU fences were built in Pālāwai gulch during 2003 and 2004 to protect *Hesperomannia arbuscula* and *D. subcordata*. Subunit IA (21 acres) is almost complete, with about 1200 m left to build; the fence should be completed by November 2007. Once this MU subunit fence is completed, NRS will compose a weed control plan for it. Subunit IB (11 acres) is slated for construction in Year 5 of the MIP. At this time, the EA is completed for the proposed fence but route has yet to be determined (Figure 1.4.29).

Ungulate Control Efforts

No ungulate control efforts were conducted this year other than constructing Subunit IA fence.

Table 1.4.21 Weed Control Effort in Palikea

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present		
IP MU: Palikea								
Palikea-01	Habitat	0.04	0.01	16.03%		HesArbu		
					Treatment Type	**# of Visits**	**Effort (Person Hrs)**	**Species Controlled**
					Ecosystem Weed Control	1	1.00	PsiCat, SchTer
					Totals	1	1.00	
Palikea-02	Trail	0.56	0.05	8.61%		HesArbu		
					Treatment Type	**# of Visits**	**Effort (Person Hrs)**	**Species Controlled**
					Grass Control	1	2.00	EhrSti, MelMin
					Ecosystem Weed Control	2	0.60	MyrFay
					Totals	3	2.60	
Palikea-05	Habitat	9.95	1.30	13.04%		CyaGriOba		
					Treatment Type	**# of Visits**	**Effort (Person Hrs)**	**Species Controlled**
					Ecosystem Weed Control	4	24.50	CasEqu, CliHir, MyrFay, PsiCat, PsiGua, RubRos, SetPal, SphCoo
					Totals	4	24.50	
PalikeaNoMU-03	Trail	1.17	1.17	100.00%				
					Treatment Type	**# of Visits**	**Effort (Person Hrs)**	**Species Controlled**
					Grass Control	3	15.50	EhrSti, SetPal
					Ecosystem Weed Control	1	0.10	CasEqu
					Totals	4	15.60	
Total IPMU: Palikea		11.71	2.52	21.51%		12	43.70	

WCA Discussion

Palikea-01; Hesarb fence

Palikea-01 is located in the upper reaches of Pālāwai Gulch (Figure 1.4.29). This WCA is centered on a wild population of *H. arbuscula* and is relatively free of alien species from past years of weeding. NRS conducted one weeding trip (one person hour) in the WCA this year. Two staff covered about 16 % of the WCA (Table 1.4.21). Effort was focused in the understory eradicating weed re-sprouts and seedlings. NRS believed that weeding in this WCA would encourage *H. arbuscula* regeneration. So far, this hasn't been the case but there seem to be other factors in play here that NRS does not understand.

Palikea-02; Pālāwai Hesarb unfenced

Palikea-02 is the trail to and the area immediately outside of Palikea-01 (Figure 1.4.29). NRS conducted two weeding trips (2.6 person hours) to the WCA this year. One staff member covered about 9% of WCA spraying *E. stipoides* and M. *minutiflora* along the trail to Palikea-01 (Table 1.4.21). NRS regularly conduct spray operations as an effort to stem the spread of *E. stipoides* to the exclosure and the possible spread to areas outside of Palikea. The sprayed area is a very small percentage of the entire WCA but the point was to focus interest on *E. stipoides*. So far, it appears that the spraying is working and the population has been severely reduced. Staff also spent some time killing a couple of large *M. faya* trees.

Palikea-03; Hedpar Hālona

This WCA surrounds a wild population of *Hedyotis parvula*, located mostly on the State owned cliff face. While there are both native canopy and understory components, much of the area is dominated by *M. faya* and *S. terebinthifolius*. Weeding effort in this area is focused on reducing competition from surrounding understory weeds, *M. minutiflora* in particular. The area is steep and difficult to navigate with a backpack sprayer. NRS plan to return to this site in the coming reporting year to assess the need for further weeding and investigate options for using ropes to access areas. NRS will also investigate clearing a drop zone that could be used to fly in a small power sprayer. This would allow NRS to use the 100 ft hose connected to the sprayer to access treatment areas without having to maneuver with a backpack sprayer while on rappel.

Palikea-05; Palikea CyaGri Fence

Palikea-05 is a small PU fence located with Subunit IA that is constructed around a population of *Cyanea grimesiana* (Figure 1.4.29). Many of the canopy weeds have been removed in this area so that most of the focus now is on understory species. This understory is predominantly native and seems to have responded favorably to all of the weed eradication. NRS conducted four weeding operations (24.5 person hours) in the WCA this year. Thirteen staff covered about 13% of the WCA (Table 1.4.21). Overall this is a small percentage of the WCA but most of the weeding effort was conducted around the population of *C. grimesiana*. Efforts included scoping and hand-pulling *S. cooperi* and ecosystem wide weed control. Once the larger MU fence is constructed, NRS will spend more time in the WCA conducting ecosystem-wide weeding operations and investigating the need to enlarge the WCA boundaries or increasing the amount of WCAs within the MU. To date, NRS has overlapped weeding efforts with the quarterly restocking of rodent baiting grids around *Achatinella mustelina* populations.

Palikea NoMU-01; Palikea Meadow site

Palikea NoMU-01 is located on the ridge trail from Mauna Kapu to Pu‘u Palikea (Figure 1.4.29). It is the location of a NRS did not conduct any weeding operations within this WCA during the 2006-2007 reporting year but will do so if needed.

Palikea NoMu-02; Pālāwai Delsub Pal-C

Palikea NoMU-02 is located in the mid reaches of Pālāwai Gulch. The MU consists of a small PU fence around *D. subcordata* that is designated as ‘Manage for Genetic Storage’. NRS did not conduct any weeding operations within this WCA during the 2006-2007 reporting year but will do so if needed.

Palikea NoMu-03; Palikea trail Ehrsti

Palikea NoMu-03 consists of the trail from Mauna Kapu to Palikea-05 (Figure 1.4.29). NRS made three weeding trips (15.6 person hours) and one scoping trip to the WCA this year. Four staff covered 100% of the WCA, spraying *E. stipoides* and *Setaria palmifolia* on the trail out to the Palikea MU (Table 1.4.21). NRS initially started spraying *E. stipoides* as a way to stem its spread throughout Palikea and other areas that NRS work. Prior to this, NRS would find seeds clinging to clothing and inside the vehicles after visits. The treatment has been effective so far for *E. stipoides* but there is still some re-growth and seedlings coming in. *Setaria palmifolia* is a newer weed found inside the WCA. NRS will take the same approach with this weed as it appears to be quite widespread in the area as well. With the completion of the new MU fence, NRS will have more of a presence in the WCA and be able to expand the treatment area for both *E. stipoides* and *S. palmifolia*.

PalikeaNoMU-04; Hālona Ridgeline

This ridgeline WCA spans the area from a LZ along the proposed Subunit IA fence to the Palikea-03 WCA (Figure 1.4.29). The area is alien-dominated, therefore ecosystem scale control is not done at this WCA. However, there are a few non-native species in the area that NRS believes would significantly threaten the rare plant populations in the surrounding area if allowed to spread unchecked. These species include *G. robusta, P. cattleianum, M. faya*, *E. karvinskianus*, *M. minutiflora*, *Sphaeropteris cooperi,* and *Melaleuca quinquenervia.* NRS controlled these species in the 2005-2006 and did not work in the WCA this year. NRS will revisit the WCA in the coming year and follow up with the weed control performed two years ago. Visitation of this WCA on a two year cycle should be adequate.

Region: *Kahuku Training Area, KTA*

The Kahuku Training Area (KTA) is owned by the Army and contains six MUs in which the primary focus is six populations of *Eugenia koolauensis* (Figure 1.4.30). The MU fences at Kaunala, ‘Ō‘io, and Pahipahi‘ālua were completed by NRS during the summer of 2006.

Fire is a serious potential threat at most of the MUs in KTA. In 2003, a fire burned down from the ridge above the Pahipahi‘ālua WCA, traveling through duff in the *Casuarina equisetifolia* which dominate the ridge top near the fenceline. In 2004, NRS contracted tree trimmers to remove most of the *C. equisetifolia* in Pahipahi‘ālua and ‘Ō‘io. NRS also removed a large stand of the *C. equisetifolia* in Kaunala. To date, the majority of these ironwoods have been removed.

NRS will continue removing the remainder of these trees and bucking up slash left by the contractors. In the coming year NRS will begin to cut back *C. equisetifolia* from the fencelines, as well as retreat any regrowth of cut *C. equisetifolia* within the fences.

Weed control in KTA has been a constant battle as the area has a host of weed problems. *Eugenia koolauensis* habitat is predominantly *Psidium cattleianum* canopy. Initially, most of the invasive *P. cattleianum* canopy was removed from the *E. koolauensis* habitat in an effort to reduce competition for resources. However, this created light gaps that enabled the increased establishment of aggressive understory weeds that now out compete native seedlings. Weeding efforts are now primarily focused on understory weeds and limited canopy removal around *E. koolauensis*.

In order to assist in mitigating the weed issues in KTA, NRS plan to use common natives to fill in light gaps and act as natural competitors to weed domination. This year, working with PhD candidate Naomi Arcand, NRS transplanted *Cibotium glaucum* into all three fences as an experimental reintroduction. NRS are interested to see if native fern canopy will help to reduce weeding effort needed in this area. Initially the *C. glaucum* flourished, but later were hit hard by drought conditions during the summer of 2007. Future reintroductions may need more frequent site visits, accompanied by hand watering.

NRS made an effort to collect *Acacia koa* seeds this year in Kahuku to outplant during the rainy season but the *A. koa* did not appear to have a substantial seed set. In the coming year, NRS will collect *A. koa* seeds as well as other common natives from the area to outplant in the fenced PUs.

One possibility that may assist in common native plant propagation is the establishment of field nurseries. The benefits of using onsite field nurseries to grow common native species include minimizing risk of non-native pest introduction to wild rare plant populations, eliminating transport issues, and using plants that are already suited to outplanting conditions. Water catchments set up with automated irrigation would be installed so that maintenance of the nursery is minimized. Once the common natives have reached sufficient height they can be outplanted into the nearby areas.

In the past couple of years, *E. koolauensis* has been heavily impacted by the ‘Ōhia rust, *Puccinia psidii.* As the driving force for management in these areas is for the *E. koolauensis* stabilization, and the fate of the populations is in question due to the impacts of *P. psidii*, NRS is struggling with what management action should be undertaken in the next year (See the Rare Plant Chapter). Many person hours of weed control could be spent attempting to stabilize the *E. koolauensis*, however if they are ultimately extirpated by *P.psidii* then the effort will be wasted. This decision should be considered carefully because person hours spent in these areas could be time used working in more pristine areas where a little weed control goes a long way. In considering these factors NRS propose the following plan for the KTA MUs over the next year.

1) NRS will strive to increase volunteer involvement in managing these areas. A goal of two trips to each fence per year will be set (with three fence units, a total of six trips). In this way, NRS can maintain management presence with minimal personnel effort. This is also an excellent place for volunteer groups as it has easy access and relatively gentle terrain.

2) NRS will work with volunteers to translocate *A. koa* seedlings into fenced units to continue area rehabilitation.
3) NRS will focus staff efforts on monitoring *E. koolauensis* to determine the impacts of the rust and adapting management appropriately (see Rare Plant section for details).
4) NRS will continue to work with the *C. glaucum* reintroduction project to maintain the translocation and document results that can be applied to future *C. glaucum* projects.

Presently there are no ungulate control actions occurring in this region aside from maintaining the MU fences discussed below.

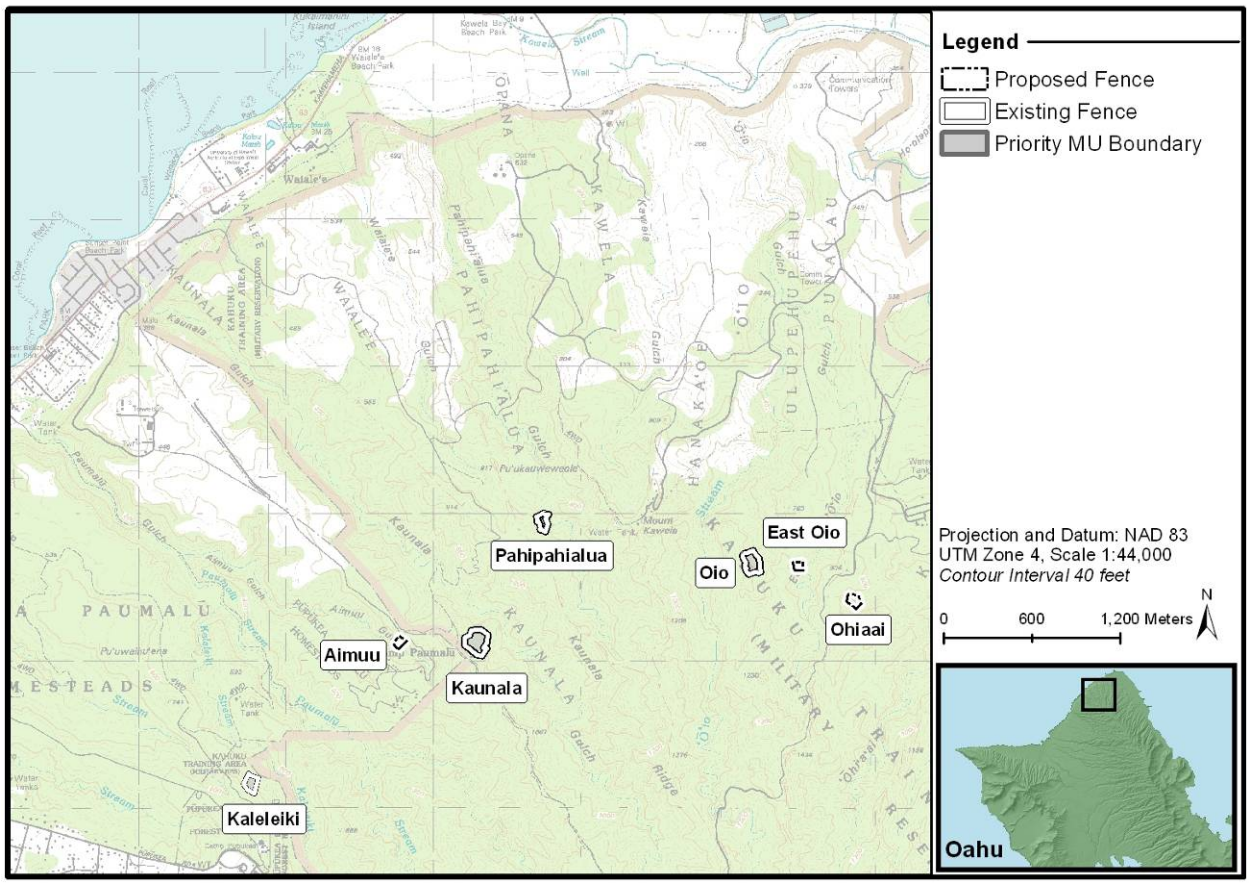

Table 1.4.29 Kahuku Training Area MUs

IP MU: East of ʻŌʻio

There is one WCA in this MU encompassing a small population of *E. koolauensis* (Figure 1.4.30). Since this population is not designated MFS, weed control efforts here are currently minimal and no ungulate control is conducted.

WCA Discussion

East ʻŌʻio-01; EugKoo KTA-D East ʻŌʻio

Due to the dominance of *P. cattleianum* at this site and the low numbers of *E. koolauensis*, weeding at this WCA is limited. The goal of weed control here is to make the area immediately around the plants more hospitable to *E. koolauensis* recruitment. This area was not weeded last year. NRS will follow the plan outlined in the regional discussion. As this WCA is outside of a fenced unit and not MFS, it will be low priority for management.

IP MU: Kaleleiki

This WCA is drawn around a population of *E. koolauensis* found on State Forest Reserve land. NRS conduct management here in collaboration with State personnel. This site is not designated 'MFS' for *E. koolauensis*, thus NRS effort here is limited.

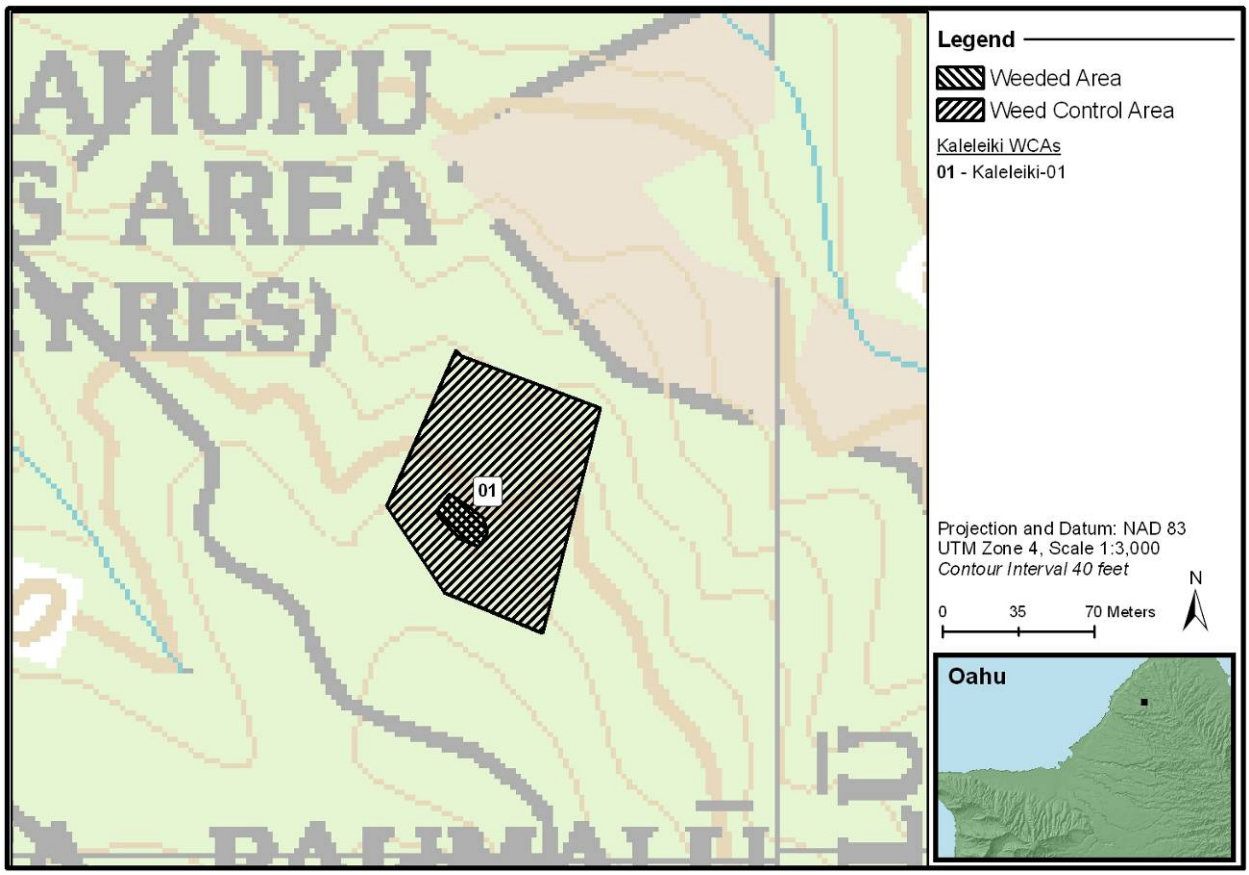

Figure 1.4.30 Ecosystem Management in Kaleleiki, Kahuku Training Area

WCA Discussion

Kaleleiki-01; EugKoo KTA-C Kaleleiki

This WCA is defined by a small ungulate-exclusion fence installed by the State (Figure 1.4.31). NRS targeted understory weeds around the core of the *E. koolauensis* population. Canopy weeding was minimized to prevent drastic alteration of microsite conditions. NRS weeded once

here in 2006-2007 (Table 1.4.22). *Clidemia hirta* was controlled in an area where there were many *E. koolauensis* seedlings. In the future, NRS will follow the plans discussed in the regional discussion above. This is not an MFS population. NRS will work with the state to determine the potential for using volunteers at the site; this could be a viable volunteer work site, once goals are met for MFS PUs in the region.

Table 1.4.22 Summary of Kaleleiki Weed Control Efforts

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
IP MU: Kaleleiki						
Kaleleiki-01	Habitat	0.80	0.03	3.79%		EugKoo

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	1	24.00	CliHir, PasEdu
Totals	1	24.00	

Total IPMU: Kaleleiki						
		0.80	0.03	3.79%	1	24.00

IP MU: Kaunala

One of the largest populations of *E. koolauensis* occurs in this MU, which encompasses two gulches: Kaunala and Aimu‘u. Weed control is concentrated around the greater part of this population in Kaunala Gulch (Figure 1.4.30). No work is currently done at the smaller part of this population in Aimu‘u Gulch. The Kaunala portion of this population is designated MFS, while the Aimu‘u portion is not. Kaunala-01 is defined by a fence, completed in 2006, which protects *E. koolauensis*, while Kaunala-02 is defined around a landing zone and camp site. NRS did not conduct any weed control at either WCA this year due to staffing limitations. Like the other MUs in KTA, this site poses major weed challenges, as it is made up of predominantly weedy species. However, it does include some tiny remnants of one of the most endangered ecotypes in the State: lowland wet-mesic forest. Future management will center on common native reintroduction, and weed control, with an emphasis on using volunteer labor. NRS will strive to visit the site 2-4 times in the next year.

Ungulate Control Efforts

The Kaunala MU fence is the largest of three exclosures protecting *E. koolauensis* in the KTA. The 4.9 acre fence was completed in July 2006 and remains ungulate-free. No other ungulate control efforts were conducted.

IP MU: ‘Ō‘io

This IP MU contains one WCA, is delineated by the ‘Ō‘io fence (Fig. 1.4.32). The fence protects a large population of *E. koolauensis* which is designated MFS. NRS will strive to visit the site two times for weed control with volunteers in the next year.

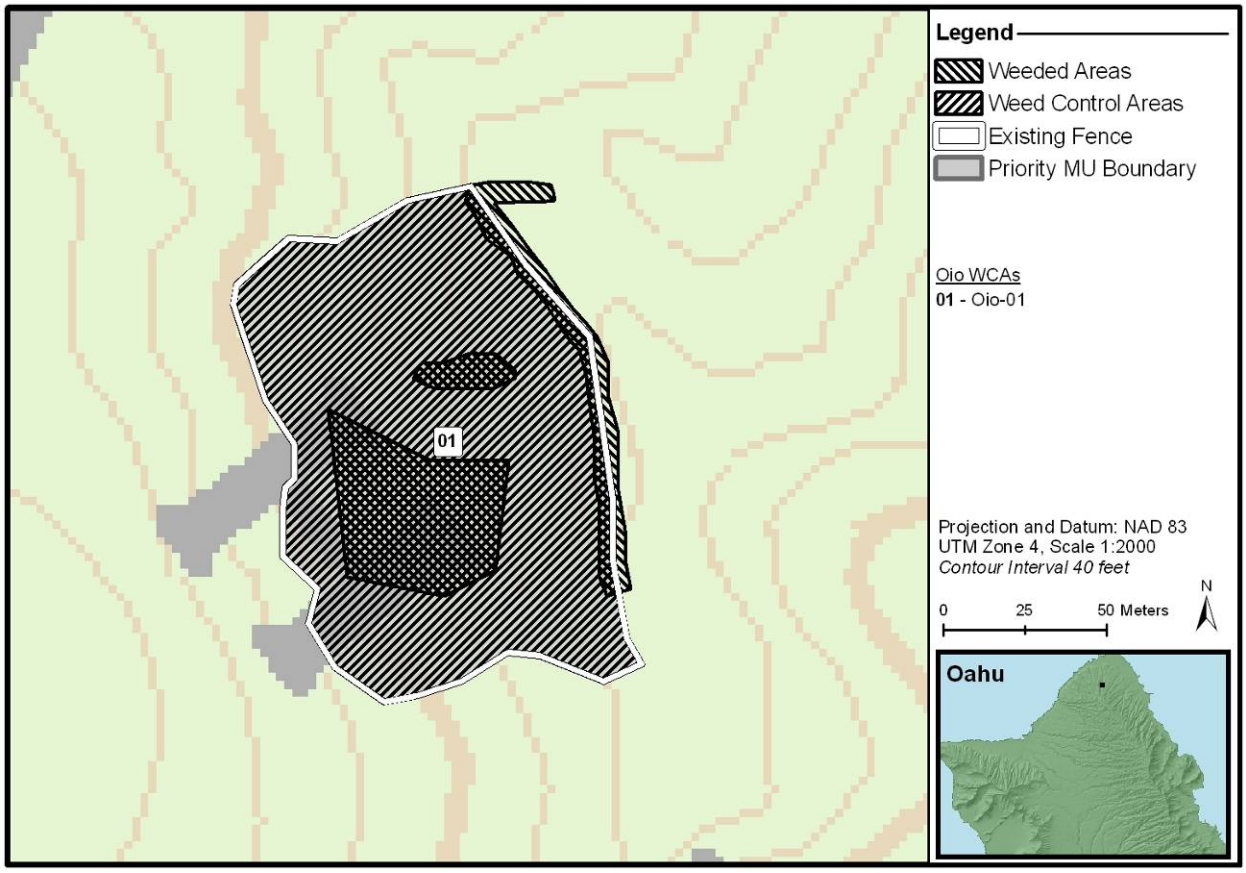

Figure 1.4.31 Ecosystem Management in ʻŌʻio, Kahuku Training Area

Ungulate Control Efforts

A 3.3-acre ungulate exclosure was completed in July 2006. Built to protect a population of *E. koolauensis,* the fence was routinely checked and found to still be ungulate-free. No other ungulate control efforts were conducted.

Table 1.4.23 Summary of ʻŌʻio Weed Control Efforts

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
IP MU: Oio						
Oio-01	Habitat	1.33	0.21	15.70%		EugKoo

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	1	21.00	ArdEll, CasEqu, ChrPar, CliHir, OplHir, PimDio, StaDic, TreOri
Totals	1	21.00	

Total IPMU: Oio						
		1.33	0.21	15.70%		EugKoo

	1	21.00	

WCA Discussion

ʻŌʻio -01; EugKoo KTA-F ʻŌʻio

This WCA is very weedy and has few native forest remnants. Much of the patch is dominated by *P. cattleianum* and the WCA is surrounded by *C. equisetifolia*. As a result, the strategy for this site has been to weed understory, vine, and grass components around *E. koolauensis* clusters. NRS are very cautious about opening the canopy further. *Christella parasitica* is proliferating as other understory weeds are killed, and more time was spent treating it this year. Control efforts are summarized in Table 1.4.23. The area is so weedy that regular understory weeding will not suffice. Instead, in the coming year NRS hope to transplant naturally-occurring *Raovulfia sandwicensis* and *A. koa* seedlings from nearby areas into the weeded site. It is hoped that planting canopy native species will help restore some level of shade to the site in both the short and long term. Weed control will be conducted directly around plantings. Restoration of this site will be challenging. NRS will strive to visit the site two times for weed control with volunteers in the next year. If more volunteer time is available, this area will be considered a priority.

IP MU: Pahipahiʻālua

This IP MU contains one WCA, which is delineated by the Pahipahiʻālua fence (Figure 1.4.30). The fence protects a population of *E. koolauensis*, consisting of a number of large mature individuals as well as younger age classes scattered throughout the exclosure. This site is designated MFS.

Ungulate Control Efforts

A small fence was constructed and finished in July 2006. The 1.5 acre exclosure continues to be pig-free. No other ungulate control efforts were conducted.

WCA Discussion

Pahipahiʻālua -01; EugKoo KTA-A Pahipahiʻālua

There are three main groups of *E. koolauensis* within this WCA, and hence there are three main target weeding areas. By observing the effects of light gaps on *E. koolauensis* created by weeding effort near the trees, NRS believe that *E. koolauensis* may be harmed by direct sunlight, and may prefer being in at least partial shade. For this reason, the weeding strategy has focused on controlling canopy and understory weed species directly around the *E. koolauensis* trees, allowing the native canopy trees to begin filling in. NRS have seen noticeable *Carex* and mixed native recruitment in a portion of the WCA. No weed control was conducted this year. NRS will strive to visit the site two times for weed control with volunteers in the next year.

Region: *Northern Koʻolau Mountains*

This region includes parcels with multiple landowners, namely Kamehameha Schools, the State of Hawaiʻi, the US Government and Hawaiʻi Reserves Inc. Within this region is Kawailoa Training Area (KLOA), which the Army has a license to use from Kamehameha Schools. NRS work extensively in the summit portion of this region. Presently, there are eleven MUs

designated in this region; NRS are currently working in four. There are three fenced units including two large units, Opaeula and Helemano, where NRS are involved in vegetation management. A fourth large scale fence is being pursued at Koloa, on Hawaii Reserves Inc. land. At Helemano and Opaeula, three WCAs are designated in each fenced area. In these six WCAs, NRS work to remove invasive species from otherwise predominantly native landscapes. There are two WCAs designated outside of fenced areas; they were created to track invasive species management along the summit, to the north and south of the fenced units. NRS is currently involved in ungulate management within all the fenced areas. No ungulate control occurs outside of fenced areas. Access to this area is difficult as it requires helicopter support.

IP MU: Koloa

Work in this MU just began this year. NRS have conducted several surveys and preliminary fence-scoping trips to the region, but no management activities except incipient invasive control have yet been implemented. See the Incipient Weed Report for details concerning *H. coromandelianum* and *L. scoparium* control efforts in this MU.

IP MU: ʻŌpaeʻula/Helemano

This large MU is divided into two subunits, ʻŌpaeʻula, and Helemano. Encompassing approximately 100 hectares, this MU protects pristine wet forest at the Koʻolau summit. A host of IP taxa, including *Achatinella sowerbyana*, *A. lila*, *Cyrtandra viridiflora*, and *Cyanea st. johnii* are found in the MU. The primary threats to this MU are pigs and weeds. In addition, rats are controlled around rare snail sites, as discussed in the Rare Snail Management chapter. All three ʻŌpaeʻula WCAs are contained within the ʻŌpaeʻula exclosure (Figure 1.4.34), which was completed in 2001. The 175-acre Helemano fence was completed in May 2007 and encloses the Helemano WCAs (Figure 1.4.34). The primary weed threats to the MU include *P. cattleianum*, *S. palmifolia*, *C. hirta*, and *Pterolepis glomerata*. Of these, *C. hirta* and *P. glomerata* are very widespread and are not controlled. *Setaria palmifolia* has a patchy distribution and is treated in as an incipient in ʻŌpaeʻula (Incipient Weed Report).

The short term objectives for this MU are:

1) Complete control of all ungulates in Helemano subunit.
2) Continue weed control in ʻŌpaeʻula subunit.
3) Resume weed control in Helemano subunit.
4) Conduct periodic fence checks to maintain structural integrity of both exclosures.
5) Evaluate the distribution of *S. palmifolia* in Helemano to determine whether control efforts are best tracked via WCA or ICA designation
6) Monitor vegetation plots, including LCTA plots and *P. glomerata* plots on a defined schedule.

Most of the weeding done in the Helemano WCAs was primarily to clear fenceline. Future weeding efforts of the Helemano WCAs will be similar to weeding in the ʻŌpaeʻula WCAs. This year, the priority in Helemano was to control ungulates inside the fence. In the coming year, NRS will sweep for *P. cattleianum* and control *S. palmifolia* (see Incipient Weed Report)

Weeding within the ʻŌpaeʻula WCAs consists mainly of large scale sweeps for scattered *Psidium cattleianum,* which is a threat to the integrity of the ecosystem. Occasionally, NRS find other weedy tree species, such as *Schefflera actinophylla,* on sweeps. All woody weeds are killed. In all WCAs, sweeps consist of preferably large groups of individuals armed with hand tools (clippers and hand saws) and applicator bottles of 20% Garlon 4 herbicide. Sweepers are advised to place decapitated parts (limbs, trunks, etc.) on top of other vegetation and to apply herbicide to the slash as well as the stump. NRS have in the past observed cut pieces lying on the ground sprout into trees. Usually, spotters with binoculars are placed strategically on neighboring ridge tops (see Figure). The spotters locate *P. cattleianum* clumps and direct the sweepers to them. This method is necessary because sweepers navigating through gulches have severely limited visibility due to the dense nature of the vegetation. The Koʻolau summit environment is not easily infiltrated by most weeds, including *P. cattleianum,* and with ungulates excluded from ʻŌpaeʻula, weed dispersal vectors are severely limited. NRS are confident that with regular but infrequent sweeps of the exclosure, *P. cattleianum* will become an almost non-existent component of this summit ecosystem. Control efforts for this year are summarized in Table 1.4.24. In the coming year, NRS will focus on weeding those portions of the ʻŌpaeʻula fence which have not been weeded in the last five years. These relatively small areas are noted in Figure 1.4.34.

Figure 1.4.32 NRS searching for *Psidium cattleianum* along ridge top in Koʻolau Mountain Range

The Koʻolau summit is very wet and is frequently obscured by rain clouds. Since access to the MU is most efficient via helicopter, and since herbicide use must be conducted in dry conditions, NRS are not always able to conduct management operations on a quarterly basis. However, since the MU is fenced, and thus weed spread via ungulates is reduced, NRS are able to have the flexibility to wait for optimal weather conditions.

Ungulate Control Efforts

Ungulate control efforts within the Helemano fence are ongoing and include primarily snaring (Figure 1.4.34). The difficulty of accessing the remote Helemano area has limited NRS to four work trips, resulting in six natural resource staff spending 118 person hours deploying 138 snares in the upper half of the fence. A total of 12 pigs were removed from the area. The last trip in August 2007 resulted in no new fresh sign in the snaring areas as well as other areas surveyed in the lower half of the fence. NRS will continue to monitor pig sign to determine if control strategies need to be adjusted to attain an ungulate-free exclosure.

The ʻŌpaeʻula fence has been ungulate free since its completion in 2002. In May 2007, breaches by smaller pigs prompted NRS to install eight snares along the fence line. No pigs have been

caught thus far. Further monitoring of the fence line and enclosed area for pig sign will determine future ungulate management actions in this area.

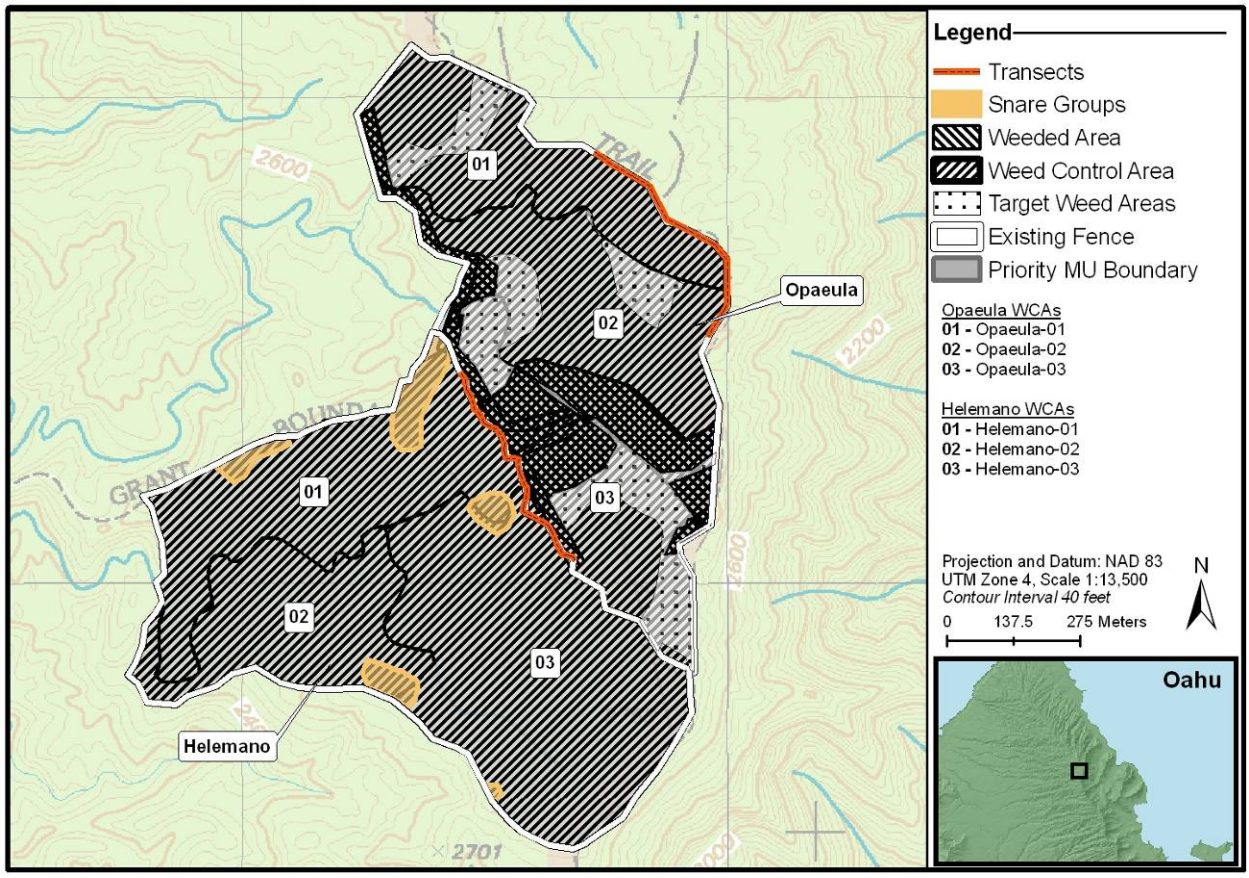

Figure 1.4.33 Ecosystem Management in Helemano & Peahinaīʻa, KLOA

Transect Discussion

Two transects are read in this MU. NRS found that an incipient invasive, *S. palmifolia*, was observed in new locations along one of the transects. *Setaria palmifolia* control is discussed in the 1.2, Incipient Weed Report.

WCA Discussion

‘Ōpae‘ula -01; Northern ‘Ōpae‘ula

NRS visited this area once this past year to sweep for guava. The weeding efforts took place mainly along the fenceline (Figure 1.4.34). It is important that NRS continue to walk the fenceline and weed for *P. cattleianum* to keep it from penetrating deeper into the WCA. Before the fence was built, *P. cattleianum* was spread through the area by pigs, but now the pigs are eradicated from within the fence. The pigs may still spread *P. cattleianum* along the fenceline so it is important that we contain these *P. cattleianum* outbreaks along the fence. NRS plan to visit this site quarterly next year and will continue with their quest of sweeping this entire WCA.

Table 1.4.24 Summary of ʻŌpaeʻula/Helemano Weed Control Efforts

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
IP MU: Opaeula/Helemano						
Opaeula-01	Habitat	14.42	0.43	2.95%	JoiAscAsc, LobGauGau	CyaKoo, CyrVir, MyrJud, VioOah

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	1	2.00	PsiCat
Totals	1	2.00	

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
Opaeula-02	Habitat	20.29	4.27	21.03%		CyrVir, VioOah

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	3	39.00	PsiCat
Totals	3	39.00	

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
Opaeula-03	Habitat	14.41	5.94	41.22%	JoiAscAsc	ChaRoc, CyrVir, VioOah

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	3	37.00	PsiCat
Totals	3	37.00	

Total IPMU: Opaeula/Helemano						
		49.12	10.63	21.65%	7	78.00

ʻŌpaeʻula -02; Central ʻŌpaeʻula /Goosehead Ridge

This year NRS visited this WCA tree times and observed a decline in the *P. cattleianum* population. Sweeps were made throughout this WCA and along the fenceline. NRS plan on revisiting this WCA quarterly over the next year and hope on penetrating deep into the thick native vegetation to finish weeding this entire area.

ʻŌpaeʻula -03; Southern ʻŌpaeʻula

Three sweeps were made in this WCA over the past year and NRS staff observed low numbers of *P. cattleianum*. A *Cyrtandra viridifolia* was found on one of the sweeps and weeds were removed from its immediate area. NRS plan to revisit this WCA quarterly next year to continue sweeping mainly for guava.

KLOANoMU-01

This WCA covers the summit trail between the ʻŌpaeʻula fence and the Lehua Makanoe bog fence, including the bog fence. While this site itself is not fenced, there is heavy pig activity along the summit trail, and NRS hope to reduce the spread of *P. cattleianum* along it. Doing so will help to reduce the effects of *P. cattleianum* to other rare taxa in the region, including *Lobelia gaudichaudii*. This WCA was not weeded last year. NRS plan on weeding this WCA two times next year, and will continue to focus efforts on *P. cattleianum*.

IP MU: Poamoho

The Poamoho MU includes a large region around the uppermost portion of the Poamoho Trail, including the summit. Several species of *Achatinella* are found here, as well as numerous rare plant species, including *Sanicula purpurea*. Dominated by native forest, the primary threats to the area include ungulates, *P. cattleianum*, and *L. scoparium*. Management work centers around rodent control and incipient invasive control of *L. scoparium* (see Incipient Weed Report). Only one WCA has been designated, along the Poamoho trail. The MU fence is proposed to be built in Year 3 of the OIP.

Ungulate Control Efforts

No ungulate control efforts were planned for Poamoho this year. However, this area is a well known Public Hunting Area (Hunting Unit C). In the summer of 2007, DOFAW modified Poamoho Road with new gates and access points. Ungulate control efforts in this area will, in a large part, remain a public affair. A fenced management unit is planned for the summit portions of this area. NRS will re-evaluate ungulate control measures prior to construction of this fence.

WCA Discussion

Poamoho-01; Poamoho Trail

Encompassing the uppermost portions of the Poamoho Trail, the primary target of this WCA is *P. cattleianum*. NRS almost exclusively work in this WCA with volunteer groups. It is a good volunteer project, as large numbers of people can be accommodated, weed targets are easy to identify and kill and are located along the trail, and the dense native forest provides many educational opportunities. No control was done this year, but NRS hope to revisit the site in the coming year.

IP MU: Lower ʻŌpaeʻula

No weed control has been done in this MU for over two years. The area is home to diverse forest and several rare taxa, and historically has seen significant levels of weed control. NRS stopped weeding in this area due to high pig presence; open weeded areas were targeted by pigs. Once ungulates are removed NRS believe that this MU has a high potential for restoration. A large fence is proposed to be built at Lower ʻŌpaeʻula. Once the fence is completed NRS will resume weed control. NRS are awaiting a license agreement with Kamehameha Schools to begin work in this MU.

Region: *Schofield Barracks East Range, SBE*

Schofield Barracks East Range (SBE) is owned by the Army. NRS do not work extensively in this region at this time, due to staffing limitations and the prioritization of other projects. There are three MUs designated around rare plant populations. There are no WCAs presently designated for native vegetation management. This reflects NRS decision to focus weed management within fenced MUs and ungulate management areas. There are no fenced areas presently in this region. Weed and pest management is being conducted in the lowest-elevation portion of SBE. Presently, NRS work at one WCA centered on vegetation management to

facilitate coquí frog control (Figure 1.4.35). NRS also participate in control of a coquí frog infestation located near Leilehua Gate. There are many ICAs designated in the lower areas of the region where NRS is working towards eradication of invasive incipients (see Incipient Weed Report for details). As incipient weed control projects progress toward completion and NRS begins to develop plans for possible future fencing, NRS will expand weed management actions in this region.

Ungulate Control Efforts

No ungulate control actions were conducted this year. There are two snare line present at in SBE and NRS plan to monitor them in the coming year.

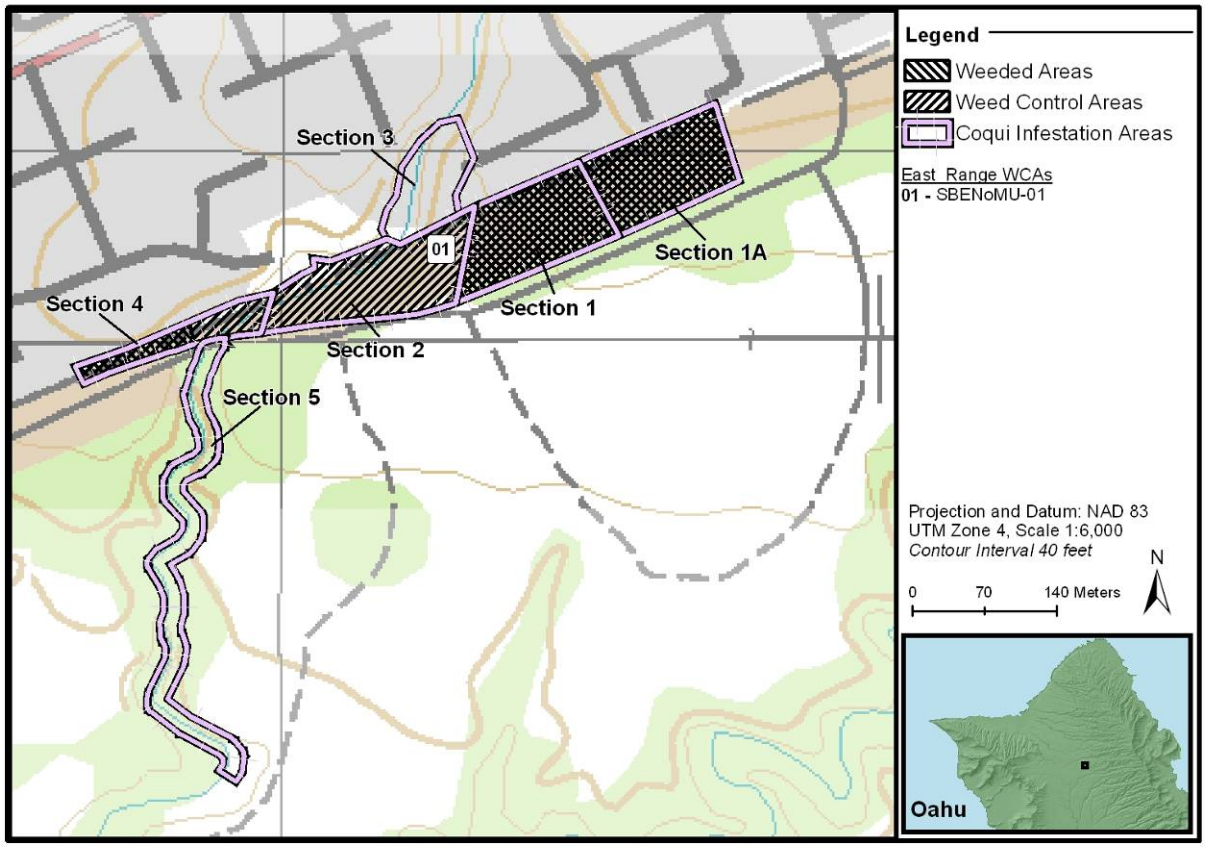

Figure 1.4.34 Ecosystem Management in Schofield Barracks East Range

Coquí Discussion

In 2001, *Eleutherodactylus coqui*, or coquí frogs, were discovered in Wahiawa. Introduced into the area on greenhouse plants at a private residence which runs a plant rental business, the frogs quickly spread into neighboring areas, including SBE. At the time, the infestation was the largest on O‘ahu. A joint task force was created to deal with the infestation. Partners from the Department of Agriculture (DOA), O‘ahu Invasive Species Committee (OISC), US Fish and Wildlife Service (USFWS), and the Conservation Branch of DPW created the Coquí Working Group (CWG). Over the past six years, the CWG directed control efforts in Wahiawa, working with both private residents and the Army to eradicate the infestation. The infestation was

divided into six areas: Sections 1, 1A, 2, 3, 4, and 5; see Figure 1.4.35. Originally, the infestation was limited to Sections 1, 2 and 3. However, despite control efforts, it expanded first to include Section 1A, and later, in 2006, Sections 4 and 5. The basic strategy for treating the Wahiawa infestation has evolved over the years. Currently, both daytime leaf litter drenches and nighttime forest canopy drenches of citric acid are used very effectively. Daytime drenches are used to treat large areas, and nighttime drenches are used to treat small areas known to contain calling frogs. Both citric acid and lime are effective at killing coquí; due to label restrictions, however, the CWG only uses citric acid at Wahiawa. Sprays are conducted by a crew of temporary staff hired by OISC (3 positions) and NRS (1 position). Regular night time monitoring surveys are conducted by various members of the CWG to track frog presence and absence in the various Sections.

In 2005 and 2006, large scale sprays of citric acid were highly effective in reducing frog numbers. In 2006, sprays were conducted between April and September 2006, during the coquí breeding season, when the frogs are easiest to locate. At the end of the 2006 season, the infestation was estimated at 30-40 frogs, down from hundreds of frogs in 2001. Section 3 was deemed clear of frogs, in part because the area had been cleared for construction. However, frogs had spread into Sections 4 and 5. This may have been a result of heavy rains washing frogs downstream.

Nightly monitoring efforts between the end of the 2006 spray season and the beginning of the 2007 spray season in May showed no frogs calling in any of the six sections. In previous years, coquí had always been observed calling by April at the latest. Encouraged by this, the CWG decided to continue to treat the area aggressively, and hopefully prevent any remaining frogs from reaching maturity. NRS assisted with preparing the area for spraying (see SBE-NoMU-01 WCA discussion below). Sprays were conducted between May and September 2007, prioritizing the previous season's hot spots: Sections 4 and 2. High priority areas were drenched twice and low priority areas were monitored for frogs and spot sprayed as needed.

At the conclusion of the 2007 spray season, coquí are yet to be heard in Wahiawa. Figure 1.4.36 shows the number of calls heard at Wahiawa over time. Typically, calls peak during summer calling seasons, but these peaks have been steadily becoming shorter from year to year as control has continued. Note the lack of a peak in 2007. Generally, an area is considered coquí free when no calling has been heard for 9-12 months. Given this guideline, it appears that the Wahiawa population may be extirpated. However, the results of this season's spray will not be obvious until the calling season begins in May 2008. Future management plans for the site will be discussed by the CWG in the coming months. In 2008, it is likely that efforts will focus on night monitoring, including using remote sensing techniques (digital recorders) to thoroughly survey the area. NRS will continue to participate in the CWG until Wahiawa is labeled "coquí free."

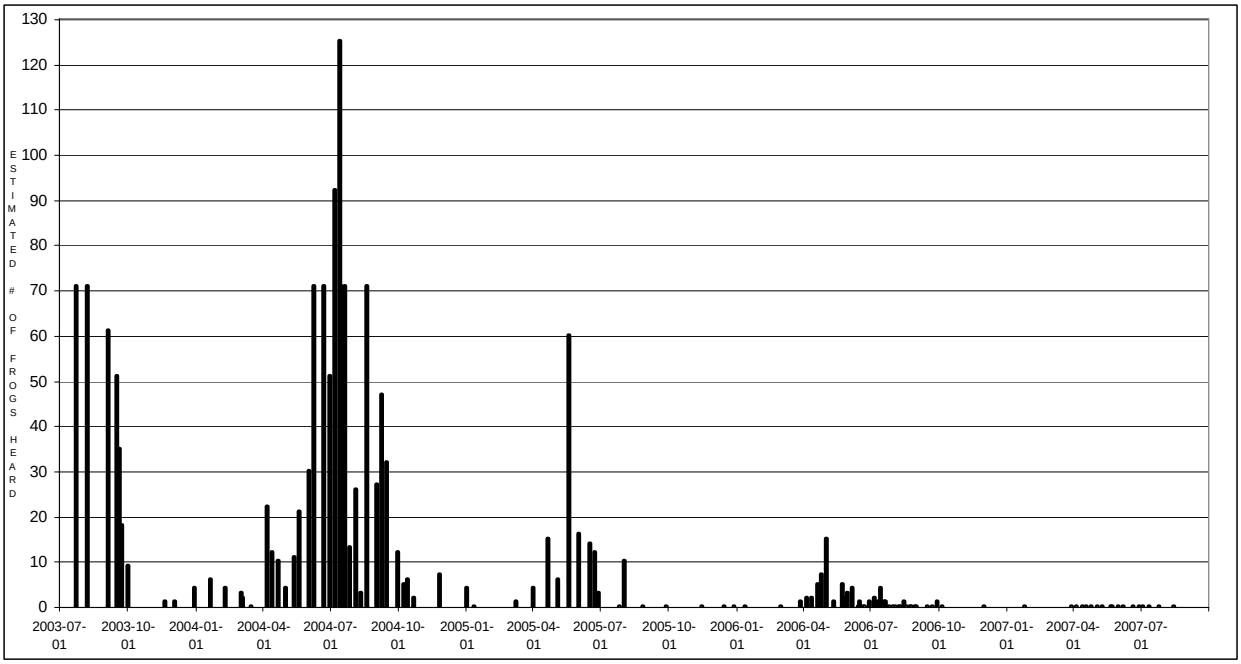

Figure 1.4.35 Number of Coquí Heard Over Time, 2003 to Present

Table 1.4.25 Summary of SBE Weed Control Efforts

WCACode	WCAType	WCA TotalArea (hectare)	Total Area Covered (hectare)	% Area Covered	Rare Taxa Present	Stabilization Taxa Present
IP MU: SBE No MU						
SBENoMU-01	Habitat	3.95	2.40	60.82%		

Treatment Type	# of Visits	Effort (Person Hrs)	Species Controlled
Ecosystem Weed Control	2	61.00	CitCau, CluRos, PanMax, PsiCat, PsiGua, SchTer
Totals	2	61.00	

Total IPMU: SBE No MU						
		3.95	2.40	60.82%	2	61.00

WCA Discussion

SBENoMu-01; Coquí Area

Management at this WCA is geared towards facilitating coquí management. As described above, the coquí infestation site is divided into several areas. This year, NRS assisted in controlling weeds in three areas: Sections 1, 1A, and 4. In Sections 1 and 1A, NRS sprayed 22 access transects with Roundup in order to keep them clear, drivable, and unattractive to coquí. In Section 4, a joint NRS and OISC team cleared vegetation from the area, decreasing its attractiveness to the frogs, as well as improving access for coquí drench treatments. This clearing resulted in a huge pile of debris; perfect habitat for the frogs. Rather than leaving it or moving this potentially coquí contaminated material off-site, NRS contracted Glad's Landscaping and Tree Inc. to chip the material so that it could be left on-site. Unfortunately, due to contract difficulties, this clearing work did not happen in June, as originally planned, but rather in September. Despite this, the temporary spray crew was able to drench the area twice.

Given the current positive prognosis for the coquí's eradication from Wahiawa, it is unclear how much longer NRS will work in this WCA. Once the infestation has been eradicated, NRS will discontinue this WCA. Until then, NRS will continue to maintain access trails and otherwise facilitate coquí drenches.