

CHAPTER 3: RARE PLANT MANAGEMENT

3.1 Introduction to Rare Plant Management

Ninety-seven plant taxa with a federal status are known from Army training lands on O`ahu. There are 57 taxa with Endangered Status, 24 Species of Concern, 15 Candidate taxa, and 1 Threatened taxon. Of these, many are critically endangered with very low numbers of individuals remaining in the wild. Conserving these resources requires a program that integrates large-scale ecosystem protection and single species management. Large-scale ecosystem protection is done primarily with fencing and invasive plant control in Management Units. Single species management incorporates fieldwork, careful planning, ex-situ propagation, storage and reintroduction. Our program draws on a diversity of resources to help plan and prioritize rare plant management actions. These resources include extensive consultation and planning with the U.S. Fish and Wildlife Service, ongoing surveys to clarify current status and adjust goals and systematic monitoring of populations to keep abreast of changes in status and threats. These resources are incorporated in an adaptive management approach that responds throughout the year to new information. Actions in the field are focused on controlling threats, improving conditions for recruitment, collection, propagation, and sometimes reintroduction. The following is a discussion of this process. The species discussed in this report are included because they meet at least one of the following criteria: they are listed as Endangered or Threatened, they are a species in one of the two consultations discussed below or they are otherwise considered worth mentioning by NRS.

3.1.a Consultations with the U.S. Fish and Wildlife Service

NRS is currently involved in two consultations with the U.S. Fish and Wildlife. These consultations have pooled expert opinions on diverse resource management issues including background information on species distribution and abundance, outlining management actions and goals, and developing monitoring frameworks and objectives.

The Mākuā consultation process resulted in the production of the Mākuā Implementation Plan that outlines impacts of military training in Mākuā, requires measures to reduce impacts and outlines required mitigation actions to offset risks of training. NRS actively utilize the stabilization plans developed for each species. These plans outline species status, management actions, and goals to achieve stabilization.

The O`ahu Training Area consultation will result in the development of the O`ahu Implementation Plan. This plan will cover federally listed species on the other four training areas; Schofield Barracks Military Reservation, Kawaihoa Training Area, Kahuku Training Area and Dillingham Military Reservation. The development process for this plan has been greatly streamlined and will benefit by utilizing many of the methods and strategies developed in the Mākuā plan. The development of this plan has just begun with the hiring of a coordinator by NRS that will oversee meetings and be the principal author.

3.1.b Surveys and Monitoring

3.1.b.1 Rare Plant Surveys

Surveys determine population size and range, which are necessary to provide the basis for management recommendations. Surveys also allow NRS to monitor potential military training impacts. Results of these contracted surveys are summarized as maps and reports stored in the GIS and plant databases. The U.S. Army Garrison Hawai`i first contracted botanical inventories of its training areas in 1977. In 1993, the Nature Conservancy of Hawai`i was contracted to conduct additional surveys, the results of which were used in writing Ecosystem Management Plan Reports. The National Tropical Botanical Garden (NTBG) was contracted during the winter of 1999-2000 to conduct surveys of areas off Army lands for federally Listed species found in and around Mākuā Military Reservation (MMR). NRS accompanied the NTBG botanists on these surveys to State and Private lands including: Wai`anae Kai, Mākaha, Makaleha, Lower Ka`ala NAR, Lualualei Naval Magazine, Honouliuli Preserve, Pahole NAR, Mokulē`ia Forest Reserve, and Kuaokala. These surveys targeted populations that had not been visited in a long time and helped determine appropriate management actions.

Every year since 1998, the Hawai`i Natural Heritage Program (HINHP) has been contracted to survey for certain critically endangered plant species on Army training land and has assisted NRS with botanical orientation. Recently NRS has expanded surveys to cover state and private lands. These surveys have helped to identify resources off Army lands that have conservation potential.

NRS schedule time to survey for rare plants, and in addition, incorporate surveys into other daily fieldwork. New populations are recorded on the Hawai`i Rare Plant Restoration Group (HRPRG) Rare Plant Monitoring Form (RPMF) (Appendix 3-A). Once a population is discovered and mapped, it is put on a monitoring schedule.

3.1.b.2 Rare Plant Monitoring

Critical populations are monitored regularly by NRS to track their health, collect propagules for ex-situ propagation, conduct management actions and monitor threats to plants. The RPMF (Appendix 3-A) is used in the field to record monitoring data. NRS use a reference code to track each population and individual plant. The location is mapped with a hand-held GPS unit or from a topographical map when satellite reception is poor. The location is also described on the form by the NRS visiting the population. The field form records individual plant information that may change between visits, such as plant height, basal diameter, age class, reproductive status, sex, vigor, type and number of propagules collected and the propagule destination. Population structure is recorded by defining the age classes and noting the number of individuals in each age class. The field form also records the population information and habitat characteristics. These include phenology, condition, light level, overstory and understory heights, soil drainage, topography, moisture class, slope, and aspect. The associated species are recorded on the form to aid future surveys and locate proper reintroduction sites. In addition, any threats that warrant further attention are listed. This information determines population health and stability, which

helps in recommending management and directing threat control for that species. The background form contains information that is unchanging, such land ownership and location.

A database built by HINHP on Microsoft Access is now a central part of NRS's data management system. HRPRG monitoring forms and nursery data is entered regularly. Databases built for the Lyon Arboretum Seed Storage Facility and the Micropropagation Lab are linked to the NRS database and are used to determine the ex-situ status and design reintroductions. The database is queried on an almost daily basis to help direct a diversity of tasks including collection goals, nursery management such as stock amplification, and reintroduction design. The database has become a powerful tool in NRS's adaptive management approach.

3.2 Management Actions

3.2.a Threat Control

Threats identified during surveys and monitoring visits are managed by NRS in many different ways. All threat control is focused on increasing the number of individuals in the field by improving the conditions for recruitment and survival. Management actions addressing threat control are prioritized based on threat levels and manageability. Where control of feral ungulates is a priority, they are excluded around rare plants and habitats using fences and the various hunting methods discussed in the Ungulate section of this report (Chapter 1). During the fruiting season, those species threatened by rats are protected using snap traps and poison bait stations. Invertebrates are very difficult to control. NRS is currently supporting the slug research of Stephanie Joe in the Botany Department at UH Manoa. She is investigating slug impacts to native species and efficiency of different enclosure techniques. NRS has great hopes that her research will result in better understanding of slug impacts and management options. Unfortunately, there is not as much momentum with black twig borer research (*Xylosandrus compactus*). There are still no adequate methods for killing slugs or the black twig borer in a forest. NRS has identified only one systemic insecticide that is approved for use in a forest setting. Although the black twig borer is not a target pest of the insecticide, it is being used at this time on *Flueggea* and *Alectryon* and will be discussed below for each species. Any pest management research project will require approval from the Command Consultant as stated in AR 200-5. Invasive plant species can be controlled using a number of techniques, depending on the threat. These are discussed in detail in Weed Management (Chapter 2).

3.2.b Propagation

For species that have a critically low population size and high threat levels, ex-situ management is necessary. These species may have as few as one individual, or may have very poor population structure as a consequence of seed and/or seedling predation by invertebrates or rats. The threats to these plants can be minimized in the field. However, in some cases, the effective population size is so small and/or threat level so high, that every seed is valuable and should be collected. Propagules are collected for propagation and storage. Alvin Yoshinaga and Lauren Weisenberger are managing the Lyon Arboretum Seed Storage Facility, a short-term deposit/withdrawal type storage facility at the Lyon Arboretum. This facility may be used for storage of seeds that will be needed for future projects. As reintroduction plans and sites are

prepared, those collections can be banked and held until called upon. NRS has made many deposits into this storage facility in the past year and will continue to support the facility in the coming year.

Other propagules that can be used right away or have poor storage records are brought to one or more facilities for propagation. There are now six facilities where propagules from rare plants on Army land are grown: Lyon Arboretum, Pahole Nursery, Army Rare Plant Propagation Facility, and the Koko Head, Waimea and Wahiawā Botanic Gardens. The Lyon Arboretum in Mānoa Valley practices both micropropagation and traditional greenhouse propagation. When NRS collect immature seeds, or vegetative material, they are taken to Lyon for micropropagation. The plants that are successful in micropropagation can be stored and cloned in test tubes and then returned to NRS for transplanting and reintroduction. The Pahole Nursery is a State of Hawai`i Division of Forestry facility located at the old NIKE missile storage site near the State's Pahole NAR. It is adjacent to MMR; an area with many managed rare plant populations. Because of the close proximity of the facility to MMR, it is used to harden off plants bound for reintroduction in Mākua.

The Army's Rare Plant Propagation Facility is located on Wheeler Army Airfield. The Facility is permitted to propagate and grow rare plants collected from Army lands on O`ahu. Plants propagated at this facility will be reintroduced into the wild or botanical gardens. NRS also bring propagules to both the Waimea and Wahiawā Botanical Gardens for propagation. Both of these facilities receive funding from the Center for Plant Conservation (CPC) to propagate certain species that are on the Center's genetic safety net list. Propagules of those species on the list that are found on Army lands are brought to the Gardens by NRS. When propagules are turned over to these various facilities, they are accompanied by the RPMF. These forms, completed when the propagules were taken, contain the Population Reference Code that will be used to track the propagules and to ensure they are reintroduced into the proper location. The highest priority plants will be represented by living collections; reintroductions and mature seeds will be stored at Lyon. Other species may only be represented by frozen storage of mature seeds.

In the coming year, NRS hope to cooperate with the Honolulu Botanic Gardens to establish representatives of Army plants on their grounds. This stock would be used to collect mature seed for storage and cuttings for reintroduction. A collection at a Botanic Garden would serve the purpose as a source of collections for Army stabilization projects and serve the public as an educational resource and propagule source.

3.2.c Reintroduction

The Army's Natural Resource Program uses reintroduction as a management tool to help increase the number of individuals in the wild with the goal of increasing the effective population size and establishing good population structure. NRS have reintroduced eleven listed endangered plant species into MMR. Seven have been planted into Kahanahāiki Gulch (*Delissea subcordata*, *Cyanea superba* ssp. *superba*, *Alsinidendron obovatum*, *Cenchrus agrimonioides* var. *agrimonioides*, *Alectryon macrococcus* var. *macrococcus*, *Schiedea nuttallii*, and *Euphorbia haeleeleana*), two into Kaluakauila (*Hibiscus brackenridgei* subsp. *mokuleianus*, *Neraudia angulata* var. *dentata*), two onto `Ōhikilolo Ridge (*Pritchardia kaalae*, *Sanicula mariversa*), and

two into Lower Mākua (*Nototrichium humile*, *Neraudia angulata* var. *angulata*). One species has been reintroduced into SBS (*Urera kaalae*), one into SBW (*Labordia cyrtandrae*), and two into KLOA (*Stenogyne sherfii*, and *Sanicula purpurea*). These reintroduced populations are being monitored using a form developed by NRS to track the source of the population and the date they were planted. The success of these reintroductions will be discussed below for each species. These reintroduced plants were collected from the wild parents by NRS and NARS and grown at the Army's Rare Plant Propagation Facility, Lyon Arboretum, and at the State's Pahole Nursery.

Three types of reintroductions are commonly described: augmentation of an existing population, a site within the historical range of the species but separate from existing populations; and a site outside of the historical range. During the reintroduction, sanitation, transport, and planting methods are discussed. After the reintroduction, suggestions are made regarding monitoring, watering and maintenance of threat control operations. The Army's Natural Resource Program assisted the Hawaii Rare Plant Restoration Group (HRPRG) to draft guidelines for reintroduction and has adopted the guidelines for their own program. The guidelines are attached, as Appendix 3-B. NRS will seek approval from appropriate landowners and range control for reintroduction projects.

3.3 Species Accounts

3.3.a *Abutilon sandwicense*

Abutilon sandwicense is a shrub growing up to six meters tall with pale greenish yellow flowers. It is a rare component on steep slopes in dry forest (Wagner et al. 1990).

3.3.a.1 Mākua Military Reservation

A single *A. sandwicense* tree was found during surveys in MMR by HINHP in May of 2002. It is the only report of this species from the MMR and it is the northernmost tree known from the leeward side of the Wai`anae Mountains. Cuttings were taken from the plant by HINHP when the plant was found. Cuttings have been propagated at the Army nursery and NRS plan to reintroduce this plant to Kaluakauila in the coming year. NRS will continue to survey for this plant in Mākua.

3.3.a.2 State Land

There are several known locations for this species in the Lower *Ka`ala* Natural Area Reserve. NRS has noted new locations in the past year and will continue to in the coming year. There is currently no management proposed for this area for this species.

3.3.b *Alectryon macrococcus* var. *macrococcus*

Alectryon macrococcus var. *macrococcus* can grow to eleven meters in height and is found in mesic to dry forests on O`ahu, Moloka`i, Kaua`i and Maui. The fruit contains a glossy pale brown seed surrounded by a bright red aril (Wagner et al. 1990).

3.3.b.1 Mākua Military Reservation

Twenty-eight mature trees are known from MMR. They are found across the Lower Mākua, Kahanahāiki, Ohikilolo and East Rim management units (MUs). Few of the trees have been observed flowering and fewer have been observed with mature fruit. Most of the trees show significant damage from the black twig borer. No trees are protected from ungulates and only two (in the Lower Mākua MU) have bait stations to control rats.

There are two mature trees known from the Kahanahaiki MU and one experimental reintroduction site. The mature trees are in moderate health and are not fenced from ungulate threats. A reintroduction site within the Kahanahaiki Gulch fence was established with plants collected from trees in the Lower Mākua MU. They were planted in December of 2002. The plants were drenched twice in the year after planting. This treatment interval was not sufficient and all the plants were attacked by black twig borers. Since then the plants have been treated four times per year. This interval of insecticide application may be more effective at keeping the plants free of black twig borer. Eight of nine plants have survived though few are healthy. NRS will continue to treat these outplants quarterly in the coming year.

NRS revisited three mature trees in the East Rim MU in April of 2004. They were in moderate health and had no flowers or fruits. Once a propagation method is perfected, cuttings will be taken from these trees.

There are four trees in the Ohikilolo MU. They have been monitored in the last year and cuttings were brought to the Army Nursery. In the coming year, NRS will air-layer these trees as they are declining rapidly.

In order to develop a successful propagation method for these trees NRS performed propagation trials on a mature *Alectryon* tree growing ex-situ. Multiple attempts were made to graft on tip cuttings from material collected from MMR stock. Grafts were also attempted using tip material collected from the same tree. None of these preliminary trials were successful. NRS will attempt to test air-layers on this same *ex situ* tree this winter. NRS installed several air-layers on this same *ex situ* tree this past year. Several have produced roots and have been collected from the tree. NRS will attempt to use this method with other trees in the coming year.

3.3.b.2 Schofield Barracks Military Reservation

There are 24 mature trees on SBW and no juveniles or seedlings have been observed. Most trees are in moderate condition and only some flower and produce fruit. NRS continues to find rat depredated fruit around the 17 trees in SBW, however, controlling rats with bait requires frequent re-stocking and this is not feasible given access restrictions. Three air-layers were put onto one tree in SBW in May of 2003. They were left for a year and one had grown roots and

was collected in May of 2004 (Figure 3-1). This air-layer is now established at the Army Nursery in a 3-gallon pot and is over 2 meters tall.

There are seven trees known from SBS. They are in moderate health and only one has been observed fruiting. A small fence has been constructed in the area in the last year and may serve as a potential reintroduction site in the future.

In the coming year, NRS will continue to search for more individuals, monitor known plants for new threats and collect mature fruit when available.

Figure 3-1 *Alectryon macrococcus* var. *macrococcus* Air-layer



3.3.b.3 State land

In Pahole Natural Area Reserve there are approximately 7 mature trees and no juveniles or seedlings are known. Most trees are in moderate condition and only some flower and produce fruit. NRS has just recently begun to work with this species in Pahole. NRS will monitor trees for threats and fruit production and consider trying to collect from these trees for storage.

In West Makaleha there is a more robust population of *Alectryon* with 36 matures and four immature trees. NRS has monitored these plants in the last year. NRS is also in discussion with NARS biologists regarding the construction of a large-scale fence that would encompass these individuals. NRS will continue to monitor these plants in the coming year.

NRS has just begun to work in Central and East Makaleha and has not been to any of the known trees in the last year. In the coming year, NRS will work on propagation methods for this species.

The trees in this area will be monitored and collected from in the coming year. No trees have been monitored in Lower *Ka`ala* NAR or Waianae Kai in the last year. NRS will begin to visit the known trees in the next year and prioritize management actions.

3.3.b.4 TNC Honouliuli Preserve

In Kalua`a NRS has completed status surveys in the central and south branches. Locations reported by TNC staff were visited and new areas surveyed. A total of 21 mature trees and one seedling were observed. There are additional areas to search and NRS believes that more individuals will be discovered. Most individuals were in poor health and no fruit or flowers were observed. NRS will continue to search for and monitor individuals.

A formal survey of South Waieli and Ekahanui has not been conducted. However, in the years following 2000, six individuals have been observed in Waieli and another six in Ekahanui by TNC, NRS, and HINHP staff. In April 2004 two mature fruits were collected from an individual in Ekahanui and the seeds sown at the TNC greenhouse in Kunia. NRS will conduct surveys in South Waieli and Ekahanui in late 2004.

3.3.b.5 Makaha BWS

NRS presently know of about twenty plants in Makaha and believe that there is a significant number more to be found. One of the most prolifically fruiting trees NRS has ever seen is located in Makaha. NRS visited this individual in July of 2004 and collected over fifty mature fruit. This collection is significant because it is large enough to perform storage testing on. This collection was submitted to the Lyon Arboretum for storage testing. NRS will continue to search for additional trees and monitor known individuals in the coming year.

3.3.c *Alsinidendron obovatum*

Alsinidendron obovatum was reported from scattered ridges and gulches in mesic forest throughout the Wai`anae Mountains. It is a small shrub with white and purple flowers (Wagner et al. 1990).

3.3.c.1 Mākua Military Reservation

One individual was known from Kahanahāiki Gulch from 1997 through 28 February 2001, when it was found dead. NRS has annually searched the area where the plant was known. In the last year, none were found. Dozens of fruit were collected and propagated over the years. These plants were reintroduced to several sites in the gulch. There are currently a total of 35 mature *A. obovatum* outplants in Kahanahāiki. Five immature and over 60 seedlings have germinated around those plants, but the hurdle of establishing significant successful recruitment in situ still hinders the progression of this population to stability on MMR. NRS have been collecting mature seed from the reintroduced plants so that there are now over 186,500 mature seed frozen at the Lyon Arboretum. These are available for future reintroduction projects. Weed control is conducted regularly around the old wild site and the reintroductions to improve habitat for this species.

Alsinidendron seedlings are suspected of being very susceptible to slug predation. NRS have begun working with Ms. Stephanie Joe, a graduate student from the University of Hawai`i Botany program studying the effects of slugs on native plants. She installed plots in Kahanahaiki and has been collecting data from these plots for about six months. *Alsinidendron* is one of the species she is using in her plots and she has found that there is significant slug damage to young plants. Preliminary results of slugs test plots show about %30 mortality of seedlings of several species can be attributed to slug predation.

Ms. Joe observed that only at our driest out-planting site do we have mature F1 generation plants. Slugs are not able to survive in dry microclimates; therefore, even though germination may be lower at dry sites, it may be offset by the low rate of slug predation observed at these sites (S. Joe pers. comm.).

In the coming year, NRS will supplement the most successful reintroductions with stock from the original wild plant.

3.3.c.2 State Land

Makaleha is the only site where *A. obovatum* is extant in the wild. There are two sites in Makaleha referred to by NRS as LEH-A and LEH-B. NRS found the plants at LEH-A during surveys in 2000. Since then NRS has been monitoring them and has collected mature fruit several times for propagation and storage. In the coming year, NRS will reintroduce progeny from this site to nearby ungulate exclosure. NRS consulted with NARS about fencing the wild plants at LEH-A. However, due to the steep nature of the site and plans to construct a larger ecosystem scale exclosure in the near future, immediate fencing was not executed.

The plants at the LEH-B site were discovered by HINHP and NRS in November of 2003. This site has a robust population of about 21 mature plants, 12 immature plants and 40 seedlings. This population is by far the healthiest NRS has ever seen. The site was visited with NARS staff in December and on this visit a fenceline was laid out. In February the fence was completed by NRS and NARS. In March a collection was made for seed storage from the site and weeding efforts began with the control of both canopy weeds and invasive grasses. NRS will continue weed control in the area and monitor population trends.

There are three sites in Pahole where this species was known (PAH-A,B,C). All sites where visited by NARS and NRS in the last year, to check for new plants, none were found. The plants originally known from this gulch have not been seen for several years. NRS have visited the site twice in the last year and have not seen any seedlings. Collections were made by Dr. Steve Weller of U.C. Irvine, in 1999. Those seed were grown in the greenhouse at U.C. Irvine and seed produced by those plants were sent to NRS and deposited at the Lyon Arboretum. In the coming year, NRS will grow plants from Dr. Weller's seed and the plants will be used as a propagule source and reintroduced.

In January of 2003, NRS supported NARS in the reintroduction of stock collected from the PAH-B population back into Pahole NAR. The site was chosen by NARS staff. NRS monitored

the site in April of 2004 and was astonished by what was seen. There were thirty of the original 50 out-planted plants remaining, 21 new immature F1 plants and 295 seedlings! As discussed above this site may have also somehow escaped intense slug herbivory suspected in other reintroduction sites. NRS will continue to monitor this site and will take Stephanie Joe to the site to get her input on the dynamics of slug population in the area.

3.3.c.3 TNC Honouliuli Preserve

A. obovatum was known from the Southern end of the Honouliuli preserve in the early 1990's. NRS accompanied HINHP botanist on a survey of the area. No plants were seen.

3.3.d *Alsinidendron trinerve*

Alsinidendron trinerve is known to be rare on slopes in wet or wet-mesic forest from between Pu'u Kalena and Mt. Ka'ala (Wagner et al. 1990).

3.3.d.1 Schofield Barracks Military Reservation

Over this last year surveys by NRS staff dramatically increased the number of known plants. From only 76 plants last year, there are now 508 known plants. Most are found on the summit of Ka'ala while others are known from the ridge between Pu'u Kalena and Ka'ala. Many seedlings and juveniles have been found at these sites. NRS feels that since new plants are found and mapped virtually every time we enter a new gulch at Ka'ala NAR, and since there is no predation observed on these plants, collecting and monitoring of this plant is not a priority.

Pigs continue to be a threat to these plants, especially all those found in the flat areas in the bog. However, in the past year, NRS has been working with other landowners to exclude ungulates from the bog. NRS and staff from BWS, NARS and TNC installed four sections of fence around the bog. These sections do not form a complete enclosure but rather bridge gaps between natural barriers (i.e. cliffs). Although NRS felt they should serve to exclude ungulates from the bog, pigs are continually seen. It is unclear if the pig sign occurs from resident pigs that were fenced in, or if pigs found places to go around the fences, or both. In the coming year, NRS will continue to monitor the bog for ungulate sign and respond accordingly to make it ungulate-free. In the past year, NRS used staff hunters to control pigs in the bog and determine where if any, the pigs are entering the bog. This will continue in the coming year.

In 2001, NRS helped the State NARS staff reintroduce ten plants into the Mt. Ka'ala NAR. In 2002, about 70 plants, grown from seed collected by NRS from Mt. Ka'ala and grown by Lyon Arboretum, were reintroduced into the Mt. Ka'ala NAR site by NARS staff. In the last year, NRS and NARS staff supplemented this reintroduction with stock grown from NRS collections. NRS will work with NARS staff to ensure these plants are monitored and any new threats addressed.

There are 20 counted plants, and an estimated 91 other plants, located at two sites between Mt. Ka'ala and Pu'u Kalena. These plants are significant because they are the largest group of plants not on Mt. Ka'ala. The habitat where they occur is considerably drier and steeper. At this time

they are more threatened by goats and pigs, and may be fenced if control does not significantly reduce the threat. In 2002, NRS documented major pig damage around these plants. The only surviving plants were being sheltered at the base of large trees or growing above ground in a larger tree. There is more appropriate habitat in this area and more plants may be found.

Due to the vast increase in plants found this past year, collecting from all the plants for seed storage and reintroduction is no longer a priority.

3.3.e *Bobea sandwicensis*

This *Bobea* species is a tree that grows up to 10 meters tall. It was known from the dry to mesic forest of the Wai`anae Mountains and Wailupe Valley in the Ko`olau on O`ahu and also from Maui, Moloka`i and Lāna`i (Wagner et al. 1990).

3.3.e.1 Mākua Military Reservation

On MMR, *Bobea sandwicensis* is known from the Lower Mākua, Kahanahāiki, `Ōhikilolo and Kaluakauila MUs. There are about 50 known mature trees on MMR and this species is found in areas considered to have a high fire threat. This species is not monitored regularly.

There are thought to be more than 20 mature trees in Lower Mākua and NRS monitor the trees only in conjunction with other management work. Monitoring has not been systematic, but it appears that there is a decline in population in general.

In Kahanahāiki, there are three mature trees that were observed in January of 2003. They are within an area that is proposed to be fenced by 2006.

On `Ōhikilolo, the few trees are not monitored regularly.

In Kaluakauila, there are about 20 *Bobea* and they are protected from ungulates by a pig fence. NRS continue to control fuels by removing guinea grass (*Panicum maximum*) from the forest patches and may focus more effort around *Bobea* populations in the future. In July of 2003, there was a prescribed burn that escaped the firebreak road. This fire burned three *Bobea sandwicensis* trees at the edge of a native forest patch. All of these trees appear to be alive and are producing new leaves.

3.3.f *Bobea timonioides*

This species is known from dry to sometimes-mesic forests from Hawai`i, Maui, O`ahu and Kaua`i. It can grow up to ten meters tall (Wagner et al. 1990).

3.3.f.1 Kawailoa Training Area

NRS conducted surveys above the drum road in the Kawailoa Training Area for rare and endangered species that could be impacted as part of road construction. The Drum road may be widened to accommodate the needs of the new Army Stryker Brigade. In these surveys NRS

identified a *Bohea* that is suspected to be species *timonioides*. Unfortunately the tree had no reproductive structures and therefore could not be positively identified to the species level. This may be a significant discovery as *B. timonioides* has become extremely rare. NRS will monitor the individual for reproductive structures so that it may be keyed to the species level. NRS will ask HINHP for review once material is collected.

3.3.f.2 Kahuku Training Area

There is one known individual in KTA, and there are no juveniles or seedlings known. NRS will map this species as individuals are found to better assess population size and structure. MUs must be surveyed and defined in KTA. This species will be a target for any surveys in KTA next year.

3.3.g *Bonamia menziesii*

This species is known from Hawai'i, Maui, Moloka'i, O'ahu and Kaua'i. It is a rare liana found in dry to mesic forests (Wagner et al. 1990).

3.3.g.1 Mākua Military Reservation

On MMR, this species is known from the Kaluakauila and Lower Mākua Management Units. There are estimated to be about eleven mature individuals.

There are less than ten known individuals in the Kaluakauila MU, and all the plants are in a pig enclosure. A single mature fruit was collected for seed storage in the last year. The fuel load in and around these plants has been reduced significantly in the last year, and NRS will continue to remove grass from inside the enclosure. NRS will continue to monitor and collect from these plants in the next year.

In June of 2004, NRS discovered a single *Bonamia menziesii* growing in the Lower Mākua Management unit. This was the first time that this species has been seen in the nine years that NRS has been working in the area. NRS suspects that the removal of goats from the management unit has contributed to its return. This species would have been easily browsed by goats and could have been easily extirpated by them.

3.3.h *Cenchrus agrimonioides* var. *agrimonioides*

This endangered species of grass is known from Lāna'i, O'ahu and Maui. The other variety (var. *laysanensis*) was known from the northwest Hawaiian Islands and is thought to be extinct (Wagner et al. 1990).

3.3.h.1 Mākua Military Reservation

Thirty-nine mature wild individuals are known from four sites in the Kahanahāiki MU. Three of these sites are located inside a large-scale enclosure, and the fourth has just one individual and is outside the fence. Approximately 100 meters separate the three subgroups within the enclosure.

In the last year, NRS conducted weed control around all of the known *C. agrimonioides* individuals and in the vicinity of the three reintroductions in Kahanahāiki MU. This has improved habitat for this species.

The population trend for MMR-A shows a general increase in the number of plants in all size classes since the fence was installed in 1997 (Figure 3-2). NRS controlled weeds around these plants in the last year and will continue to collect cuttings to supplement existing reintroductions in the coming year.

The MMR-B population of *Cenchrus* has one mature individual. It is not protected by fencing and may still be disturbed by ungulates, though no sign was observed in the last year. This area is proposed to be fenced in the coming years. Several seedlings have been observed at this site over the past few years however, none has survived to become a juvenile plant. A single seedling was found at this site when it was monitored in the last year. In the coming year, propagules will be grown to supplement the reintroductions in Kahanahaiki and Pahole. This plant is represented by reintroductions inside the fence enclosure.

MMR-C has about twenty mature plants, and has displayed a positive growth trend for the past few years (Figure 3-3). The site is protected from pigs and weed control around these plants in the last year should help to limit competition for the *Cenchrus*. NRS will continue to collect propagules in the coming year to supplement the reintroductions in Kahanahaiki and Pahole.

The MMR-E reintroduction site is located just inside the fence near the Mākua Rim. Thirty-two plants were planted here in December 2000 and eleven more were added in January 2002. There are many juvenile plants that have come from seed germinating on site. NRS expects this trend to continue and there may be several wild born mature plants in this site in the coming year (Figure 3-4). In the next year, NRS will supplement the MMR-E reintroduction with un-represented and under-represented stock from the wild populations.

A few plants have been found in new locations in the last year (MMR-F, G, H). These plants will be collected from and represented in the existing reintroductions. There is one reintroduction site that NRS has abandoned (MMR-D). The plants never did very well and the stock was represented elsewhere.

3.3.h.2 State Land

Cenchrus agrimonioides was known from two locations in Pahole NAR. NRS visited one site in July of 2004. At this site NRS found thirteen mature, six immature and one seedling. NRS did not have time to completely monitor the site and expect that there may be more individuals. There are significant weed threats at this site including encroaching *Melinis minutiflora* and *Psidium cattleianum*. NRS discussed these weed issues with NARS biologists and have developed a plan to implement weed control for the area. NRS will also begin seed collection for storage and reintroduction in the next year.

NRS installed a reintroduction of *C. agrimonioides* in Pahole in December of 2000 (PAH-A). This reintroduction has flourished since. There are presently 114 seedlings and 37 immature

plants at the site (Figure 3-5). These are all plants that have germinated on-site. NRS will continue to balance founders at this site and conduct monitoring and weed control twice a year.

3.3.h.3 Waianae Kai and Makaha

The *Cenchrus* along the ridge-top between Makaha and Waianae Kai are considered one population by NRS. The large fire in that area last year did not burn any of these plants, but significantly changed the habitat along the ridge-top. In June of 2003, NRS counted nine mature plants, two juveniles and one seedling. Cuttings were taken from all the mature plants and one juvenile and were brought to the Army nursery for propagation. Plants grown from these propagules will be used to produce seed in the greenhouse for storage and will be reintroduced into a fenced unit in Makaha when the fence is complete. NRS will continue to monitor this population and will continue collections to ensure good ex-situ representation.

3.3.h.4 Honouliuli Preserve

There are two wild populations in Honouliuli, one in North Ekahanui and the other in South Huliwai. Within the Kalua'a fence there are also two populations of reintroduced *C. agrimonioides*. Along with TNC staff, NRS mapped and tagged all individuals in the wild and reintroduced populations in 2003-2004. There are a total of 69 individuals within the wild populations (49 in Ekahanui and 20 in Huliwai) and 144 within the reintroduction sites. The wild populations are currently not protected from browsing by ungulates, but the Ekahanui population will be included in the upcoming Ekahanui fence expansion. The Huliwai population is to be managed for genetic stock only. TNC is currently searching for additional reintroduction sites of suitable habitat within fenced areas.

3.3.i *Chamaesyce celastroides* var. *kaenana*

Chamaesyce celastroides var. *kaenana* is a shrub with prostrate stems and erectly held red fruit. This variety is rare and is found along beaches and in dry shrublands on O`ahu (Wagner et al. 1990). *Chamaesyce celastroides* var. *kaenana* is known from MMR, Waianae Kai, Keawa`ula and Ka`ena Point. There are estimated to be almost 900 plants on Oahu.

3.3.i.1 Mākua Military Reservation

This species was first found on MMR in 2000. There are now at least 475 plants known from six sites. Seedlings and juveniles have only been found in the bigger populations. They are found from 200 to almost 2000 feet above sea level. All known sites are surrounded by grass, are highly threatened by fire, and most of the populations on MMR show signs of being burned in the past ten years. No rat damage has been observed at any of the monitored populations. NRS developed a bagging technique that made collecting seed from this species possible. The bags are made of a synthetic material, which is light, durable and well ventilated. Branches that have pollinated flowers and young fruit are carefully selected and bagged. When the bags are removed NRS sends the seeds to Lyon Arboretum for seed viability tests and storage. Some of the seeds were germinated and are currently growing at the Army Nursery. The fire in July of 2003 burned plants at three of the sites. NRS have established photopoints and will monitor the long-term effects of the fire on individual plant survival.

In Punapohaku, approximately nine *C. celastroides* var. *kaenana* were impacted by the fire of July 2003. NRS returned to evaluate impacts in July of 2004 and found that three of the nine plants were dead. These three plants were located at the base of lowest cliff within the area. This lower cliff abuts fields of *Panicum maximum*, whereas the rest of the population does not. The photos below show plant number three (Figure 3-6), which was located at the base of the lowest cliff and did not recover from the fire (Figure 3-7). Plant number six (Figure 3-8) did recover and is shown in the other picture (Figure 3-9).



Figure 3-6 Plant #3 Burned in July 2003



Figure 3-7 Plant #3 July 2004 Dead



Figure 3-8 Plant #6 Burned in July 2003

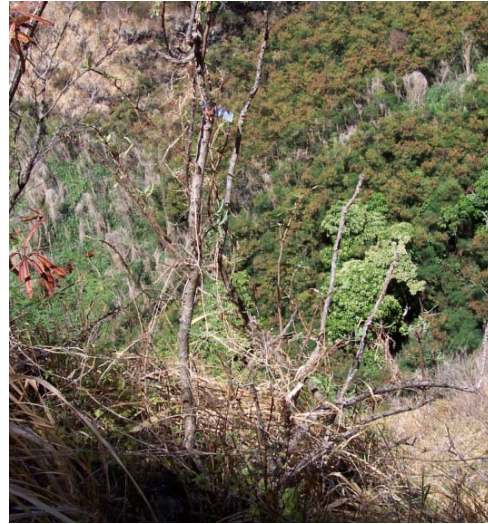


Figure 3-9 Plant #6 July 2004 Recovered

Although six of the plants appear as if they will survive, they are not fully recovered. None of the six plants that were impacted by fire produced as much fruit as un-impacted plants. Two of these six plants had no fruit at all. NRS placed bags around fruit on eight plants to facilitate collection this year.

There are two plants in Lower Kahanahaiki. One was heavily impacted by the fire of July 2003 (Figure 3-10). The other was higher on a cliff and further from alien grass fuel and was not impacted by fire. NRS returned to monitor the effects of the fire in August 2004. The lower plant was still recovering from the fire and had only a few live branches and no sign of reproduction (Figure 3-11). In contrast, the upper plant was covered with flowers and immature fruit (Figure 3-12). NRS believe that it will take at least another year if not two for the lower plant to recover from the effects of the fire. See pictures below for an illustration of the impacts and contrast to the upper plant.



Figure 3-10 *Chamaesyce* (MMR-A-1)
Burned at C-Ridge July 2003



Figure 3-11 MMR-A-1 August 2004



Figure 3-12 Upper *Chamaesyce* flush with fruit, August 2004

In Kaluakauila there are about twenty plants. They are located on State land just north of Kaluakauila Gulch. These plants were not burned in the 2003 fire and are monitored just once a year. In the coming year, NRS will collect from these plants for genetic storage.

In Lower `Ōhikilolo there has been an impressive increase in recruitment of individuals over this past year, attributed to both the fuel break installed and maintained by NRS staff, and the high amount of rain this winter. Thirty-one new individuals (mature and large immature) were tagged at lower `Ōhikilolo bringing the total count in the upper and lower patch to 104 seedlings, 55 immatures, and 57 matures as compared with the last thorough count on October 10th 2001, which found 21 seedlings, 26 immatures, and 27 matures.

On Puaakanoa Ridge, there is a large group of 145 mature plants with at least ten immature and probably many seedlings. The plants are on nearly barren cliffs and it would be very difficult to access all the plants. This area was not burned in the fire of 2003. In the coming year, NRS will monitor this area, and will determine whether to collect from these plants or not.

At the Kahanahaiki site, there are thought to be about twenty plants and they have not been monitored in the last year.

In the up coming year NRS will focus again on bagging immature fruit at populations at risk of fire in MMR. NRS will continue to maintain the fuel break at Lower `Ōhikilolo and work to monitor the effects of the fire on MMR's populations of this taxon. In addition, NRS will conduct a thorough annual monitoring of the Lower `Ōhikilolo population during the wet season and present population trends in the next year-end report.

3.3.i.2 State Land

There are estimated to be about 70 plants on the Keawa`ula side of Ka'ena Point (KAE-C). Several plants were bagged in July of 2003 in an effort to collect mature seed for germination

trials and storage testing. The bags were removed in October of 2003, and mature fruit were taken to Lyon Arboretum. In the coming year, NRS will monitor the plants once. No weed control had been conducted at this site.

There are estimated to be about 320-470 plants in two groups, on the north side of Ka'ena Point (KAE-A and B). Many of these fall within the NAR and are protected from off-road vehicles. NRS has been conducting weed control around these plants. In the coming year, NRS will continue to expand weed control. These efforts are described in detail in the Weed Chapter (Ch. 2).

About thirty mature plants were found in Waianae Kai during surveys in the spring and fall of 2002. Some of these plants were burned in fires in 2003. The sites have not been revisited since the fire. In the coming year, NRS will monitor the plants when working in the area, but they will not be targets for management.

3.3.j *Chamaesyce herbstii*

C. herbstii is a small tree growing up to 8m tall. It is found only on O'ahu in the northern and central Wai'anae Mountains (Wagner et al. 1990).

3.3.j.1 State Land

C. herbstii is found in four different locations in Pahole NAR. A total of 41 plants were observed, all are mature. In one location there were an additional twenty dead plants. NRS will attempt to locate additional plants in Pahole in the future. NRS will return to the plants to place collection bags over the immature fruit in an attempt to acquire seeds for seed storage and trials at Lyon Arboretum. NRS will also begin weeding around these populations in the next year.

In the past year, NRS has begun to work in this area. During weed control in an area where plants have been known in the past, 2 mature and 3 immature plants were discovered. In the coming year, NRS will work on propagation methods for this species. NRS will begin to visit the other known locations in the next year and prioritize management actions. Weed control will continue around the plants as directed by NARS staff.

3.3.j.2 TNC Honouliuli Preserve

The last of the known Ekahanui population died in 2002. TNC staff has checked the area in the last year and no plants were found. In the coming year, NRS will revisit the site to check for seedlings. The historical site is protected from pigs by the S. Ekahanui enclosure.

3.3.k *Chamaesyce rockii*

Chamaesyce rockii is known only from the upper crest and cloud-swept summit ridges in the Ko'olau Mountains. The large red capsules of this species are unique in the genus (Wagner et al. 1990). It is also known from the windward side in deep wet gulches.

3.3.k.1 Kawailoa Training Area

There are six different locations in KLOA with about thirty of the estimated 600 mature individuals on O`ahu. There are estimated to be hundreds more in KLO, however this has not yet been confirmed.

The Army has been working with the Ko`olau Mountains Watershed Partnership (KMWP), which funded the construction of the pig enclosure in the upper `Ōpae`ula drainage. NRS participates in this partnership by having directed the fence route, slingloading gear, maintaining the unit and surveying for protected species. In the coming year, NRS will continue to participate in the KMWP as it moves towards beginning construction of another enclosure in the upper Helemano drainage. This fence will surround a number of the known plants of this taxon and over a hundred acres of undersurveyed habitat. This species will not be a target for management action in the next year but NRS will continue to survey for it when working in appropriate habitat. Plans for the stabilization of this species will be developed by the OIP.

3.3.l *Ctenitis squamigera*

Ctenitis squamigera is a fern with a short creeping rhizome. It is found on Kaua`i, Moloka`i, Lāna`i, West and East Maui and in the Wai`anae Mountains (HINHP 2000).

3.3.1.1 Mākua Military Reservation

On MMR, *C. squamigera* is known from the Lower Mākua MU. This population is not considered significant because it included four plants and represents less than 2% of those known statewide. Large populations of this fern are found elsewhere in the Wai`anaes in Mokulē`ia Forest Reserve and Lower Ka`ala NAR. NRS currently monitors this population, but have not successfully collected mature spores from it. NRS collected spores again this past year and results are pending. NRS expects that this species will present many propagation challenges. This species will benefit from ecosystem-scale weed and ungulate control but will not be the target of any prioritized management action besides tissue storage if propagation trials are successful. NRS will continue to survey for this species while in Mākua and note locations for the GIS database.

3.3.1.2 State Land

NRS have observed this species while conducting other management in Makaleha in the last year. There are estimated to be over 200 plants in this area. In the coming year, NRS will work with State NARS staff to identify populations and monitor them while conducting other work in Makaleha.

3.3.m *Cyanea acuminata*

Cyanea acuminata is known from mesic to wet forest in the Ko`olau and Wai`anae mountains on O`ahu, Lāna`i, Moloka`i and West Maui. It has narrow leaves and a white and purplish corolla (Wagner et al. 1990).

3.3.m.1 Kawailoa Training Area

NRS knows of about 74 plants in KLOA and there are estimated to be over 2000 statewide. These plants are mostly found along the Ko`olau Summit, although some are found on the leeward side down slope from the summit. *Cyanea acuminata* will not be a target for management action in the next year but NRS will continue to survey for it when working in appropriate habitat. In the coming year, NRS will continue to participate in the KMWP as it moves towards beginning construction of another exclosure in the upper Helemano drainage. This fence will surround a number of known plants of this taxon and over a hundred acres of undersurveyed habitat.

3.3.m.2 Schofield Barracks Training Area

On SBW, 107 plants are known from three sites. Rat damage has been observed at one of the populations in the past. NRS has monitored two of these sites in the past year. NRS discovered a new location with about 50 more *C. acuminata* this year and expect that with more surveys, more plants will be found.

3.3.n *Cyanea crispa*

Cyanea crispa is known from mesic to wet forest in the Ko`olau Mountains. It has fleshy stems, broad obovate leaves and a pale magenta corolla (Wagner et al. 1990).

3.3.n.1 Kawailoa Training Area

There is one site with about 5-10 *Cyanea crispa* in KLOA. The site is severely degraded and slugs, which damage the plants, cannot be controlled at this time. Weed control may harm the *Cyanea*, which are smothered in and growing throughout *Clidemia hirta*. Removing the *Clidemia* would greatly increase the light levels, potentially impacting the plants. Rat bait stations meant to protect snails are already in the area and may be expanded to protect fruiting plants. NRS collected cuttings from this population in previous years and now has established plants in the nursery. NRS plan to reintroduce these plants into the Opaepala exclosure in the coming year. The location of this species in KLOA is on the periphery of its range thus there are not many other appropriate reintroduction sites in KLOA (J. Lau, pers. Comm. 2004).

3.3.o *Cyanea humboldtiana*

Cyanea humboldtiana is found throughout the Ko`olau Mountains. It grows to be a small shrub with woody stems up to two meters tall. It has dark magenta or rarely white flowers and pale orangish-yellow berries (Wagner et al. 1990).

3.3.o.1 Kawailoa Training Area

There are estimated to be at least 100 mature individuals statewide. There are four sites in KLOA with 13 known individuals. There are hundreds of acres of undersurveyed habitat for this

species in KLOA. This species will not be a target for management actions in the next year but NRS will note new locations. The proposed Helemano fence will surround over 100 acres of appropriate habitat.

3.3.p *Cyanea koolauensis*

Cyanea koolauensis is a small woody shrub up to 1.5 meters tall, having three to six flowers with dark magenta corollas. It is found on exposed ridges in wet cloudswept forest and less often in mesic valleys (Wagner et al. 1990).

3.3.p.1 Kawaioloa Training Area

Cyanea koolauensis is endemic to the Ko`olau mountains and is known from Kawaioloa Training Area and Schofield Barracks East Range. It is one of the more common *Cyanea* species on O`ahu and not a high priority for management. NRS knows of this species from 20 sites in the Ko`olau Mountains and discovers new locations every year. NRS will continue to map new populations and monitor some existing populations for new threats. A fence project is being planned for the Helemano drainage of KLOA and it would surround some known plants and over a 100 acres of appropriate habitat.

3.3.r *Cyanea grimesiana* ssp. *obatae*

Cyanea grimesiana ssp. *obatae* is a shrub 1-3.2 meters tall. It has pinnately divided leaves, and the flowers are white and purple or magenta. The sub-species *obatae* is distinguished by having linear to triangular calyx lobes, separated at the base by small sinuses.

3.3.r.1 State Land

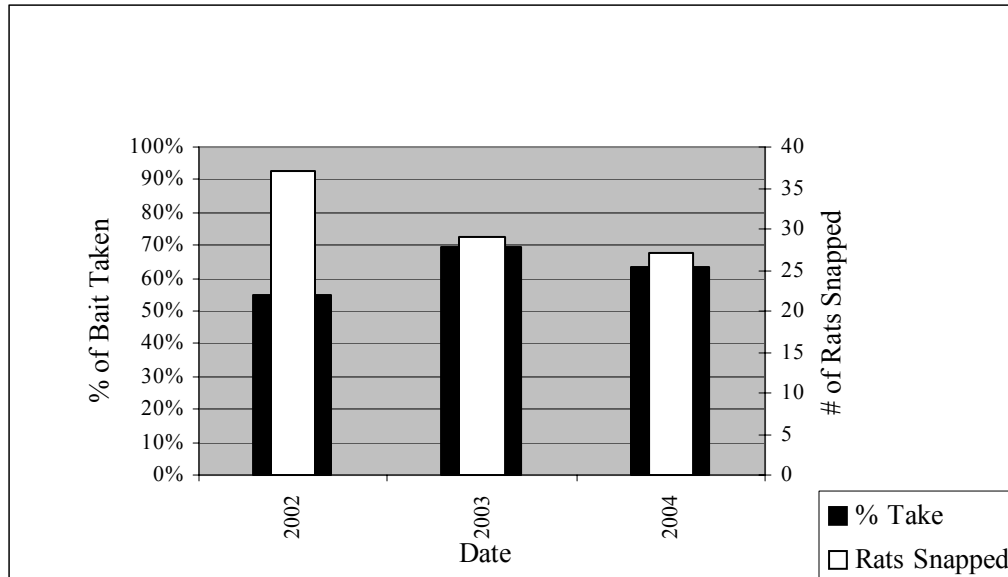
During surveys in 2000, NRS found a group of *Cyanea grimesiana* ssp. *obatae* in the headwaters of West Makaleha. There are five mature plants, two juveniles and one seedling. Predator control for rats was initiated in 2000 by NARS. An enclosure fence for these plants was completed in 2001, for protection against feral ungulates. During the flowering/fruiting season of 2001, NRS established six rat bait stations and 15 snap traps in the area to control rats. In May 2002, NRS discovered major rat damage to the five mature plants. Four had leaves eaten off and one had a damaged stem. By September 2002, the damaged plants were back to health and mature fruit was collected and brought to Lyon for propagation and storage. In response to the rat damage, NRS increased the number of bait stations to eight in the area and monitors them twice a quarter. No mature fruit was collected in 2003. Mature fruit collection is anticipated for 2004 with two mature plants flowering at the present time.

During the first seven months of 2004, a total of 486 blocks (13.8 kg) of rodenticide were taken from bait stations. The total bait consumed was 63.3% of the bait put into the bait stations. Twenty-seven rats were caught in snap traps during the first seven months of 2004 with an average of 4.5 rats per monitoring trip (6 monitoring trips). Figure 3-13 below is a graph of the amount of bait taken from the stations and the number of rats caught in snap traps for the last 2.6 years. Continued bait station and snap trap monitoring twice a quarter and bait station

modifications, initiated in 2004 to increase bait viability, will increase bait availability and more effectively control rats resulting in lower levels of take.

There is one juvenile plant inside a small fence in Palikea Gulch at Lower Ka`ala NAR. It has not been observed flowering yet but may in the coming year. If fruits are produced, they will be collected and germinated and if enough are collected, stored at the Lyon Arboretum. NRS will monitor the plant and the fence again in the coming year.

Figure 3-13 Rat Control at *Cyanea grimesiana* ssp. *obatae*



3.3.r.2 TNC Honouliuli Preserve

There are currently no known wild populations remaining in Ekahanui. NRS is assisting TNC in managing stock from plants known from the area. Currently there are nine individuals of mixed stock reintroduced within the Ekahanui fence, with three bearing flowers this July. TNC plans to collect fruit from these individuals for additional reintroductions.

In Kalua`a gulch there are presently two wild *Cyanea grimesiana*. KAL-A is in South Kalua`a and KAL-B is in Central Kalua`a. KAL-A is the type location for this species and therefore has great taxonomic importance. NRS constructed a fence in May 2004, to protect this plant from ungulates. There are 15 outplanted individuals remaining of the KAL-A stock, with several bearing fruit this August. KAL-B was recently discovered in central Kalua`a in close proximity to actively managed areas. The plant was previously buried by *Clidemia* and was not visible. NRS received more than a hundred seedlings from this plant from TNC and plans to outplant these individuals into the northern-most gulch of Central Kalua`a.

Pu`u Palikea, the southernmost area of the preserve under active management, has a small fence containing a healthy wild population of eight mature plants, seven immature plants, and 15 seedlings when monitored in July. The population was augmented twice in the 2003 and 2004

winters with 35 individuals of its own stock. NRS along with TNC staff manage the site for rats with baiting, and control feral pigs outside the fence with snares.

3.3.r.3 State Land

There are two extant *C. grimesiana* in Pahole NAR. The NARS biologist has been monitoring and collecting from these plants. NARS is working to develop a plan for the management of these plants and will enlist the help of NRS if necessary.

3.3.s *Cyanea longiflora*

C. longiflora is a shrub growing up to 3m tall. When individuals are young, they have small, sharp projections that gradually become smooth with age. This plant is only found on O`ahu. It previously occurred in the Ko`olau Mountains, but is now only known from the Wai`anae Mountains.

3.3.s.1 State Land

Recent surveys conducted by NRS in Pahole NAR located 19 seedlings, 40 immature, and 22 mature plants in 2 gulches and in 1 sub-gulch. NARS biologists estimate that there may be around 50 plants in the enclosure. These plants are all within the Pahole fence and are protected from ungulates. NRS plan to work with NARS to achieve a big collection by the end of this summer since the mature plants possess abundant immature fruit.

There are currently three known sites with this species in Kapuna Gulch. The NARS biologist estimates that there are 40 mature plants left in Kapuna and Keawapilau combined. In the coming year, NRS will monitor the known sites and assist State NARS staff in preparing the site for fence installation in Kapuna.

There are two known sites in Keawapilau Gulch. NRS has not monitored these sites, but will in the coming year. There is currently no ungulate control in this area and pigs undoubtedly affect the plants. NRS will monitor these plants in the coming year and determine the need for management at this site.

There are three mature plants located in West Makaleha. The plants are not within a fence but are not thought to be threatened directly by pigs. This past year, NRS didn't collect any fruit since Lyon Arboretum has over 2000 seeds in stock from these plants. NRS is hopeful that by not collecting, and allowing seeds to hit the ground, they will germinate on their own. In the upcoming year, NRS will monitor the mature plants as well as look for seedlings. No seedlings have been observed at this site.

3.3.s.2 BWS Makaha

There are currently three or four mature plants left on the Kumaipo ridge, which separates Waianae Kai and Makaha. A campfire that got out of control in early September 2003 killed one plant (Figure 3-14). NRS has worked with the BWS biologist to collect from this population and

over 2700 seeds have been deposited at the Lyon Arboretum seed bank for storage and trials. NRS monitored the plants in August of 2004 but did not collect. NRS will continue to monitor and collect from the unrepresented individual should it flower.

Figure 3-14 Burned *Cyanea longiflora*



3.3.t *Cyanea st.-johnii*

Cyanea st.-johnii is known only from the windy cloudswept ridges and gulches of the Ko`olau Mountains. It is relatively short for an O`ahu *Cyanea*, 0.3-0.6 meters tall, with white flowers that are sometimes tinged pale purple (Wagner et al. 1990).

3.3.t.1 Kawailoa Training Area

This species was found on Army land in 2000. There is one site with four mature plants and one juvenile plant in the Helemano drainage of KLOA. This population is the northernmost population in the Ko`olau Mountains and one of the few known from the leeward side. It is in a very intact native area. To reduce impact to the area, it has not been monitored often. On the trips that NRS have taken to visit the site the focus has been on trying to secure stock for propagation and reintroduction. Cuttings have been taken on two occasions and parts of a fruit were once retrieved from the ground. The cuttings were tried with both traditional methods and tissue culture. Unfortunately, no cuttings have yet rooted. Fortunately, there are presently approximately thirty plants in tissue culture at the Lyon Arboretum Tissue Culture Lab. These plants are from two seeds found in the partial fruit that was collected off the ground. NRS will ask Lyon to propagate these plants for storage and reintroduction. It will most likely take at least

another year for individuals to move through the lab and mature in a greenhouse setting before being ready to plant. In July 2004, immature fruit was observed on one individual. NRS will work to collect mature fruit this year.

The upper Helemano drainage is going to be fenced in the near future. This will exclude ungulates from the area around the plants and secure additional habitat that may be used for reintroduction. The fence should have been completed last year but there were problems with consolidating moneys from the partners and finding a route that had low overhead.

3.3.u *Cyanea superba* ssp. *superba*

Cyanea superba ssp. *superba* is known only from the Northern Wai`anae Mountains. Plants can reach six meters in height and have long dangling inflorescences (Wagner et al. 1990).

3.3.u.1 Mākua Military Reservation

The wild population of this species died out in 2003. NRS have reintroduced 251 *Cyanea superba* ssp. *superba* plants at four sites in Kahanahāiki Gulch from fruit collected from the wild plants. This is the first year that these sites have flowered. Last year NRS collected 30 leaf samples from *Cyanea superba* ssp. *superba* reintroductions for genetic analysis. Dr. Clifford Morden at the University of Hawai`i has analyzed these samples. Although NRS haven't received his written report at this time, personal communication with him reveals that the reintroduced plants are all genetically similar. If any plants show genetic variation, NRS will focus collection efforts on them. Plants grown from this stock will be used to supplement existing outplantings.

NRS will continue to monitor and perform weed control regularly around these plants.

3.3.u.2 State Land

Eighty nine plants were planted at one site in Pahole Gulch. Last year, only two plants were mature. This year there are now twelve mature plants. As seedlings of this species are susceptible to slug predation, NRS hope that S. Joe's slug research may result in techniques that could be applied to an area like this. (S. Joe's research is described in the *A. obovatum* section.) NRS will use this Pahole site to refresh the seed stock at the Lyon seed bank. NRS will continue to monitor and perform weed control regularly around these plants.

There are two sites with about ten mature and 45 reintroduced *Cyanea superba* ssp. *superba* in Kapuna Gulch. State NARS staff planted them in 1997 and 1998 and NRS supplemented the sites with stock from MMR in 2001. NRS monitors these sites periodically when conducting other management. In the past, NRS has assisted the State in controlling rats around these plants and collecting the fruits for storage at Lyon Arboretum. Recent research by Dr. Cliff Morden of the University of Hawai`i Botany Department shows that these plants are not much different from those plants found in other reintroduction sites. Based on this, NRS will manage other existing reintroductions in Kahanahaiki and Pahole Gulch.

3.3.u.3 Lyon Arboretum

Five plants were planted on February 14, 2003 in the Hawaiian section of the Lyon Arboretum. However, the plants are not thriving. NRS will strive to create a healthy living collection at a Botanical garden in the future.

3.3.u.4 Honouliuli Preserve

The Palikea fence now houses 39 individuals planted in spring 2004. Another 97 individuals of mixed stock were planted within the Kalua‘a fence in spring 2004. NRS and TNC continue to monitor their growth and manage the rat populations with bait stations.

3.3.v *Cyrtandra dentata*

Cyrtandra dentata is a shrub growing one to five meters tall. It gets its name from the dentate margins of its leaves. It is known only from two distinct areas in the northern Ko‘olau and Wai‘anae Mountains (Wagner et al. 1990).

3.3.v.1 Mākua Military Reservation

In Mākua, there is a thriving group of plants in the fenced enclosure in Kahanahāiki Gulch. All the known individuals of this species on MMR are within this fence. There are 156 mature plants, 57 juveniles and 27 seedlings at this site. It is suspected that the seedlings of this taxon are highly susceptible to slugs but no impact has yet been observed. Stephanie Joe, a graduate student from the University of Hawai‘i is studying the impacts of slugs on native taxa in Kahanahāiki. NRS will continue to support her important research in the up coming years. In the last year, NRS conducted weed control on two occasions around the *Cyrtandra dentata*.

In April of 1999, following fencing and ungulate removal, there was a spike in the number of seedlings observed. In September of 2001, a large number of those seedlings became juveniles. As of the most current monitoring, a large number of these juveniles had become mature. The overall trend at the Kahanahāiki population of this taxon is very positive.

This species is monitored annually by NRS, additional threats or changes in the population structure will be noted. In the coming year NRS will collect seed from this taxon to determine its seed storage potential. In addition NRS will continue to conduct weed control to improve and expand habitat for this population.

3.3.v.2 Kawaihoa Training Area

In KLOA, *Cyrtandra dentata* is known from three sites with over 100 individuals. This represents a small fraction of the more than 2,000 plants known statewide. There are seedlings and juveniles in these populations, although none of the Ko‘olau plants are protected from ungulates. NRS has seen populations grow rapidly when protected from ungulates in the northern Wai‘anae Mountains. This species will not be a target for management actions in the next year but NRS will continue to survey for it when working in appropriate habitat.

3.3.v.3 State Land

Recent surveys in Pahole NAR found a large amount of plants. 174 seedlings, 390 immature, and 405 mature plants were observed. NRS is confident that future surveys will reveal more plants. In this coming year, NRS will document any new plants in other locations.

HINHP reported *Cyrtandra dentata* from West Makaleha in the summer of 2003. There is no estimate of numbers and plants are recorded as “locally common”. NRS will monitor the recorded location in the next year and better quantify numbers and threats.

3.3.w *Cyrtandra subumbellata*

Cyrtandra subumbellata is known only from the North and Central Ko`olau mountains. It is rare and is found in moist gulch bottoms and ridges near the summit on the leeward and windward sides. It has white flowers and white berries (Wagner et al. 1990). Expert botanists believe that the center of abundance for this species is mid-elevation Windward Ko`olau forest to the east of SBE.

3.3.w.1 Kawaioloa Training Area

There are 30 plants at two sites on SBE. Both sites have seedlings and juveniles and there are hybrids with two other *Cyrtandra* species in one of the populations. NRS accompanied botanists from the NTBG and HINHP to a large population of *C. subumbellata* on the windward side of the Ko`olau Mountains east of Kawaioloa. There were more than a hundred individuals and many were hybridizing with other species. There were eight species of *Cyrtandra* found in this one small area. Finding this population makes the plants on the Army's portion of land less significant. NRS will continue to map new populations.

3.3.x *Cyrtandra viridiflora*

Cyrtandra viridiflora is known only from scattered windy cloudswept ridge tops in the Ko`olau Mountains on O`ahu. It is a small shrub growing half a meter to two meters tall with densely pubescent leaves and stems (Wagner et al. 1990).

3.3.x.1 Kawaioloa Training Area

There are 61 known individuals of this species found in KLOA. The `Ōpae`ula Watershed Protection Project Fence surrounds most of the known individuals of this species in KLOA. This fence has secured the area around the plants, especially those close to the Ko`olau Summit Trail, which is frequented by pigs. Those individuals outside the fence are still at a high risk for ungulate damage. In the coming year the Helemano enclosure will be completed and protect another 14 plants and over a hundred acres of undersurveyed habitat. NRS has been storing mature seeds at Lyon Arboretum. In the coming year, NRS will store mature seed from unfenced plants and those individuals not represented *ex situ*.

3.3.x.2 Schofield Barracks Military Reservation

One individual was found by NRS during surveys in SBE in 2002. It has not been monitored in the last year. There has been no management for this plant. The area in which this plant is found is not visited by NRS regularly and requires helicopter access. NRS will monitor this plant when in the area for other management. This species is also known from the USFWS Refuge to the south of SBE.

3.3.y *Delissea subcordata*

Delissea subcordata was known from O`ahu, in the Wai`anae and Ko`olau Mountains. This species grows to three meters tall, has green and white flowers, and berries that turn purple when ripe. It is now found only in diverse mesic forest on the windward side and crest of the Wai`anae Range (Wagner et al. 1990).

3.3.y.1 Mākua Military Reservation

Only one possibly wild mature plant is known from MMR. The origin of this single plant is still unclear. There is a reintroduction of *Delissea subcordata* from the Pahole NAR nearby and this plant may have come from seed dispersed from those plants. It may also be a new seedling from a historic population. NRS collected leaf material from the plant for Dr. Cliff Morden to analyze. Until the results of the study are in, NRS will treat this individual plant as unique and significant.

The *D. subcordata* reintroduction site in Kahanahāiki Gulch was initiated in January 1999. There are now over 30 reintroduced plants at this site and they have been observed flowering and fruiting. No seedlings apart from the possible plant discussed above have been observed in this reintroduction. Mature fruit has been collected for genetic storage trials at the Lyon Arboretum.

3.3.y.2 Schofield Barracks West Range

Last year, two plants were known in Mohiakea gulch. However, on a recent access day into West range, only one healthy mature plant could be located. The other plant appears to have died after the top was broken off by a rock fall. Access to the population is restricted by training activity, which limits the management options available to NRS. There have been successful collections of mature fruit from this population in the past. Collections are being stored at Lyon Arboretum. Seedlings from germination testing were grown at the Army Nursery. Plants from this population have been reintroduced to Kalua`a gulch.

3.3.y.3 Honouliuli Preserve

All the outplanted plants in the Kalua`a enclosure are doing great. This past year, mature fruit was collected from reintroduced plants for seed sowing trials being conducted by TNC. Two plants were recently discovered on a ridge in central Kalua`a, in a fenced area. NRS will outplant, among other things, *Cyanea grimesiana* ssp. *obatae* in the area around the plants. NRS will also conduct rare plant surveys to locate more plants.

This year NRS began working with TNC to manage the two mature and three immature plants found in two different areas in Palawai gulch. Fences were constructed around both areas and some weeding occurred. Two mature fruits were collected from PAL-A in July 2004 for seed storage.

In Ekahanui gulch, there are two sites with plants. One has two mature and one immature plant and the other has one mature plant. NRS and TNC built fences around these sites in the last year. Collections have been made and are being grown for reintroduction and stored at Lyon. This coming year NRS will continue to monitor the plants and collect fruit for seed storage at Lyon Arboretum.

3.3.y.4 State Land

NRS visited the known population location in Kapuna gulch with State NARS staff in the last year, and no live plants were found. Weed control is being done in this area to support other species and NRS will continue to monitor for more plants at this site.

A new site with one mature plant was discovered near the historic location in Kapuna in the last year. In the coming year, NRS will assist NARS staff to monitor this plant and collect fruit for genetic storage at the Lyon Arboretum.

Joel Lau and NRS visited the historic location for this species in Kaawa Gulch in Lower Ka`ala NAR in the last year. No live plants were found. This site may be monitored in the future for new plants when conducting other management in the area, but will not be a target for management.

Two locations with this species are known from Palikea Gulch in Lower Ka`ala NAR. One has one mature plant and it was in poor condition when monitored in July of 2003. There have been no known collections from this plant. State NARS staff has monitored the other site in the past and fruit has been collected and is stored at the Lyon Arboretum. NRS will assist NARS as needed in monitoring and collecting from these sites in the coming year.

In 2002, NRS worked with NARS at West Makaleha to establish a reintroduction of stock collected from the LKN-A population. Twenty plants were planted inside the enclosure in January 2003. Two plants sustained damage from rats and several from slugs in May 2003 and were in moderate health at that time. In July 2004, the two plants damaged by rats had died and the remainder of the plants were in good health with several fruiting. In May 2003, five bait stations were placed around the out-planted plants and are monitored quarterly. During 2004, monitoring increased to twice quarterly and 10 snap traps were added to the baiting area. A total of 143 blocks (4.1 kg) of rodenticide was taken from bait stations during the first seven months of 2004. The total bait consumed was 59.6% of the bait put into the bait stations. Twelve rats were caught in snap traps during the first seven months of 2004 with an average of 2.0 rats per monitoring trip (6 monitoring trips). Continued bait station and snap trap monitoring twice a quarter and bait station modifications, initiated in 2004 to increase bait viability, will hopefully increase future control efficiency. In the coming year, NRS will work with NARS to restock the stations and monitor the plants.

3.3.z *Diellia falcata*

Diellia falcata is a medium-sized endangered fern found in scattered populations in loamy soil. It is known only from the mesic forests of O`ahu (Palmer 2003).

3.3.z.1 Mākua Military Reservation

D. falcata is known from at least two sites on MMR. One site has fewer than ten individuals and the other several hundred. There are estimated to be more than 1000 individuals statewide. Although no specific management is conducted for this taxon, *Diellia* benefits from MMR-wide goat control efforts and from protection within the Kahanahāiki enclosure. NRS has worked with researchers from the NTBG to track population trends at the Kahanahāiki site in the past year. Results from these studies will be presented when they are available.

3.3.z.2 Schofield Barracks South Range

There is one small population of *D. falcata* in SBS. The site is not protected with a fence and will not be a target for management. Ungulate control would help to stabilize these populations and prevent further habitat degradation; however, access restrictions limit the ability of NRS to control weeds around rare plant populations in SBW where most are located. This species is not a priority for management given the relatively small number of individuals known from SBW.

3.3.aa *Dubautia herbstobatae*

Dubautia herbstobatae is known from the Northern Wai`anae Mountains. It is a small spreading shrub known only from dry ridges and cliffs (Wagner et al. 1990).

3.3.aa.1 Mākua Military Reservation

There are thousands of individuals known from the Northern Wai`anae Mountains. Over 98% of the known individuals are found on `Ōhikilolo ridge in MMR. Goats have been almost completely removed from MMR by control efforts. Elimination of goats from MMR potentially will have a large positive impact on this taxon by possibly no longer limiting it to places inaccessible to goats. NRS continue to control goats with in MMR with the short-term goal of complete eradication. In the coming year, NRS will work to develop a monitoring method for this species and collections of mature seeds will be made to conduct seed storage trials.

3.3.aa.2 Waianae Kai

There is one site with this species on the cliffs of Waianae Kai. There are at least five mature individuals there, but this site has not been adequately surveyed. In the coming year, NRS will survey more of this site and adjacent areas and attempt to collect from the known plants to keep as a living collection.

3.3.aa.3 Makaha

There was one known location of *D. herbstobatae* from Makaha. Presently no plants are known. The site where plants occurred has been surveyed in the last year. Stock was collected from this location before it was extirpated. NRS maintain this stock in the Army greenhouse. Once the Makaha fence is complete, NRS plan to reintroduce individuals into the fenced area.

3.3.ab *Eugenia koolauensis*

Eugenia koolauensis is known from dry gulches and slopes on O`ahu and Moloka`i (Wagner et al. 1990).

3.3.ab.1 Kahuku Training Area

There are estimated to be 210 mature, 195 juvenile and 1540 seedlings of this species in eight different sites in KTA. This is over 90% of the *Eugenia* trees known statewide. They are threatened by weed encroachment, especially from Ironwoods, ungulate damage from pigs, motocross use of the area and fire. In 2000, a fire suspected to have been ignited by a flare and grenade from Marines using the Training Area burned within 400 meters of a stand of *Eugenia* trees. In 2003, another fire burned near two known populations of this species. One juvenile and one mature tree showed signs of heat stress. The fire burned to within a half meter of seedlings, likely killing others and the fire burned to within six meters of juvenile and mature trees. The fire occurred while troops were clearing a helicopter-landing zone. A branch of a mature tree was cut in order to fortify a firebreak. Along the perimeter of the fire, invasive plant species have invaded aggressively. Weed control is conducted twice a year in each population. In the coming year, NRS hope to prioritize the populations and implement further management. There are plans to fence and control Ironwoods at these locations.

3.3.ab.2 Kawaioloa Training Area

There are two locations in Kawaioloa Training Area where NRS has discovered *Eugenia koolauensis*. Both sites are in the vicinity of the Kamananui drainage and drum road. A single tree was discovered in June of 2000. The second location is a more robust patch with 15 mature trees, 16 juveniles and 15 seedlings. This site was discovered in February of 2004. NRS will monitor this larger concentration of plants and continue to survey for more individuals.

3.3.ab.3 State Lands

Two mature trees and two seedlings were found in 2000, during surveys of Palikea Gulch in Lower Ka`ala NAR. In the coming year, NRS will work to prioritize the populations and determine management designations.

One mature tree was found in Hauula in 1999, but has not been monitored since. In the coming year, NRS will determine the priorities for this species and collect from those for genetic storage. The Papali Loop population has not been monitored by NRS at this time, but in the coming year, NRS will work to prioritize the populations and determine management designations.

3.3.ac *Euphorbia haeleleana*

This species is a small dioecious tree known from Kaua`i and the Wai`anae Mountains of O`ahu. On Kaua`i, it is most often found in mesic forest, but it is found in drier forest on O`ahu (Wagner et al. 1990).

3.3.ac.1 Mākua Military Reservation

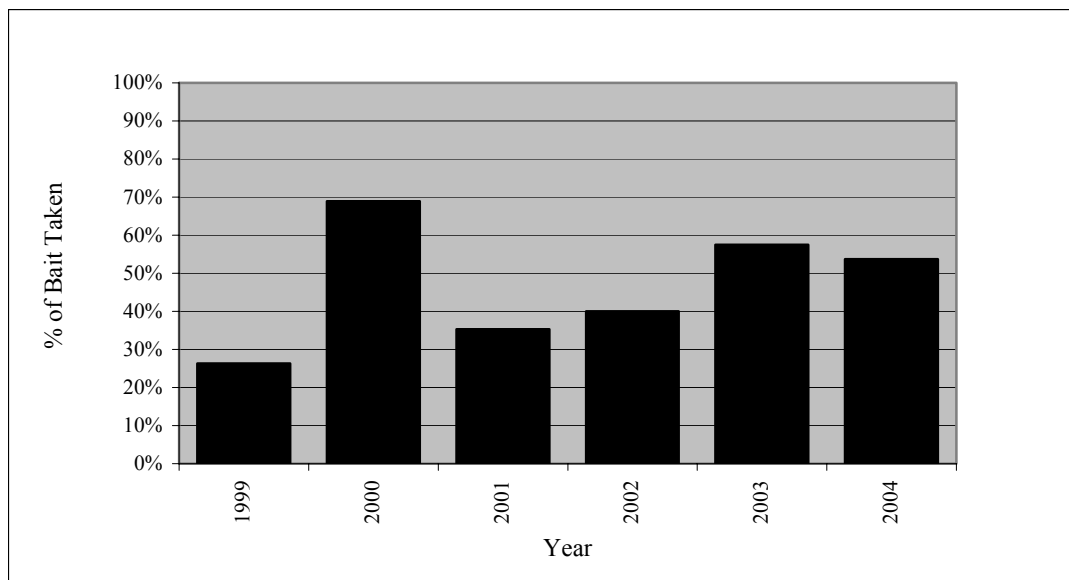
The *Euphorbia* in MMR are found in the Kaluakauila Gulch MU. There are two groups of trees (MMR-A and MMR-B) in the gulch, and both were fenced in 2002. A thorough count of the mature individuals was done in 2002, significantly increasing the known population size. Rats are known to eat the seeds of this species. A complete count of all individuals will be done every few years.

There are about 175 mature trees in the MMR-A population (lower patch). There are a few additional trees that appear old enough to flower, but have not yet been observed in flower. These are considered to be juveniles. Seedlings have been observed in the patch but seldom live for more than two years.

Baiting for rats in Kaluakauila began in 1999 and the grid was expanded in 2001. NRS continue to control rats at both the patches, MMR-A and B. A large baiting grid of 39 stations, which covers a 4.29-acre area, is established at MMR-A the Lower Patch. A grid of 18 stations, which covers a 2.5-acre area, is established at MMR-B the Upper Patch. Bait is restocked twice per quarter.

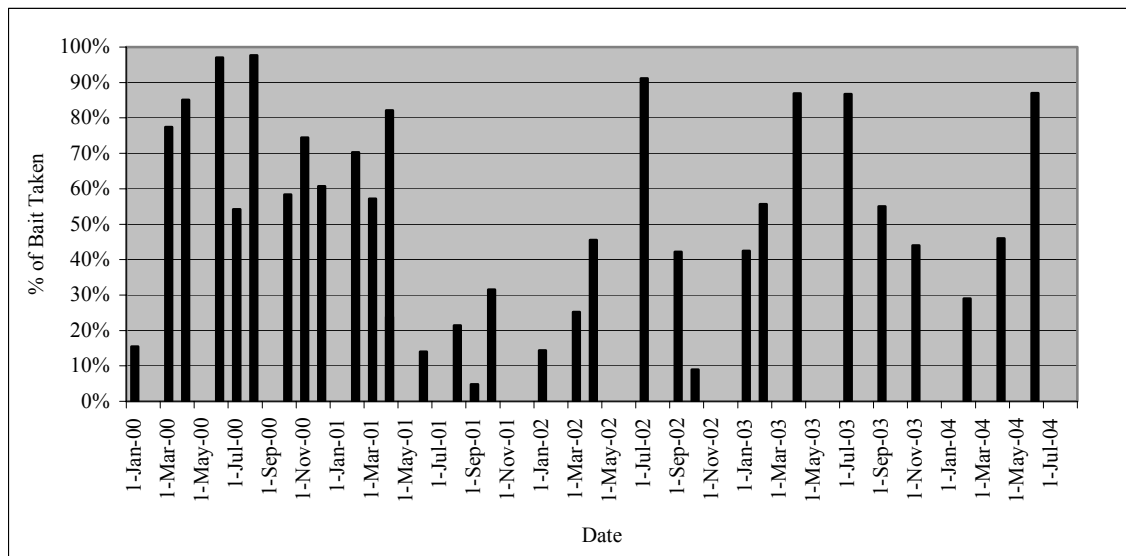
Figure 3-15 shows that in 2002 the percent bait take for the year was 40%, for 2003 it was 57%, and for 2004 it was 54%. The percent take for 2004 is average with respect to the previous years.

Figure 3-15 *Euphorbia haeleleana* Lower Patch (MMR-A) Rat Control by Year



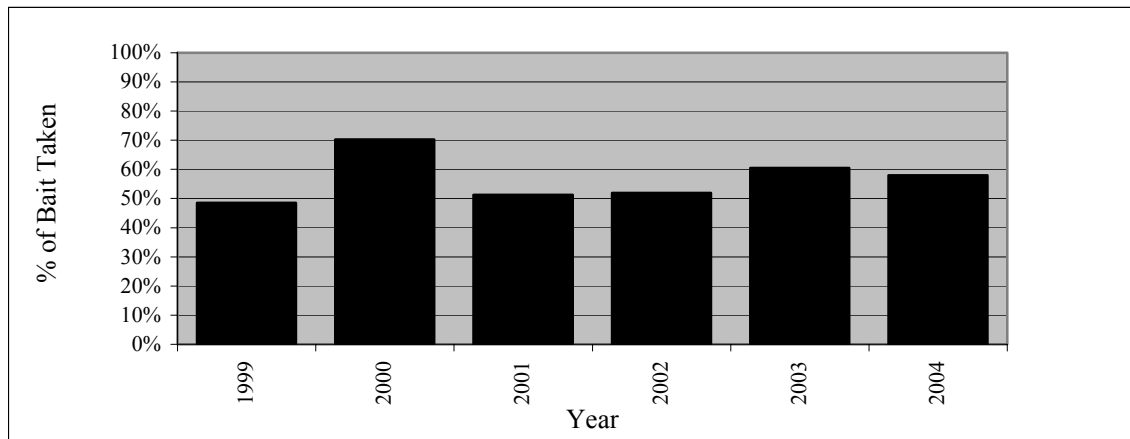
In Figure 3-16, a seasonal trend shows that the highest bait take in the lower patch occurred during the late spring to summer then dropped off into fall and winter in every year since 2000. This may indicate an annual trend for the rat population in Kaluakauila. Although there has never been 100% take during the spring to summer season, NRS may consider changing the amount of bait available during the different times of the year to better match the take. In general, this may produce less wasted bait during the slow season and prevent the take from approaching 100% in the summer.

Figure 3-16 *Euphorbia haeleleana* Lower Patch Seasonal Trends 2000-2004



There are about twenty known mature trees in MMR-B (upper patch). A few seedlings have been observed in this patch over the past few years, but none have grown to a juvenile tree.

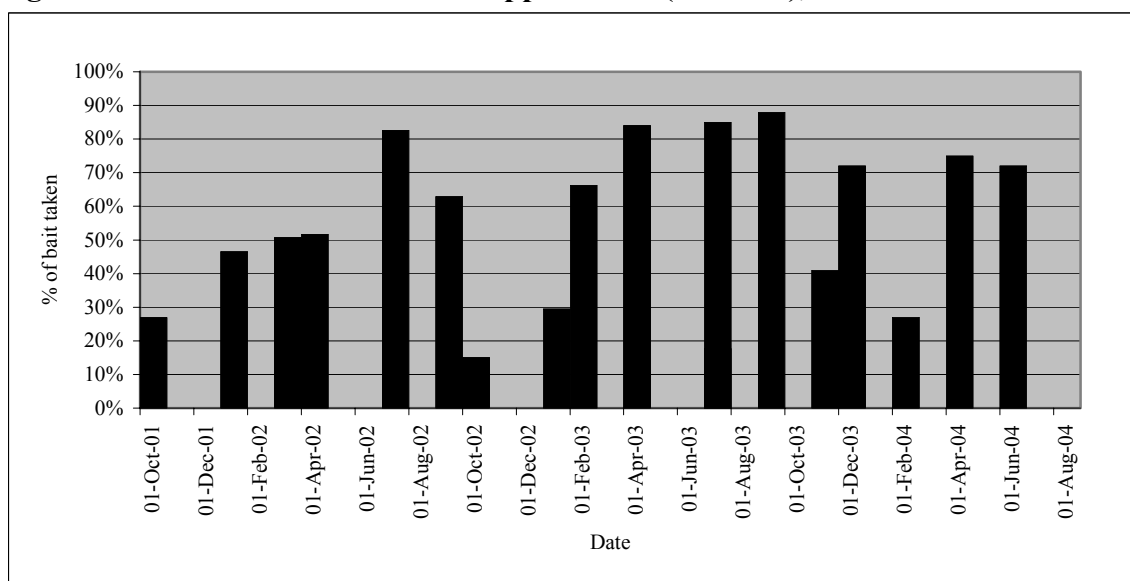
Figure 3-17 shows that in 2002 the percent bait take for the year was 52%, for 2003 it was 60%, and for 2004 it was 58%, which is about average for the past few years.

Figure 3-17 *Euphorbia haeleleana* Rat Control at the Upper Patch by Year

In Figure 3-18, a seasonal trend similar to the one in the lower patch shows that the highest bait take in the upper patch occurred during the late spring to summer then dropped off into fall and winter in every year since the winter of 2001.

NRS reintroduced stock from the Kaluakauila population of *E. haeleleana* into Kahanahāiki in January 2000, at the MMR-D site. Thirty-four of the 39 survived and most are healthy. No plants have been observed flowering yet.

In the coming year, NRS will continue to monitor the wild population for new threats and trends, continue rat control, and monitor the enclosure to ensure that it is ungulate free. The reintroduction site will be monitored once. A fire prevention plan is being developed for this area. NRS is helping to identify priority areas for fuel control.

Figure 3-18 Seasonal Trends in the Upper Patch (MMR-B), 2001-2004

3.3.ac.2 Dole Lands

There are three mature trees reported from two different sites below the Lower Ka`ala NAR access road. These trees have not been visited in the last year. In the coming year, NRS will prioritize management for this area. This may involve fencing and weed control for other species near the *Euphorbia* and they may benefit from this management.

3.3.ad *Flueggea neowawraea*

Flueggea neowawraea is one of the rarest trees in Hawai`i. It was known from all the major islands. On O`ahu it is known only from the Wai`anae Mountains. This taxon is known to grow to thirty meters tall with a base two meters in diameter and is dioecious (Wagner et al. 1990). Most plants are terribly impacted by the black twig borer. NRS have been successful in propagating *Flueggea* from air-layers (Figure 3-19, and 3-20), however access and BTB damage limit the success of this method. Air-layers can dry out during the months between visits and the material being air-layered is still vulnerable to the black twig borer. Cuttings have been successful as well and are proving to be a more efficient method. NRS are currently working with researchers from the University of Hawai`i and the State Department of Agriculture Extension Service to control this threat. This will require much lab and fieldwork to determine the interaction between the tree, the borer, and the fungus associated with the pest and possible control methods. NRS is currently seeking out interested researchers to work on this issue.

3.3.ad.1 Mākua Military Reservation

There are five live mature trees in four different sites on MMR. Access to two of the trees is restricted and therefore, NRS are limited to quarterly monitoring. NRS have conducted weed control around most of these trees, and two are within a fence to exclude pigs and goats. The main threat to these trees is the damage caused by the black twig borer.

Population MMR-A consists of one tree and is located on the rim of Mākua Valley. It is not within a fence, but one will be built in 2005-06. NRS has been unsuccessful getting cuttings from this tree to produce roots. More will be taken in the coming year and air-layers will be put on the tree. Propagules collected from this tree will be grown out at the Army nursery and cloned for reintroduction.

Population MMR-B consists of one mature tree, it is inside the Kahanahaiki Gulch fence. NRS have collected an air-layer cutting from this tree and other tip cuttings have been successfully rooted in the last year. Stock collected from this tree will be grown at the Army Nursery and cloned for reintroduction.

Figure 3-19 Air-layer on *Flueggea neowawraea*



Figure 3-20 Rooted Air-layer from *Flueggea neowawraea*



Population MMR-C consists of two mature trees in the Lower Mākua Management Unit. A fence to exclude goats, which were browsing the suckers, was built around one of these trees. Fruit has been collected from this site, however none have ever germinated.

Population MMR-E consists of one mature tree below the Kahanahaiki management unit. This tree is outside the fenced enclosure. However, the canopy is taller on this tree and it is not at risk from ungulate browse. NRS have never collected fruit from this individual and cuttings and air-layers have not established in the nursery. NRS will work in the next year to establish *ex situ* stock from this tree.

In Kahanahaiki Gulch, MMR-F consists of a reintroduction initiated in the last year with 26 immature trees grown from fruit collected from a tree in West Makaleha (LEH-A-2). These trees were planted in December of 2003 and are treated quarterly with a systemic insecticide Merit. As of April of 2004 no plants had died, but several had black twig borer damage. NRS will continue to apply Merit quarterly and monitor the success of this technique.

3.3.ad.2 Schofield Barracks Military Reservation

The single tree that was known from SBMR was inspected again this year and appears to be completely dead.

3.3.ad.3 Lualualei Naval Magazine

NRS has helped the Navy to collect from trees known from Lualualei in the last year. There are four trees known and cuttings and air-layers have been collected from two in the last year. The propagules are being grown at the Army Nursery and will be cloned. One tree is within a small fence and the others are unprotected. NRS will collect from the other trees in the coming year and work with Navy staff to monitor the other trees.

3.3.ad.4 State Land

There are two trees known from Central Makaleha. NRS has relocated and installed air-layers on these trees in the last year. Both trees are in moderate condition and are not fenced. Cuttings have rooted from one tree so far and will be grown and cloned at the Army Nursery. In the coming year, NRS will continue to monitor these trees and collect from the unrepresented tree.

In West Makaleha there are three *Flueggea* known by NRS. NRS attempted to establish air-layers on these trees in the last year however, the air-layers were destroyed by black twig borer. Cuttings were successful in the greenhouse for two of the three trees. NRS will work to secure stock from the third individual in the next year.

In East Makaleha, four trees have been reported. NRS has not visited these sites in the last year. In the coming year, NRS will revisit these trees and collect for propagation at the Army Nursery.

In Pahole Gulch NRS there are three mature trees. NRS recently collected cuttings from these trees and they are being propagated at the Army Nursery. They are looking good and NRS expects that they will root.

One tree is known from Kapuna Gulch in the Pahole NAR. The tree is not within a fence and NRS has just begun weed control in the area in the last year. NRS has visited and collected from this tree. Cuttings were taken to the Army Nursery and will be grown for cloning and reintroduction.

In Lower Ka'ala Natural Area Reserve, Kaawa Gulch, there are three mature trees, one tree was discovered by NRS in the last year. NRS has collected from two of the trees and cuttings are being rooted at the Army Nursery. Propagules will be grown from cloning and reintroduction in the future.

In Lower Ka'ala Natural Area Reserve, Manuwai Gulch, NRS relocated one of the two known trees in the last year, and it had died. The other tree was not located and others may be found in this area in the coming year. If trees are found, cuttings will be taken and grown at the Army Nursery.

The tree known from Waianae Kai was found to be dead in the last year. NRS will continue to look for more trees when working in the area.

3.3.ad.5 BWS Makaha

NRS worked with BWS biologist in the last year to install air-layers on three of the five known trees. The air-layers were successful on two of these trees and they are now rooted in the Army greenhouse. NRS will work in the coming year to secure stock from the other three trees. Four of these trees are within the proposed Makaha fence enclosure.

3.3.ad.6 TNCH Honouliuli Preserve

One *Flueggea* was known from Honouliuli, it died sometime in 2002. NRS never saw this tree. Nature Conservancy Biologists visited the location this year and report that the tree is dead.

3.3.ad.7 Waimea Botanical Garden

NRS has worked with the staff of the Garden to plant immature trees that were grown from fruit collected from the West Makaleha (LEH-A) trees in the last year. Fourteen trees were planted and are being treated with a soaking of Merit quarterly. NRS will continue to treat and monitor these trees to assess the success of this site.

3.3.ae *Gardenia mannii*

Gardenia mannii is known to be uncommon from mesic to wet forest on O'ahu. It is one of three species of *Gardenia* endemic to Hawai'i. This species is a tree growing from five to fifteen meters tall. The leaves are clustered at the tips of the branches. The white, fragrant flowers open

in the late afternoon and last for two days. The fruit is yellow to orange with reddish orange pulp (Wagner et al. 1990).

3.3.ae.1 Kawaiiloa Training Area

NRS know of 40 trees in six different areas on KLOA. There are likely to be many more, as hundreds of acres of appropriate habitat remain undersurveyed. In the last year NRS weeded *Psidium cattleianum* and *Clidemia hirta* from around populations of *G. mannii* in the Lower Peahinaia Management Unit. A fence planned as part of the Ko'olau Mountains Watershed Partnership would surround many of the known trees in this area. In the coming year, NRS will continue to search new areas.

3.3.ae.2 Schofield Barracks West Range

There is one site with two *Gardenia* trees in SBW (Figure 3-21). These individuals do deserve attention and management because they are among the few known from the Wai'anae Mountains. NRS had planned to construct a fence around these individuals last year. However, because of range restrictions and changes in safety planning requirements the fence was not completed. NRS is working with the Army Safety Office to gain permission to construct the fence. The fence line has already been laid out and cleared. In the past five years fruit has been collected on four occasions and taken to Lyon Arboretum for storage. Most recently a collection was made in June of 2004. Due to ordnance and schedule restrictions and the remote nature of much of SBW, there is much area that remains under-surveyed. These areas have good habitat for this species and more plants may be found.

Figure 3-21 *Gardenia mannii* from SBW



3.3.ae.3 Schofield Barracks East Range

Two *Gardenia mannii* trees are known on SBE. They were found in 2002 and have not been monitored since. There are about 300 trees known from the Ko`olau Mountains making these two individuals low priority. In the coming year, NRS will continue to search new areas as access allows. A long-term botanical garden type setting should be found for this species, so ex-situ stock can be held as mature trees.

3.3.af *Hedyotis degeneri* var. *degeneri*

Hedyotis degeneri var. *degeneri* is known from diverse mesic forests in the Wai`anae Mountains of O`ahu. The other variety (var. *coprosimifolia*) is known also from the Wai`anaes. *Hedyotis degeneri* var. *degeneri* is distinguished by having glabrous stipules (Wagner et al. 1990).

3.3.af.1 Mākua Military Reservation

There is one site with eleven individuals of *H. degeneri* var. *degeneri* in Mākua. This site represents less than 5% of the individuals known statewide. The population is located within the Kahanahāiki MU, but is outside the Kahanahāiki fence. Seedlings were observed in the population this year. This species benefits from ongoing ungulate and weed control and a fence is planned for this area. In the last year, NRS attempted to collect mature fruit for genetic storage. This taxon does not have a predictable phenology and collections were not successful. Stock is being stored at the Lyon Arboretum. The MMR fire of 2003 burned to within 50 meters of this population. NRS will continue to try and collect for genetic storage and will continue ungulate and weed control in the area.

3.3.af.2 State Land

This year NRS began working more frequently in Pāhole Gulch and visited a known population of *H. degeneri*. NRS approximated 24 plants at the site and there may be more. On a separate day NRS discovered a new site with 12 plants. As NRS spends more time in Pāhole it is expected that more plants will be discovered. NRS will monitor the known sites for fruit for storage.

At this time there are 45 mature plants in Central and East Makaleha at 4 different locations. There are a few juveniles and seedlings between the populations. In the coming year, NRS will obtain genetic representation from these plants, survey for more, and determine the best place for a proposed fence in this area.

There are 58 mature plants known from two sites in the Lower Ka`ala NAR. These plants should benefit from ungulate removal in the area. In the coming year, NRS will continue ungulate control, survey for more plants in this area, and collect for genetic storage.

3.3.ag *Hedyotis fluviatilis*

Hedyotis fluviatilis is a scandent shrub with white fleshy and waxy flowers. It is rare in mesic to wet forest on Kauaʻi and in the Koʻolau Mountains of Oʻahu (Wagner et al. 1990).

There are three groups of plants in KLOA with a total of 110 individuals. This species will not be a target for management action in the next year but NRS will continue to survey for it when working in appropriate habitat.

3.3.ah *Hedyotis parvula*

Hedyotis parvula is known only from rock ledges, cliffs and outcrops in the Mountains. It is a small shrub with white flowers (Wagner et al. 1990).

3.3.ah.1 Mākua Military Reservation

There are two known sites with *H. parvula* in MMR, one with 46 mature plants, and the other with about 45. NRS believe that goats are nearly eliminated from MMR and are pursuing the few remaining animals. The elimination of goats from the valley will reduce the ungulate threat to this taxon. NRS is controlling the incipient population of *Rubus argutus* in the vicinity of one *H. parvula* site. Both of the wild sites were visited in the last year. Both sites still have about the same number of mature plants and are stable. In the coming year, NRS will monitor the plants and determine the management strategy for these plants.

3.3.ah.2 Lualualei Naval Magazine

Twelve mature plants are known from one site in Halona. They were healthy and had no pressing threats when observed in July of 2003. No collections were made. In the coming year, NRS will survey more in this area, search for other reported plants, and collect for genetic storage.

3.3.ai *Hesperomannia arborescens*

Hesperomannia arborescens is known from wet forest on Oʻahu, Molokaʻi and Lānaʻi. It appears to be extirpated from Lānaʻi and is rare on other islands. It is a small shrubby tree averaging 1.5 to 5 meters tall with a yellowish brown or purple tinged pappus (Wagner et al. 1990). It was also found in mesic forest in the Waiʻanae Mountains of Oʻahu.

3.3.ai.1 Schofield Barracks East Range

There are three known populations in SBE. One population has fifteen mature plants, one has 25 and another has about 50. While this species will not be a target, in the coming year, NRS will continue to search new areas and map new populations.

3.3.ai.2 Kawaioloa Training Area

Further north in KLOA, there are twelve groups of plants with over 102 known individuals. There are juveniles and seedlings found in all sites. There are hundreds of acres of under-surveyed habitat appropriate for this species in KLOA. While this species will not be a target, in the coming year, NRS will continue to search new areas and map new populations.

3.3.ai.3 State Land

In Lower Ka'ala Natural Area Reserve, Palikea Gulch, three mature plants and one juvenile were found during surveys of this area in 2000. In the coming year, NRS will monitor these plants and survey the area for more.

3.3.aj *Hesperomannia arbuscula*

Hesperomannia arborescens is a tree growing up to five meters tall. It was known from O'ahu, Moloka'i and Lāna'i (Wagner et al. 1990)

3.3.aj.1 State Land

There is one mature plant known from Kapuna Gulch. Air-layers were put on the plant and have been monitored in the last year. Weed control in this gulch was begun in the last year. In the coming year, NRS will assist NARS staff in monitoring and collecting from this plant.

In Wai'anae Kai there were five mature plants and one juvenile in August of 2003. NRS conducted weed control at this site in the past but not in the last year. A fence has been scoped for this site and is pending approval from State Forestry officials. The plants are declining rapidly at this site and very few propagules have been secured from them. Also, someone picked the flowers of the tree. In the coming year, NRS will work with State NARS staff as well as GSN staff to monitor and collect from the plants. As soon as a fence is approved, it will be built. Propagules will be grown at the Pāhole Nursery.

3.3.aj.2 BWS Mākaha

The management of the *Hesperomannia arbuscula* plants in Mākaha has been executed by the BWS biologist and the O'ahu Genetic Safety Net biologist. Air-layers were installed, however they never rooted successfully. NRS scoped a fence route that encompasses the plants and is in the final stages of seeking permission to install this fence. NRS will become more involved with the BWS biologist in the management of this population in the coming year.

3.3.aj.3 TNC Honouliuli Preserve

As with the Mākaha population, much of the management for this species was conducted by the O'ahu Genetic Safety Net biologist and TNC staff. NRS constructed a fence to exclude ungulates from the area. (See Chapter 1: Ungulates for details.) Five air-layers successfully rooted and are at Pāhole Nursery. One air-layer fruited this year in the greenhouse, however it

aborted before the fruit matured. 5 seedlings were relocated to Pāhole Nursery as well. Thirteen fruits were delivered to Lyon, and several proved to be viable as germination in test tubes has occurred.

3.3.ak *Hibiscus brackenridgei* ssp. *mokuleianus*

Hibiscus brackenridgei ssp. *mokuleianus* is known to be rare in the dry forest and shrublands of all six of the major islands. They are sprawling to erect shrubs and trees up to five (-ten) meters tall. There are two subspecies. The *mokuleianus* subspecies occurs on Lānaʻi and Oʻahu (Wagner et al. 1990). There are three slightly different types of ssp. *mokuleianus* found on Oʻahu (Joel Lau pers. comm. 2001). Two of the types are found on the north end of the Waiʻanae Mountains from Waialua to Kaʻena. The other is found in Mākua Valley. The type known from Mākua resembles the plants historically known from Molokaʻi (subsp. *molokaiana*). No plants are known from Molokaʻi today.

3.3.ak.1 Mākua Military Reservation

There are now 18 mature, 8 juvenile and 11 seedling *Hibiscus* plants located in Mākua valley. NRS collected cuttings from almost all of the mature plants in the population and from the juvenile plants that were large enough to collect from. NRS have a complete complement of these clones at the Army propagation facility. Clones are also planted at Mākua Range Control, Kaluakauila management unit and Koko Head Botanic Garden. A full complement of clones is not yet established at any one of these reintroduction sites but in the next year NRS will work to achieve a complete set of founders at all three sites. NRS will be phasing out the living collection at the baseyard as plants are established in at least two living collection sites and in seed storage.

NRS removed all ornamental *Hibiscus* spp. that were planted at Mākua Range Control in the summer of 2004. This action was spurred by concerns over possible hybridization and pollen competition. NRS interviewed a number of horticultural experts before taking action. NRS emailed or spoke with among others, the following, Dr. Criley (UH Manoa), Dr. Koob (US Fish and Wildlife), Joel Lau (Hawaiʻi's Heritage Program), and Amy Tsuneyoshi (Board of Water Supply). In general, most thought that hybridization was unlikely but that removing the ornamental plantings would be the conservative decision.

NRS have collected more than twelve thousand mature seeds for storage from the living collection at Mākua Range Control. Unfortunately, much of the seed that has been collected is not viable. In addition, there is a long processing time required to get the seed out of the woody capsule making it difficult to obtain large numbers to offset low viability. NRS investigated seed for other living collections at Koko Head and Kaʻala Learning Center and found similar results. Lauren Wiesenberger from the Lyon seed bank came to Mākua to investigate that site and see if she could determine causes for low viability. She found that the growing tips of some plants appeared stressed and suggested that perhaps this was why the plants did not produce viable seed. NRS will work with her next year during collection to examine causes and improve efficiency of collection.

To investigate methods to improve seed viability, NRS this year began to manage the Range Control collection differently. In an attempt to improve vigor, plants were selectively pruned to reduce plant stress and to direct next season's flowering branches. A slow release fertilizer was broadcast after pruning. A slow release insecticide was also applied to address the insect pests in the area. The plant response to the actions taken appear favorable.

Since grass control began at the Lower 'Ōhikilolo population in 2001, NRS have maintained 30 meter firebreak buffer around all plants. NRS has also almost completely removed all *Leucaena leucocephala* (koa haole) and *Acacia mearnsii* (klu). For more details see Ch.2: Weed Mgmt.

In December 2002, NRS reintroduced 38 *H. brackenridgei* from Lower 'Ōhikilolo stock into the Kaluakauila enclosure. The survivorship of these outplants was over 90% as of July 2004. The fires of 2003, from Mākuā Military Reservation affected these plants. A few were killed and the area is now smothered in *Panicum maximum* responding to the fire. In 2004, eight more plants were put into a different area in the upper patch. These sites will be analyzed in the coming year to determine if the plants are able to maintain their characteristics in different microclimates. These plants will be monitored in the coming year and the sites will be supplemented with available stock.

3.3.ak.2 State and Dole Lands

Surveys for *H. brackenridgei* ssp. *mokuleianus* were conducted in areas of the Lower Ka'ala Natural Area Reserve and Dole owned lands below the NAR in the last year. At least ten mature, 210 immature and several seedlings were found in four gulches in the area. Some locations were known historically, however, the majority were never reported. In the coming year, NRS will prioritize management for this area and determine where to build a large proposed fence. Ideally, the fence will surround the most plants in the area with the most potential for restoration. Goats, *Panicum maximum*, *Coffea arabica* and other weeds pose the largest threat to this species in this area, as well as a threat of fire. Proposed management would include fencing, hunting and massive weed control. All plants not within the proposed unit would be collected from and planted into the managed unit.

In the May of 2004, NRS survey the Kealia vicinity for *H. brackenridgei mokuleianus*. One mature, ten immature, and six seedlings where seen. Collections where made for genetic storage from the mature and two immature. Plants where seen growing on exposed ledges smothered by *Panicum maximum* and *Sicyos pachycarpus*. NRS was in search of an area to perform in-situ management. This site is marginal given its low numbers of plants and steepness.

In May of 2004, NRS surveyed the Kawaii gulch area for *H. brackenridgei mokuleianus*. Six immatures and two seedlings were seen. Collections were made from five plants for genetic storage. This area is also very steep and occupied primarily by *P. maximum* therefore, management in this area is difficult.

3.3.ak.3 Private Lands

The known site in Kaomoku Nui Gulch was not monitored in the last year. There were estimated to be at least 750 seedlings at this site in 2002. Only 2 plants were mature. Collections made at that time were grown at the Army Nursery and have been planted at the Army's Wheeler Baseyard. Other living collections were established at Kaiser High School and Waialua High School. In the coming year, NRS will work with State NARS staff to monitor this site for changes in population and threats.

3.3.al *Huperzia nutans*

Huperzia nutans (formerly *Phlegmariurus nutans*) is a rare club moss that is endemic to O'ahu and Kaua'i. It is a medium-sized stout, terrestrial or epiphytic plant. The sterile portions of the stem gradually transition to the fertile portions (Palmer 2003). *Huperzia nutans* has a scattered distribution around the Ko'olau Mountains, including several known plants from the windward side. They often occur as single plants and most are isolated, some being miles away from the other known plants. Though few are now known, much undersurveyed habitat still exists for this species and other botanists estimate many more are undiscovered. We have collected strobili from individuals of this species many times in the last few years, but have not been able to grow it. NRS has begun to collect rhizomes of the more common *H. phyllantha* to try and determine a propagation technique that may work for both. NRS will continue to look for this species while conducting management.

3.3.al.1 Kawailoa Training Area

There are five individuals known from four different areas in KLOA. NRS monitored all the locations in the last year and plants appear healthy. NRS will continue to monitor these sites and focus on trying to develop a propagation technique.

3.3.al.2 Schofield Barracks Military Reservation

There is one known individual from SBE. NRS monitored this location in the last year and the plant appeared healthy. NRS will continue to monitor this site and focus on trying to develop a propagation technique.

3.3.am *Labordia cyrtandrae*

Labordia cyrtandrae is a rare Kāmakahala found only on O'ahu. Last year, only eighteen mature plants were known. It was thought to have been extirpated from the Ko'olau mountains where it was once primarily, until one mature plant was recently found in Manana by GSN staff. All other plants are found in the Wai'anae mountains in the vicinity of Mount Ka'ala. It is a shrub up to two meters tall and has long (3-4 cm.) bi-valved capsules. This species is known to be dioecious (Wagner et al. 1990). There are now forty-four plants known from SBW, Makaleha, and Manana at fifteen different sites. NRS only works with the locations at Schofield Barracks Military Reservation. This species is found only on the steep sides of Mt. Ka'ala and some plants may be visited only with a rope.

3.3.am.1 Schofield Barracks Military Reservation

This past year NRS staff nearly quadrupled the amount of known plants through survey efforts. The range for this species covers hundreds of acres of remote habitat. Surveys would likely locate more plants. There are about four male, six female and 34 plants of unknown sex. Many of these unknown plants were recently found. NRS will determine their sex over the next year with additional monitoring. There have been no seedlings observed at these populations, and only one juvenile. While the numbers are encouraging, this species still faces major challenges as it has a very poor population structure.

NRS has been collecting seed from these plants since 1996. Seed was brought to the Lyon Arboretum and grown out at the Army Nursery. Two individuals were reintroduced by NRS and NARS staff into a protected area in the Mt. Ka'ala NAR in 2001. These plants are doing well and are monitored by NRS and NARS. Nine more juveniles were added in 2003, for a total of 11 plants. In the last year NRS has collected cuttings from all the wild plants on SBW, in an effort to secure stock for future reintroduction. However, there have been low success rates and presently NRS is focusing efforts on air-layer techniques. If this propagation technique proves to be successful, NRS will work on installing more in the coming year. Collecting from all the plants is still a priority since all known plants are mature. Plants grown from cuttings and air-layers in the greenhouse will be reintroduced into protected areas on Mt Ka'ala. The air-layers take a long time to root and are expected to grow very slowly. In the coming year, NRS expect to be able to reintroduce several more to help supplement the natural wild population.

Pigs continue to be a threat to these plants, especially those found in accessible areas. However, NRS has been working with other landowners to exclude ungulates from the Ka'ala bog. NRS and staff from BWS, NARS and TNC have installed four sections of fence around Ka'ala. These sections do not form a complete enclosure, rather bridge gaps between natural barriers (cliffs). Although NRS felt they should serve to exclude ungulates from the bog, pigs are continually seen. It is unsure if the pig sign is from resident pigs that were fenced in, or if the pigs found places to go around the fences. In the coming year, NRS will continue to monitor the bog for ungulate sign and respond accordingly to make it ungulate-free. In the past year, NRS has used staff hunters to control pigs in the bog and determine where if at all, the pigs are entering the bog. This will continue in the coming year. See Chapter 1: Feral Ungulate Management.

In review, this upcoming year NRS staff will do the following: 1) try to determine why there is such low recruitment of individuals, 2) reintroduce plants grown in the greenhouse into a protected area at Ka'ala to help supplement the natural wild population, 3) work to determine air-layer techniques that prove successful in *L. cyrtandrae*, 4) continue to monitor and collect fruit from the in-situ plants for seed storage and trials, 5) survey new areas for more plants, 6) survey for gaps in the fence to determine if pigs still have access into the protected area, and 7) continue performing controlled hunts to eradicate remaining pigs from inside the fence.

3.3.am.2 State Land

There are six mature and one immature individual known from three locations in East Makaleha. The habitat for this species in this area has not been adequately surveyed. The majority of the

current distribution for this species appears to be closer to the summit of Mt. Ka'ala. No management has been done in this area in the past year. In the coming year, NRS will determine the management priorities for these locations.

The Oahu Genetic Safety Net Biologists discovered a single *Labordia cyrtandrae* in the Manana area in the Ko'olau Mtns. while surveying this year. Manana is on private land controlled by Doug Smith. NRS will collaborate with him as well as GSN staff in the near future in additional surveys.

3.3.an *Lepidium arbuscula*

Lepidium arbuscula is known from open dry ridges and cliffs in the Wai'anae Mountains on O'ahu (Wagner et al. 1990). This species will not be a target for management actions in the next year but NRS will continue to survey for it when working in appropriate habitat.

3.3.an.1 Mākua Military Reservation

Fewer than ten plants are known from two sites in Mākua. One site is protected by a fence, and weeds have been controlled in the surrounding area in the past. In the coming year, NRS will map any new locations. There is currently no management proposed specifically for this species.

3.3.an.2 Schofield Barracks Military Reservation

There are eleven known individuals in Schofield from two sites. In the coming year, NRS will map any new locations and there is currently no management proposed specifically for this species.

3.3.ao *Lobelia gaudichaudii* ssp. *koolauensis*

Lobelia gaudichaudii ssp. *koolauensis* is known from cloudswept summit forest in the Ko'olau Mountains. It is a short shrub with a dense apical rosette of leaves. The subspecies *koolauensis* is rare and its inflorescence is sometimes branched and has greenish white flowers (Wagner et al. 1990).

3.3.ao.1 Schofield

In Schofield Barracks *Lobelia gaudichaudii* ssp. *koolauensis* is known only from one population of about 50 plants. This is more than 30% of those known statewide. As a member of the Campanulaceae this species is considered susceptible to seedling predation by slugs. Rats may also damage mature plants or fruit. These plants are monitored annually during the flowering season and any mature fruit will be collected and stored. No plants have flowered in the past three years. The population could be threatened by ungulates because it is not fenced. Snares are in place to protect plants and ungulate sign in the area has been low. This area may be the target of fencing in the coming year as part of the Oahu Implementation Plan.

3.3.ap *Lobelia niihauensis*

Lobelia niihauensis is only found on dry cliff faces, and is known from Ni‘ihau, Kaua‘i and the Northern Wai‘anae Mountains on O‘ahu (Wagner et al. 1990).

3.3.ap.1 Mākua Military Reservation

There are estimated to be about 450 individuals on MMR. There is great potential for more undiscovered *Lobelia* on cliffs hundreds of feet above the valley floor and below the ridge. This plant likes mid-elevation, very exposed cliffs, making detection and monitoring difficult, even with ropes. There are thousands of plants known on Kaua‘i and Ni‘ihau. Since only about 10% of the plants known statewide are found in Mākua and many of them inaccessible, there has been little management. The Fire Threat Level for this species is Medium. The Ungulate Threat Level is High because of goats. This species benefits from the control of goats in Mākua. NRS have not conducted any specific actions for this taxon.

In the last year, NRS has continued to find new areas with *L. niihauensis*. Next year, NRS will continue goat control and will note any new plants and threats.

3.3.aq *Melanthera tenuifolia*

Melanthera tenuifolia is known from diverse mesic forest and cliffs from the Central and Northern Wai‘anae Mountains. It is a sprawling perennial herb with yellow ray florets (Wagner et al. 1990). NRS are currently trying to develop a reliable seed collection technique. With the few small collections and two better size collections in the last year, NRS and staff of the Lyon Arboretum hope to determine the storage potential for this species. In the coming year, NRS will determine the most efficient method for holding this species ex-situ.

3.3.aq.1 Mākua Military Reservation

There are estimated to be over 2500 individuals on MMR in at least seven different areas. Some of these areas are distinct, separated by geographical and ecological boundaries, and others may represent large populations broken up for ease of management. Fire was identified as a significant threat to this taxon because three of the seven areas where this taxon occurs are surrounded by or abut alien grasslands. Only the populations where NRS conducted work in the last year will be discussed below.

In July of 2003, an arson-ignited fire burned the ‘Ōhikilolo Makai population of *Melanthera tenuifolia*. Many plants were affected by the fire. This population is represented in living collections by plants from 27 founders at the NIKE site nursery as backup genetic material. NRS have been charged with maintaining living collections and developing seed storage protocols because of the high fire risk in this area. NRS worked with this *M. tenuifolia* living collection as well as others, in an attempt to collect seed for seed storage trails. Unfortunately, NRS has been unable to collect seed from the plants in the living collections due to low seed production. NRS plan to investigate moving this living collection to tissue culture in the next year to streamline greenhouse operations.

In August of 2003 four goats were discovered within the Lower ‘Ōhikilolo strategic fence enclosure. To address this issue NRS also extended a strategic fence above the population this year. (See Chapter 1: Feral Ungulate Management for details.)

At the C-ridge population of this taxon there are about 100 mature plants. Most plants occur in a small forest patch surrounded by alien grasses. NRS has collected from a total of 79 individuals over the last two years. Cuttings from 73 individuals are rooted at the Army and Pāhole nurseries. This population was impacted by the July 2003 fire, which burned outside the firebreak road. At least 5 individuals of *M. tenuifolia* from C-ridge were burned and another couple dozen were stressed by heat from the fire (Figure 3-22). In August 2004, the area of the burn was surveyed and surprisingly there are now more plants in the area than there were before the fire. Perhaps the fire lessened competition from invasive grasses, *Melinus minutiflora* and *Andropogon virginicus*. NRS expects that the grass will come back strongly over the next year and will exclude the *M. tenuifolia*. NRS is monitoring this population via photopoints in order to document the long-term impact of the fire. NRS feels that the greatest impact of the fire is that it destroys the native forest that supports the *M. tenuifolia* and replaces it with invasive grasses. With reoccurring fires the native forest area continues to shrink, and with it, endangered plant habitat.

Note in the right-hand picture (Figure 3-23) the burned *Schinus* branches in the background. There is also a dead iliahi trunk on the left hand margin of the picture. This year there were multiple *M. tenuifolia* plants in this area, where only a single mature individual had been before the fire.



Figure 3-22 Burned plants at C-Ridge in July 2003

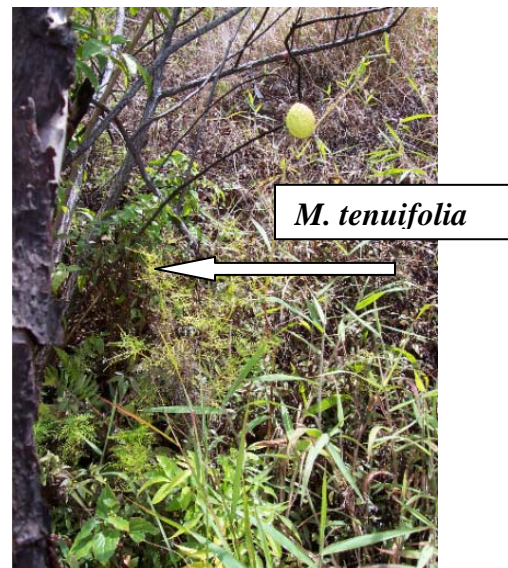


Figure 3-23 New plants growing at C-Ridge in August 2004

There are estimated to be over 100 mature individuals in the Kaluakauila Gulch MU. The July 2003 fire did not directly impact the Kaluakauila population of this taxon, yet the fire did burn within 30 or 40 meters. NRS has monitored this area in the past year. There are no major

changes in distribution or abundance. This site will be monitored in the next year and management prioritized.

3.3.aq.2 State Land

There are estimated to be over 250 mature individuals at Lower Ka'ala Natural Area Reserve, Manuwai Gulch. The plants were monitored in the last year and there was no change in the estimates of population distribution or abundance. NRS has been conducting ungulate control in the vicinity of this population for two years. Through these efforts goats numbers have dramatically dropped. See Ch.1: Feral Ungulate Management for details. In the coming year, NRS will continue ungulate control and monitor this site for changes in the population.

In Waianae Kai, there are estimated to be almost 200 hundred plants at four different locations. NRS has not monitored these plants in the last year. In the coming year, NRS will determine the management priorities for this species in Waianae Kai.

3.3.aq.3 BWS Mākaha

In Mākaha NRS know of five sites with hundreds of individuals. NRS visited most of these sites in the last year, monitoring them conjunction with other management actions. One of these sites will be protected in the planned Mākaha fence enclosure in the next year. See Ch.1: Feral Ungulate Management for details.

3.3.ar *Melicope cinerea* var. *cinerea*

Melicope cinerea is known only from diverse mesic forest on O'ahu and Maui. It is a small tree up to seven meters tall and three varieties are described. One is found on Maui, one in the Ko'olau Mountains and the last variety *cinerea*, is known from the Wai'anae Mountains. It is distinguished by having a densely pubescent inflorescence (Wagner et al. 1990).

3.3.ar.1 Kawailoa

There are 2 trees known from one site on SBW. This species is considered a Species of Concern but needs more surveys to determine its current status. NRS have conducted surveys for this species in the last year, but no new plants were found. NRS feels that with more time in West range, more plants could be found. In the coming year, NRS hope to return to the known trees and will note new locations.

3.3.as *Melicope hiiakae*

Melicope hiiakae is known only from the Ko'olau and Wai'anae Mountains of O'ahu (Wagner et al. 1990).

There are four groups with six individuals between them of this rare *Melicope* known in KLOA. This species would benefit from ecosystem-level ungulate removal and weeding. It is a Candidate for Endangered Status and more surveys should be done to better determine

population size and range. While this species was estimated to have about a 100 individuals in the state, recent estimates show a population of less than 25 individuals, making the Army plants much more significant. Joel Lau of the HINHP believes that this species is underreported, given its cryptic appearance and taxonomic challenges, which require flowers for identification. NRS will continue to survey for this species when in appropriate habitat.

3.3.at *Melicope lydgatei*

Melicope lydgatei is known from scattered populations in the Ko'olau Mountains. It is a small shrub with opposite leaves and glossy leaf surfaces (Wagner et al. 1990).

3.3.at.1 Kawaiiloa Training Area

In KLOA, 28 *Melicope lydgatei* are found in the Lower Pe'ahināi'a MU and near the Kawaiiloa Trail. No seedlings have been observed in the populations, but juveniles are present. This species has documented threats from aphids, and ungulates impact its habitat. Ungulate control has been suspended in this area due to conflicts with illegal hunting. Collection and reintroduction of extirpated individuals will be pursued by NRS once a suitable site and founder material are identified and we have landowner approval. This species would benefit from large-scale ecosystem protection from fencing and more weed control. In the coming year, NRS hope to work with the landowner to facilitate hunting access to the lower areas in KLO. A fence planned as part of the Ko'olau Mountains Watershed Partnership would surround many of the known trees. In KLOA, weed control is most effective in areas where ungulates are excluded. Weed control will begin on a large scale once the fence is built. In the Kawaiiloa trail area NRS will do additional surveys to better assess population size in area.

3.3.au *Melicope makahae*

Melicope makahae is known only from mesic forest in the Wai'anae Mountains. It is a shrub or a shrubby tree growing up to three meters tall (Wagner et al. 1990).

3.3.au.1 Mākua Military Reservation

About twenty plants are known from the forest patch on 'Ōhikilolo and a few more are known from the upper slopes of Lower Mākua. While the Army has few known plants on MMR, this species is rare and has a very restricted population range. This taxon benefits from fencing and weed control at the 'Ōhikilolo forest patch and goat control across MMR. NRS will continue working on these actions in the coming year. NRS were not able to collect mature fruit from this taxon in the last year but will attempt again this year in order to determine germination techniques and storage potential.

3.3.av *Neraudia angulata*

Neraudia angulata is known to be rare in the diverse mesic forests of the Wai'anae Mountains. It is an erect shrub growing one to three meters tall (Wagner et al. 1990). The fruit are red when ripe and are held closely to the stems.

3.3.av.1 Mākua Military Reservation

There are three sites in Lower Mākua (MMR-A, MMR-B, and MMR-D). MMR-A and MMR-B have been monitored regularly by NRS since 1998. MMR-D was monitored by HINHP and NRS in the last year. This species has proven to be an easy one to propagate vegetatively. Tip cuttings have the highest success rate at 80-90%. NRS now have established material propagated from collections made in 2003-2004 that currently serve as nursery stock plants. NRS have observed that many of these cuttings will flower and set fruit within one year. Seeds from these plants have been taken to Lyon Arboretum for storage and viability testing

Population MMR-A in Ko‘iahi Gulch experienced a large boom in numbers of seedlings and juveniles. Twenty-nine new immature and close to forty seedlings were observed. This increase in individuals is attributed to the low numbers of goats in Mākua and the high rainfall this past year. NRS has collected cuttings from 22 of these new plants and from eleven other plants that were previously tagged. This brings the total collected to greater than 60 individuals. In this coming year, NRS will outplant more individuals to the augmented population at MMR-D. NRS will also build two new fences around the two groups of plants that make up the MMR-A assemblage. These proposed fences will protect the habitat of these plants from pigs, which have dug up all plants that have germinated below the cliffs that support the bulk of the population. By installing a single fenceline between cliffs at the entrance to the two sub-gulches. NRS feel that pigs can be excluded. The first line is approximate 40m and the second sub-gulch fenceline is approximate 35m. NRS will continue to monitor MMR-A on a biannual basis.

MMR-B is presently only a single plant growing on the side of a waterfall makai of MMR-D. This plant has been collected from and is represented at the MMR-D augmentation site.

In March of 2003, and again in December 2003, NRS augmented a gulch that has a natural population (MMR-E). This action was chosen because this area could be blocked off from pigs by the installation of a single short fence between cliffs. A total of 47 juvenile plants were outplanted. These plants are all from the natural populations (MMR-A and MMR-B). The last monitoring of these plants was conducted in January 2004 and the majority of the plants looked healthy. NRS will continue to monitor this reintroduction.

3.3.av.2 Private Land

NRS has secured material from the single plant at Dillingham Ranch. Cuttings were taken to the Army facility and cloned. In January 2003, three plants were reintroduced onto the Kaluakauila Management Unit in MMR. Five more plants were planted in March 2004. They were monitored in April of 2004, and all eight plants are in healthy condition. NRS has additional plants in the Army greenhouse and will continue to out plant until the numbers are substantial. Mature seed collected from this site will be stored at Lyon. NRS will monitor the wild plant in the coming year for additional threats.

3.3.av.3 BWS Mākaha

In July of 2004, NRS observed seven mature and four immature *N. angulata* in the Kamailei area of Mākaha. Cuttings were made from eight of these plants and they are growing in the greenhouse at the Army facility. These plants are threatened by ungulates but will not be included in the larger planned Mākaha enclosure because they are geographically removed from it. This coming year, NRS, with along with Amy Tsuneyoshi the Board of Water Supply's Biologist, will survey the area around the existing known plants, as well as new areas in Mākaha for additional plants. NRS will also collect from all known individuals that are large and healthy enough.

3.3.av.4 State Land

There were eleven mature individuals and one juvenile found during surveys of Mokulē'ia Forest Reserve in March of 2003. When NRS visited the site again to scope a planned fence, there had been damage to the plants from a small landslide and goats had browsed several individuals leaving six plants. A fence was proposed to be built around the plants; however, permission is still pending from the State. When the site was visited in June of 2004, only two plants could be found, one in very poor condition. Propagules were collected during each visit and are being grown at the Army Nursery. In the coming year, NRS hopes to have permission to fence this area before the plants are all gone. The plants grown at the Nursery will be cloned and planted into a secure location on MMR when ready.

There are four sites known in Waianae Kai. There are about 45 mature plants at one site (WAI-A/E), one plant at the second (WAI-C), an estimated 45 at the third with 35 juveniles (WAI-B) and one at the fourth (WAI-D). Three sites have been monitored in the last year and the other has not been monitored since being reported by NTBG in 2000. In the coming year, NRS will continue to monitor these sites. Fences to protect the plants from pig damage have been proposed and the permission is being processed by the State.

3.3.aw *Nototrichium humile*

Nototrichium humile is found in the Wai'anaes and recently was found on East Maui. The plants are shrubs, which hold the flowers on slender spikes 3-14 cm. long. They are found in dry forest, on cliffs, steep slopes and in gulches (Wagner et al. 1990). NRS continue to work with the Lyon Arboretum seed storage lab to determine the storage potential of this taxon.

3.3.aw.1 Mākua Military Reservation

There are over 400 mature individuals in at least six locations on MMR in the Kahanahāiki, Lower Mākua, C-Ridge, Punapōhaku, and Kaluakauila MUs. This represents over 55% of the known statewide population. Juveniles and seedlings have been observed at these populations.

In Kahanahāiki there are estimated to be about 10 mature plants. All of these plants are within the fence. Weed control is conducted regularly in the gulch but rarely directed at this site. In the coming year, NRS will monitor this site to note any change in the population size or distribution.

In Kaluakauila, there are at least 200 mature plants. Almost all are within the fence, and weed control is done in the surrounding area on a regular basis. The plants are found from the gulch bottom up the south side. All the plants are found under canopy of at least 2 meters. The *Panicum maximum* found in and around the known plants is not continuous with the large grasslands that are found on the north and south side of the Kaluakauila MU. The fires in this area have burned areas where this plant may have been found in the past, but none were burned in this area in 2003.

In the Lower Mākua management unit *N. humile* is scattered in the lower dry gulches. Six individuals have been recorded but there are many areas where additional plants could be found. NRS will continue to record new individuals as they are found.

In Ko'iahi Gulch there are at least 50 *N. humile*. The steep sides of this gulch most likely conceal additional plants.

In Punapohaku, there are 152 mature plants, with 14 juveniles and at least 7 seedlings. This area was burned in the fire of July 2003. NRS approximated that five *N. humile* were burned by the fire. This species has a soft herbaceous stem and the individuals that burned were completely consumed by the fire, leaving no trace. This made quantifying damage difficult.

The C-ridge management unit contains excellent habitat for *N. humile*. However, the native forest area has been greatly reduced by past fires and the forest area is relatively small. There are more than twenty-five *N. humile* found within the forested area of this patch. These plants have been collected from to secure a living collection to guard against a catastrophic fire event.

3.3.aw.2 BWS Mākaha

NRS know of about twenty plants in Mākaha and believe that there are many more. There are extensive areas of undersurveyed habitat that most likely contain many more plants. In the areas where NRS have looked, all age classes were also observed.

3.3.aw.3 State Land

One plant is known from Lower Ka'ala Natural Area Reserve, Kaimohole Gulch. NRS monitored this plant and took cuttings in the last year. Propagules are being grown at the Army Nursery. In the coming year, NRS will develop management plans for this site. This plant will be reintroduced into protected habitat in the coming years.

There were seven mature plants reported from one site in Palikea Gulch in May of 1999. NRS have not been to this site since. In the coming year, NRS will monitor and collect from the plants and determine management goals for this site. These plants will be reintroduced into protected habitat in the coming years.

There is one site with an estimated 200 mature plants in Waianae Kai. In the coming year, NRS will determine how to keep goats from accessing this site, and monitor the plants for threats, and changes in the distribution and abundance.

There are estimated to be about 150 plants in the Keawa`ula area. The forest patch that these plants are in is surrounded by grasslands that have burned several times. These plants have been monitored in the past year. In the coming year, NRS will continue to monitor the plants. They appear to be relatively healthy and stable.

3.3.aw.4 Private Land

There are five mature plants known from Dillingham Ranch, Keawapilau Gulch. They were visited in the last year and cuttings were taken from all the plants. The propagules are now growing at the Army Nursery. They will be kept as a seed source for propagation/storage trials and serve as a living collection of these plants. These plants look very different than all other living collections.

3.3.aw.5 Lualualei Naval Magazine

There are at least four plants known from one site in Mikilua. They are within a small ungulate enclosure and are monitored by Navy staff. In the next year, NRS will assist Navy staff in monitoring and collecting from these plants.

3.3.ax *Phyllostegia hirsuta*

Phyllostegia hirsuta is a rare mint that grows as a shrub or liana. It is known from the Wai`anae and Ko`olau mountains of O`ahu. It is distinguished by having dense pubescence on the leaves and branches (Wagner et al. 1990).

3.3.ax.1 Kawailoa Training Area

This species is known from 7 sites totaling 8 individuals in KLOA, though there are estimated to be dozens more. Juveniles and seedlings have been noted in the populations. The proposed Helemano fence would protect several individuals and a hundred acres of appropriate habitat. This species will not be a target for management action in the next year but NRS will continue to survey for it when working in appropriate habitat.

3.3.ax.2 Schofield Barracks Training Area

There are four populations with about 75 individuals known from SBW and SBE. These populations will not be the target of management action due to the relatively small number found on Army lands.

3.3.ay *Phyllostegia kaalaensis*

3.3.ay.1 State Lands

In 1998, NRS staff along with Joel Lau observed about 10 plants in Pāhole Gulch. At that time, 2 cuttings were taken and sent to Lyon Arboretum. In April of 2001, NARS biologist Talbert

Takahama returned to the site to weed around the plants. He noticed a decline in the population with only 7 plants remaining. He collected cuttings from three plants which were sent to the NIKE site, where they are now living. However, in March of 2004 NRS staff revisited the site to find that all the plants were extirpated. NRS plans to reintroduce about 50 plants into Pāhole NAR this coming November. These plants came from 2 of the founders from Pāhole NAR.

The plants from Kapuna gulch are no longer there. This site was monitored by NRS in the past year.

The plants known from Keawapilau are no longer there, however collections by NARS staff are growing at the Pahole nursery and stock was reintroduced in the past year. Thirty-four plants were planted into a fenced area in the past year. When monitored this year, 20 had survived. In the coming year, NRS will assist NARS in supplementing this site with more stock from the Pahole Nursery.

The plants known from Waianae Kai were not found in the last year. They are thought to be gone. Early collections from this site are being grown and will be kept as a living collection. In the coming year, NRS will re-establish this collection at the Lyon Arboretum Micro-propagation Lab. This stock will be available for reintroduction in to Makaha when the fence is complete.

The plants known from Lower Ka`ala Natural Area Reserve were dead when the site was monitored in the last year. Collections from this site are being propagated and will be kept as a living collection and available for reintroduction once suitable habitat is protected.

3.3.az *Phyllostegia mollis*

Phyllostegia mollis was known from Moloka`i, East Maui, the Ko`olau above Honolulu and the Wai`anae Mountains. Today this species is known only from the Wai`anae Mountains and there are estimated to be less than 50 individuals at several different locations. It is a sub-erect perennial herb and is found in mesic forest (Wagner et al. 1990).

3.3.az.1 Schofield Barracks West Range

In the last year NRS conducted only partial monitoring of the population. NRS have monitored the site within the small fence enclosure in Mohiakea where there were once two mature plants but found no *P. mollis*.

NRS continue to maintain the reintroduction site KAL-B within the Central Kalua`ā enclosure in Honouliuli Preserve. Three of the original nine founder plants in Mohiakea are represented at the KAL-B site and one is available at the Army Greenhouse. NRS will supplement the KAL-B reintroduction with more plants to increase founders and boost total numbers of plants.

3.3.az.2. Schofield Barracks South Range

There have been as many as 4 plants in SBS in the past, however there is only one mature individual known now. There is a small fence in SBS that surrounds areas where there once

were plants, however 1 mature plant is not within the fence. Outside the fence, pig sign has been noted in the past. NRS have collected from plants in the past and the propagules have been kept at the Army Nursery. There are now plants grown from cuttings from four separate individuals. These plants will be reintroduced into Kalua‘a Gulch in the coming year. NRS will continue to search for more plants in SBS. If found, cuttings will be grown at the Army Nursery for reintroduction into Kalua‘ā.

3.3.az.3 TNC Honouliuli Preserve

Fifty-one plants grown from collections made from the SBW-A population have been reintroduced into Kalua‘a gulch in Honouliuli Preserve. Twenty-five individuals are inventoried in Kalua‘a. In the coming year, NRS will work with TNC to balance the founders at this site and maintain native cover through weed control. Mature seed produced at this site will be stored at Lyon.

3.3.ba *Plantago princeps* var. *princeps*

Plantago princeps var. *princeps* is known from the Wai‘anae Mountains of O‘ahu. It can grow up to a meter and a half tall with branching stems (Wagner et al. 1990).

Figure 3-24 *Plantago princeps* var. *princeps*



3.3.ba.1 Mākua Military Reservation

There have been about 8 individuals known from one site on MMR since 2000. In the last year NRS counted 22 mature plants and twelve seedlings when rappelling in different spots in the same area. Weeds and goats are still threats to this population; however, the population benefits

from MMR wide goat control efforts. NRS have not conducted weed control at this population because it is on a cliff and the weed threat is not significant. These plants were visited three times in the last year and mature seeds were collected from eleven plants. These were brought to the Lyon Arboretum for storage and may be used as a source for reintroduction in the future.

3.3.ba.2 Schofield Barracks Military Reservation

There is one population of 20 mature plants and at least three juveniles in SBW. These plants are designated for collection for genetic storage. NRS collected a single cutting for propagation trials at the Army nursery. The cutting rooted successfully but later died. NRS also collected dozens of fruit for seed storage at Lyon Arboretum. In the coming year, NRS hopes to collect mature seed for long-term storage at Lyon and will monitor for any new threats.

3.3.ba.3 State Land

In June of 2004 NRS visited the *P. princeps* site in Pāhole Gulch. Thirteen plants were seen and fruit was collected for storage. Only one plant was reproductive this year. NRS will continue to monitor the population and will strive to collect from more individuals in the coming year. The site is accessible by rope and the area is quite pristine but NRS will monitor for threats.

The Waiawa site in the Koolau Mountains was visited by NRS for the first time in the last year. There were 16 mature plants, 17 immature and about 50 seedlings. Mature seed was collected from thirteen of those plants and is being stored at Lyon. A fence is proposed for this area in a few years. In the coming year, NRS will monitor the plants and assess the need for additional management.

3.3.ba.4 TNC Honouliuli Preserve

There are two sites with this species in Ekahanui Gulch. Both are outside the existing fence, but are not significantly threatened by pigs. In the past year, NRS collected from these plants and the mature seed was stored at the Lyon Arboretum. In the coming year, this site will be assessed for fencing and mature seed will be collected and stored at Lyon. A reintroduction site will be selected with TNC staff for planting in 2004-05.

There were two sites in Pālāwai gulch that contained *P. princeps*. NRS and TNC staff visited both these sites in the past year. NRS observed seedlings at the PAL-B site but these seedlings disappeared by the next monitoring. At the PAL-A site, TNC staff observed two mature plants and two seedlings this August. NRS will continue to monitor these areas for any new plants. Collection will be a priority if plants become mature.

3.3.bb *Platydesma cornuta* var. *cornuta*

Platydesma cornuta var. *cornuta* grows one to two meters tall and is uncommon in mesic forest in the Ko'olau Mountains (Wagner et al. 1990). It is a Candidate for Endangered status.

3.3.be.1 Kawailoa

There are three sites with a total of sixteen mature plants in KLOA. None of these sites are protected by a fence. In the last year, NRS monitored one population of five individuals and all were healthy. NRS has collected from these plants in the past, but none has germinated. In the coming year, NRS will collect cuttings and seed for propagation trials.

3.3.bc *Pritchardia kaalae*

This palm species is known to grow up to five meters tall. It is found in mesic forest and on cliffs only in the Wai'anae Mountains (Wagner et al. 1990). There are thought to be 222 individuals in Mākua, Makaleha, Lower Ka'ala and on the boundary of SBW and the Wai'anae Kai Watershed Protection Area.

3.3.bc.1 Mākua Military Reservation

There are about 72 mature individuals in Mākua, all on 'Ōhikilolo Ridge. Rats are known to feed on the fruit of *P. kaalae*, and NRS continue to administer poison bait to control rats at three locations (MMR-A, MMR-B and MMR-D). Access to 'Ōhikilolo Ridge can be difficult. The most feasible way of accessing the area is via helicopter.

MMR-A has 60 mature trees and about 50 of these are within an enclosure completed in 2003. Weed control is conducted in the vicinity of these plants regularly. When NRS first began to monitor the trees in 1997 there were no seedlings and no fruit maturing on the trees. Now, there are hundreds of seedlings.

Figure 3-25 below shows rat bait take trends at population MMR-A. The bait take for this year was relatively high. This trend may be attributed to infrequent restocking because of lack of helicopter support from December 2003 through April 2004. Take will continue to be monitored to ensure enough bait is available. Management will be adapted to meet these goals in the coming year.

Figure 3-26 below shows rat bait take trends in the MMR-A patch from 2002-2004. In 2004 there were 3 bait checks and restocks. The bait was not restocked from January through April due to the helicopter shutdown. This led to the high percentage of bait taken in March and June. Also fewer rats were snapped due to the infrequent resetting of the snap traps. Fig. 3-16 shows a general trend with increasing take during the late spring and summer, dropping off into the winter months. During the months of January through March, where the bait wasn't changed, we would expect low take, increasing into the spring and summer.

Figure 3-25 Rat Control at *Pritchardia kaalae* MMR-A

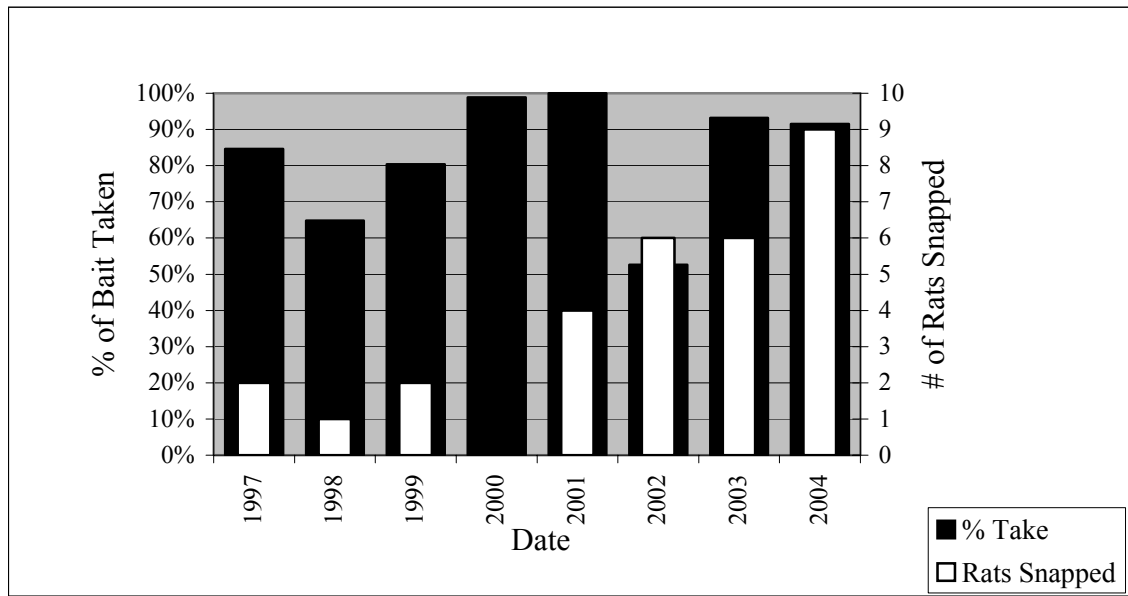
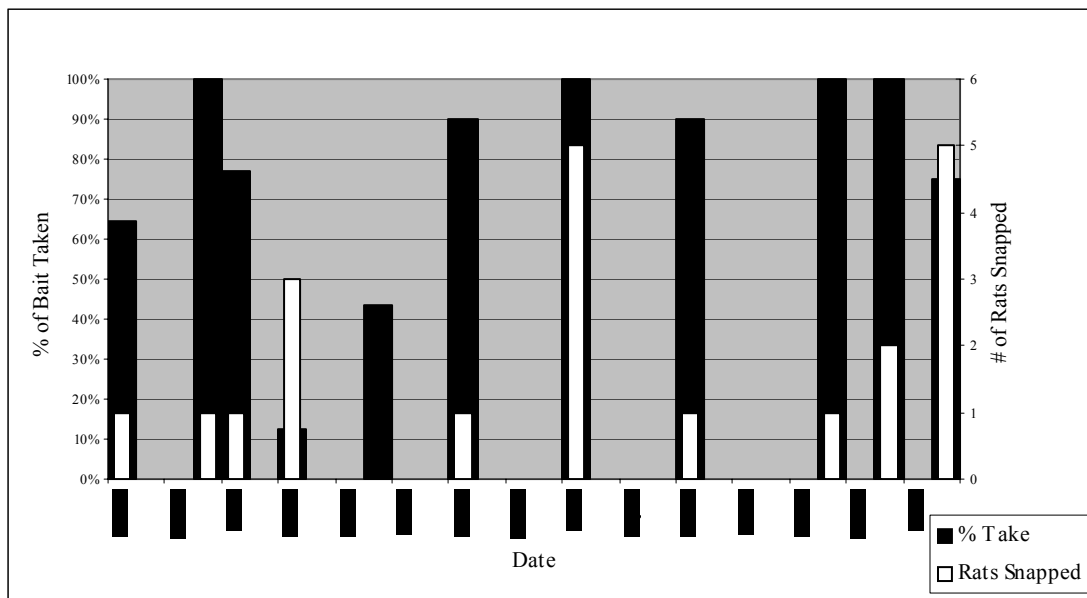


Figure 3-26 Seasonal Trends in Rat Control 2002-2004 *Pritchardia kaalae* MMR-A



MMR-B has three mature trees. One seedling has been seen in the patch, and three were observed in August 2004. In addition to more extensive rat baiting, NRS erected a chicken wire catchment below the mature trees on March 2003. This was done in order to encourage germination in the immediate vicinity of this small cluster of plants. Otherwise most of the fruit produced by these trees may roll off of the cliff just below these mature plants. NRS also continued to spray grass within this population in order to lessen the competition with seedlings.

Figure 3-27 below shows rat bait take trends at population MMR B. It shows that in 2002 the percent bait take for the year was 93%, for 2003 it was 92%, and for 2004 it was 82% which is a bit lower than the past few years. One might expect a higher value in 2004 due to the infrequent bait restocking and limited space for high numbers of stations, but it is still about average.

There are four sites with only one mature tree (MMR-C, J, K, L). Two have one immature tree as well, and one has eight seedlings. No rat control or weed control has been conducted at these sites, however the Christmas berry (*Schinus terebinthifolius*) has been removed from the canopy. NRS have collected from two of these trees in the last year and will strive to collect from the others in the coming year. The plants grown from those collections will be used in supplementing existing reintroductions.

NRS continue to bait at MMR-D where there are five mature trees. Rat control began at this population in 1999. Baiting is having a positive impact on germination. The number of seedlings found in MMR-D has increased significantly from none prior to baiting to over 40 as of July 2004.

Figure 3-27 Rat Control at *Pritchardia kaalae* in MMR-B

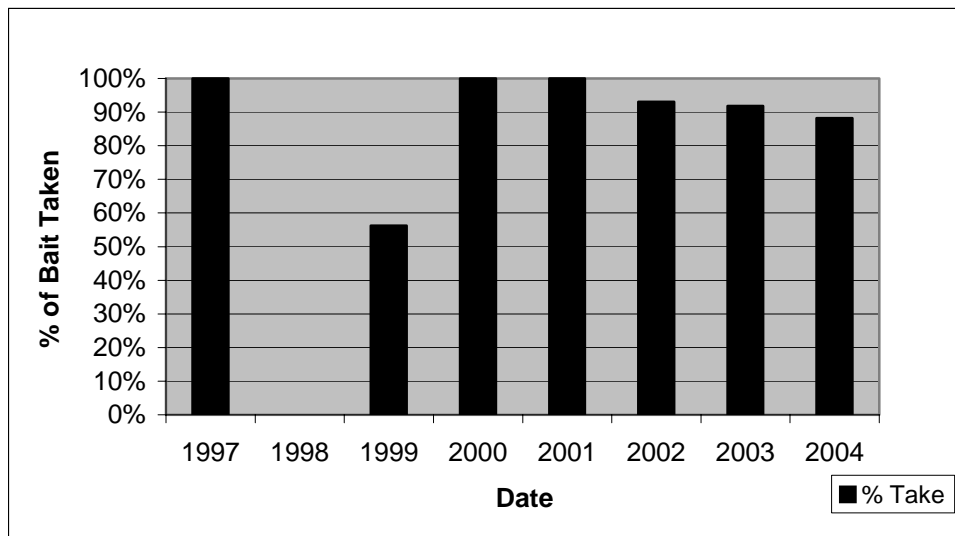
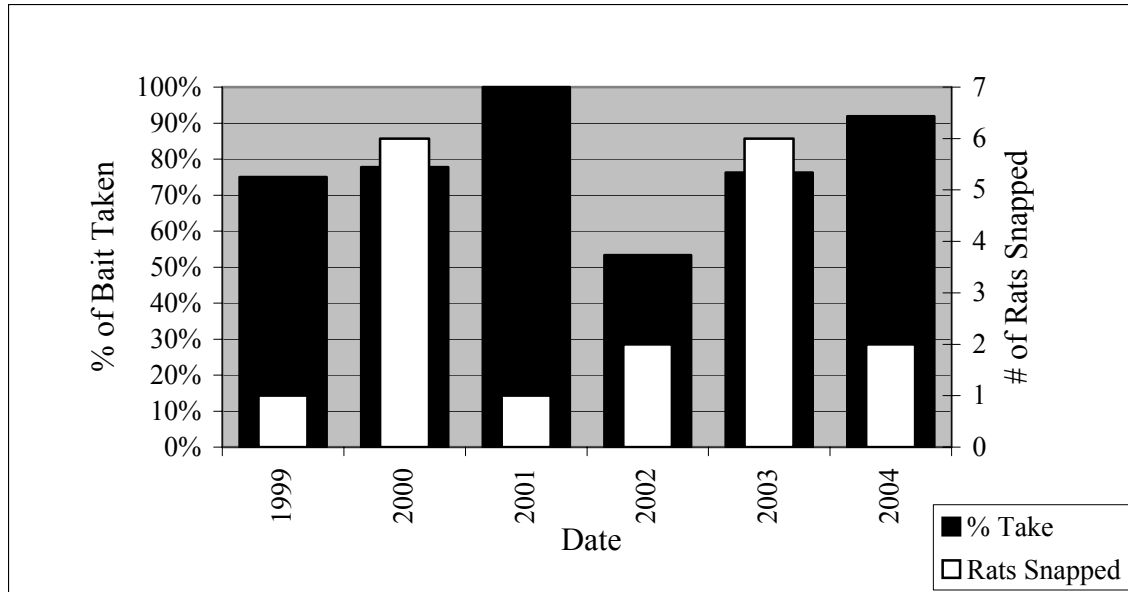


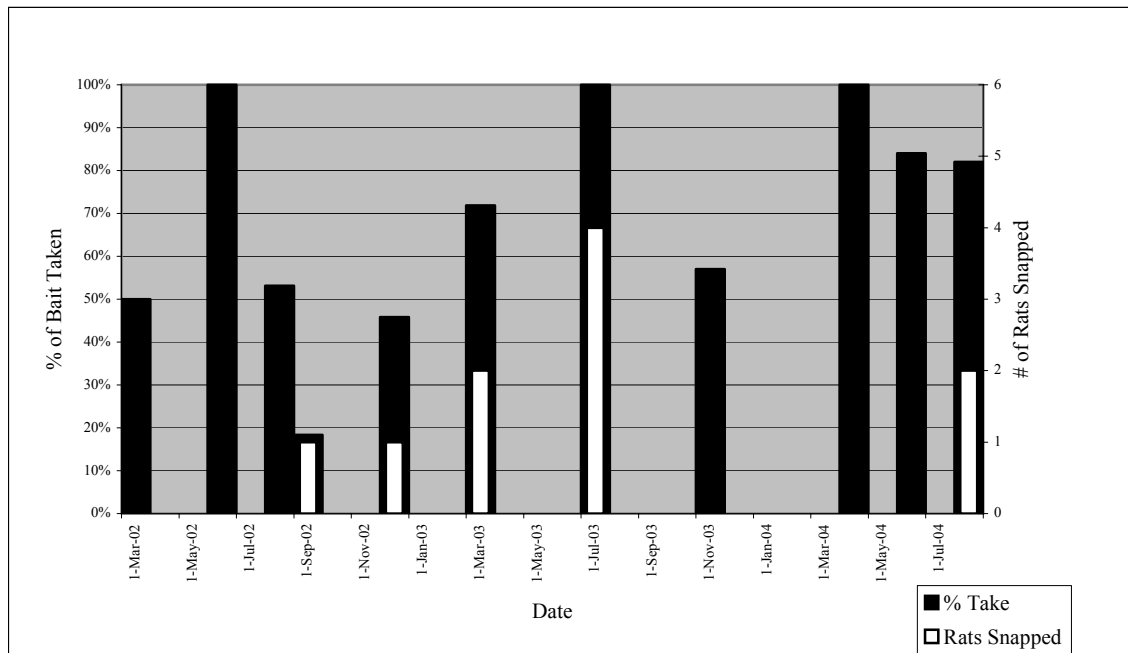
Figure 3-28 below shows rat bait take trends at population MMR-D. The bait take for this year was relatively high. The amount of snapped rats is also low. This trend can be attributed to the lack of access to restock bait and reset snaps because of the helicopter shut down.

Figure 3-28 Rat Control at *Pritchardia kaalae* MMR-D by Year



In December 2001, NRS established five sites for *P. kaalae* reintroductions in MMR. A total of 265 plants were reintroduced. At the sites in Mākua where pigs are controlled, the plants are doing very well. A fence is proposed to be built around one of the unprotected sites in the coming year. The successful sites will be supplemented with plants from unrepresented sites in the coming year.

Figure 3-29 below shows rat bait take trends from 2002-2004. In 2004 there were three bait checks and restocks. The bait was not restocked from January through March due to the helicopter shutdown. This led to the high percentage of bait taken in March and June. Also fewer rats were snapped due to the infrequent resetting of the snap traps. Fig. 3-29 shows a similar trend to Fig. 3-26 with increasing take during the late spring and summer, dropping off into the winter months. This may show a rat population trend at 'Ōhikilolo Ridge.

Figure 3-29 Seasonal Trends in Rat Control at *Pritchardia kaalae* in MMR-D

3.3.bc.2 State Land

There are four mature and six juvenile trees on the boundary of SBW and Wai`anae Kai Watershed Protection Area. These trees are on the leeward side of the ridge on State land and not on SBW. In August 2001, rat bait stations were installed around the trees. In 2002, NRS expanded the grid, doubled the number of stations and in 2003 changed the bait four times. Rats were being controlled at the site in an effort to collect mature fruit for storage and establishing a living collection at a secure site. There is no long-term management proposed for this site and in the past year rat control was stopped. In the coming year, NRS hope to establish a living collection of this population at Lyon Arboretum.

There are a few dozen mature plants in East Makaleha, but most are on cliffs that are difficult to access. However, there is one patch of about a dozen trees that State Foresters had identified as a potential site for rat control in the past. NRS visited these trees in the last year and installed a rat grid with bait stations and snap traps. There were eleven mature trees and one immature when NRS visited in June of 2004. In the coming year, NRS will continue to restock bait in an effort to control rats at the site and encourage recruitment.

NRS have not visited any populations in Lower Ka`ala NAR in the last year. In the coming year, NRS will assess these areas for any needed management.

3.3.bc.3 BWS Mākaha

There is a single *P. kaalae* tree known from the back of Mākaha Valley. NRS have never visited the site. In the coming year NRS will work with the BWS biologist to monitor and collect fruit from this tree.

3.3.bd *Psychotria hexandra* ssp. *oahuensis* var. *oahuensis*

Psychotria hexandra ssp. *oahuensis* var. *oahuensis* is known only from the Koʻolau Mountains. It grows to a six-meter tall tree (Wagner et al. 1990). It is a Candidate for Endangered Status.

3.3.bd.1 Kawaioloa Training Area

There are fewer than 20 trees known statewide. One plant is known from KLOA. It was found in March of 1999, and NRS has monitored and collected cuttings once in the last year. In December 1999, mature fruit was collected and brought to Lyon Arboretum, where there are two seedlings in the micro-propagation lab. Surveys may identify other individuals in KLOA. In the coming year, NRS hope to collect more cuttings from this plant and grow it at the Army Nursery as a living collection and propagule source.

3.3.bd.2 State Lands

In November of 2003 NRS accompanied the Oahu Genetic Safety Net Biologist on a survey of Makaua Gulch on the windward side of the Koolau Mountains. The survey was principally for *Schiedea kaalae* however *Psychotria hexandra* were also observed. A total of six trees were counted making this the largest known population on Oahu. Six cuttings were taken and although they rooted well in the greenhouse they all later died for unknown reasons.

3.3.be *Pteralyxia macrocarpa*

Pteralyxia macrocarpa is a tree found in diverse mesic forest on Oʻahu. It can grow up to fifteen meters tall and has milky white sap (Wagner et al. 1990). It is found along the upper rim of MMR in Mākua and Kahanahāiki Valleys. It is Federally listed as a Species of Concern. NRS continue to note all new *P. macrocarpa* plants that are found in order to clarify the conservation potential for this taxon and to prioritize management.

3.3.be.1 Mākua Military Reservation

There are a few dozen trees known so far on Army lands from KLOA, SBE, SBW, SBS and MMR. There also have been numerous plants observed by NRS in Mākaha, Waiʻanae Kai Honouliuli, Pāhole NAR, and Lower Kaʻala NAR. Small groups of trees are distributed in the mesic forest of the Koʻolau mountains as well as the Waiʻanae Mountains. There are usually two to twenty trees in a group and large gaps between the groups. The fruits are large and probably not dispersed far from the parent tree. HINHP estimated fewer than 250 individuals on Oʻahu. However, NRS feels this estimate is too conservative. On ʻŌhikilolo alone there are about 65 mature trees in one small subgulch. In a recent discussion with The Nature Conservancy's Dan Sailer, he said he'd stopped counting *Pteralyxia* because of the numerous amounts (pers. comm. August 3, 2004).

This taxon benefits from rat control intended to protect *Achatinella mustelina* populations at ‘Ōhikilolo. At this site recruitment of *P. macrocarpa* was zero four years ago when baiting began and is now substantial with sixty-five seedlings present. *P. macrocarpa* also benefits from the weed control conducted at the Kahanahāiki, ‘Ōhikilolo, and Lower Mākua management units.

3.3.be.2 Schofield Barracks Military Reservation

There is a medium ungulate threat identified for this species due to the large group of goats just north of SBW. This species has large fruit with big endosperms that would be attractive to rats. In Mākua, NRS noted better recruitment of seedlings from two *Pteralyxia* trees in an area where rat control is being conducted around a snail population. Large-scale rat control via aerial dispersal would benefit this species in SBW. It is listed as a Species of Concern but may warrant better protection given the small population size and threat levels. NRS will continue to map and note population data for new plants of this species in the coming year.

3.3.bf *Pteris lydgatei*

Pteris lydgatei is a medium-sized terrestrial fern, and is known from especially wet locations usually near gulches. It is known from O’ahu, Maui and Moloka’i (Palmer 2003).

3.3.bf.1 Schofield Barracks Military Reservation

There is one site with six individuals in SBE. There is much under surveyed habitat for this species in the Ko’olau Mountains and targeted surveys would likely turn up more plants. NRS will continue to monitor this population. It is fairly safe from ungulate impacts because it is up on the stream-bank but other appropriate habitat continues to be degraded by pigs. Large-scale fences are necessary to exclude pigs from these fragile habitats. NRS may propose a fence for this area in the coming years as part of the Oahu Training Areas Implementation Plan. The fence would run adjacent to the ‘Ōpae’ula fence and will protect more habitat for this species.

3.3.bf.2 Kawailoa Training Area

There are three plants at one site in KLOA, and one plant at another. The first site is a streamside cliff next to a waterfall. Spores have been collected from these plants but none were successfully grown to maturity.

The second site was found by NRS in 2002. There is much more habitat for this species in the Ko’olau Mountains and surveys will likely turn up more plants. NRS will continue to monitor this population. These 2 populations are fairly safe from ungulate impacts but other appropriate habitat continues to be degraded by pigs. Large-scale fences are necessary to exclude pigs from these fragile habitats. A fence is being planned by the KMWP to exclude pigs from the upper section of the Helemano drainage. The fence would run adjacent to the ‘Ōpae’ula fence and will protect habitat for this species.

3.3.bg *Sanicula mariversa*

Sanicula mariversa is known only from the leeward Wai`anae Mountains. It is a perennial herb with flowers in a terminal cluster (Wagner et al. 1990). This species comes up with the rains every winter, grows through spring, and goes dormant every summer. Based on NRS observations of greenhouse plants, plants at the MMR population and at Mākaha, it appears that they flower only once and then die.

3.3.bg.1 Mākua Military Reservation

The number of mature individuals at MMR-A fluctuates yearly. This last year was difficult to monitor the population, as NRS were not allowed to fly in helicopters for about four months of the year. Only one mature plant was seen with immature fruit in the last year. This plant had dropped its infructescence by the time NRS got back to it, so no fruit was collected in the last year. No plants were observed at the reintroduction site in the last year.

3.3.bg.2 BWS Mākaha

On June 1, 2004 NRS monitored the MAK-A population. On this trip more than 2500 mature seeds were collected for storage at the Lyon seed bank. A total of 35 plants were seen on this date. Goats are a significant threat to this population and NRS is in the final stages of seeking permission to construct a small fence to protect the population. In the coming year the fence will be constructed, and NRS will continue to monitor these plants and collect for storage at Lyon Arboretum.

On June 1, 2004 NRS and the BWS Biologist monitored the MAK-B population. There were no fruiting plants present. However, NRS counted a total of 36 plants. This greatly increases the number known from this location. In previous years NRS has collected seeds for storage. Goats are a significant threat to this population and NRS is in the final stages of seeking permission to construct a small fence to protect the population. The fence will be constructed in the coming year. NRS will continue to monitor this population in the summer for fruit production.

3.3bg.3 State Lands

There is one site with this species in the Keauu Public Hunting Area. This site has been monitored by NRS for years and collections of mature seed have been stored at the Lyon Seedbank. In the coming year, NRS will scope a fence for this site and collect from all plants for storage at Lyon.

3.3.bh *Sanicula purpurea*

Sanicula purpurea is known from mossy slopes and bogs in wet forest on Maui and O`ahu. It is a perennial herb with a large root. The flowers are in a terminal cluster and have purple petals (Wagner et al. 1990). All known plants are on steep wet windy slopes where the vegetation is thick and short. There are two sites with this species on Maui. One is monitored regularly by Maui Land and Pineapple Co., and is known to have about 250 individuals.

3.3.bh.1 Kawailoa Training Area

There are three sites with about 40 individuals in KLOA. All three are right on the summit of the Ko'olau Mountains. There is a High Weed Threat for this species because *Axonopus fissifolius* smothers much of the appropriate habitat in the Ko'olau. Seedlings and juveniles have been found and mature fruit has been germinated easily by NRS.

In February of 2002, four plants were reintroduced into a site just outside of the 'Ōpae'ula fence. Only one plant was found when this site was monitored in the past year. In the coming year, NRS will continue to monitor the wild and reintroduced plants. The storage potential for this species should be determined.

3.3.bi *Schiedea hookeri*

Schiedea hookeri is a small shrub known from the Central and Northern Wai'anae mountains. It is described as being scattered and locally common in diverse mesic forests (Wagner et al. 1990).

3.3.bi.1 Mākua Military Reservation

There are three locations of *S. hookeri* on MMR. Two are in Kaluakauila Gulch and the other one is in Kahanahāiki. In Kaluakauila, one population with about 50 mature plants was discovered in 2003. Another location with five plants has been known since 1999. In 2003, a prescribed burn that escaped the firebreak road burned to within 20 meters of this taxon. Another fire, which started near Yokohama Bay, burned toward the Kaluakauila management unit, re-emphasizing the significance of the fire threat to this taxon. These plants are protected from pigs by the fence enclosure around the management unit. In addition, NRS conduct grass control at Kaluakauila to reduce fuel and competition. NRS will continue to collect for genetic storage from the Kaluakauila population of *S. hookeri*.

In Kahanahāiki Gulch, 20 plants are known. In the coming year, NRS will monitor this site and determine management priorities.

3.3.bi.2 Schofield Barracks Military Reservation

There is one site on SBW with 5 mature plants and there is one large group of a 100 plants located on the Wai'anae Kai side of the boundary with SBW, but these are not included in the SBW plant total. There is no management prioritized for this species because UXO restricts the large-scale management options available to NRS in SBW.

There is one site with 40 mature plants in SBS. Seedlings and juveniles have been observed in this population. NRS has successfully rooted cuttings of this species in the past year during propagation trials. NRS will monitor these plants in the coming year for changes in population structure and threats.

3.3.bj *Schiedea kaalae*

Schiedea kaalae is known only from O’ahu. It is usually an unbranched shrub with the leaves clustered at the apex (Wagner et al. 1990).

3.3.bj.1 Schofield Barracks Military Reservation

In late 2002, one mature individual was found in SBW. This is the first time this species has been reported from there, it is a significant find. A broken branch was taken as a cutting at the time, but later failed to root. NRS collected mature seed from the plant.

Plants grown from these collections are growing vigorously in the Army greenhouse and will be reintroduced into Kalua’ā and used to produce seed for storage. NRS also constructed a small pig enclosure around the plant this year. See the Chapter 1: Feral Ungulate Management for details.

Figure 3-30 *Schiedea kaalae*



3.3.bj.2 State Land

There is one location with this taxon in Pāhole Gulch. Recently a NARS biologist indicated that he would get the location to NRS so that they could monitor the plant for seed collection and perform threat control. NRS will visit the site in the coming year.

There are two mature plants known from Kaipapa’u in the Ko’olau Mountains. They have been collected from and are being grown at Lyon. They are not within a fence, but are not highly threatened by ungulates. Slug damage has been observed at this site and no doubt impact seedling survival. In the coming year, volunteers will monitor these plants.

In November of 2003, NRS accompanied the Oahu Genetic Safety Net Biologist on a survey of Ma'akua Gulch on the windward side of the Ko'olau Mountains. A total of at least four plants were seen. Some of the plants were large beds with many rosettes. It is difficult to say how many plants were in these patches. These large patches are the healthiest representatives of this taxon that NRS has ever seen. NRS also observed a plantlet growing from a fruiting stem. This is the first time NRS has observed this. Access is difficult because there are multiple waterfalls that must be scaled to get into this zone. NRS will strive to visit the site on an annual basis for monitoring.

There are two mature plants known from Ma'akua. They are within a small fence and have been collected from. The propagules will be used as a source for mature seed, which will be stored at Lyon. These plants are monitored by NRS and other volunteers.

In the last year, eleven mature plants were discovered in a side gulch of Kahana Valley. The site is on private land and a small ungulate enclosure was built around some *Cyanea truncata* in the area. The *Schiedea* were collected from and cuttings are being grown at Lyon. These will be used as a propagule source in the future and serve as a living collection of these plants. In the coming year, these plants will be monitored by volunteers.

3.3.bj.3 TNC Honouliuli Preserve

A single individual plant collected from Huliwai (HUL-A) by TNC staff was received by NRS in the last year. This plant is being grown in the greenhouse to be used as a propagule source and living collection. Propagules collected from this plant will be stored at Lyon and grown for reintroduction.

There are six mature plants known from three sites in Ekahanui Gulch. In the past year, NRS has collected from three of these plants and mature seeds have been stored at Lyon. One of the sites has been fenced in the last year, and the others are within the larger proposed fence. In the coming year, NRS will assist TNC in monitoring the plants in Ekahanui, collecting mature seed, maintaining the fences and conducting weed control. Propagules collected from these plants will be grown and reintroduced into protected areas in Ekahanui. Currently there are 75 individuals of mixed stock that have been reintroduced into the protected areas of Ekahanui.

There are no wild extant plants in Kalua'a. TNC has reintroduced stock from Ekahanui and Pālāwai into this site for a total of 53 individuals. NRS plan to reintroduce Schofield stock to this site in the coming year.

There is a single *S. kaalae* plant in Pālāwai. This plant has seeded prolifically in past years. NRS worked with TNC to secure stock for storage this year. NRS also constructed a small ungulate enclosure around the plant to protect it from ungulates. See ungulate section for details. Small scale weeding was also conducted. NRS will continue to work with TNC to monitor this site.

3.3.bk *Schiedea kealiae*

This species is found in the Wai`anae Mountains in *Sapindus* forest and on steep slopes and exposed ledges. It is a sprawling subshrub that flushes with winter rains. It is thought to be dioecious (Wagner et al. 1990).

3.3.bk.1 Dillingham

There is one population with 15 mature individuals in DMR. There were 28 seedlings and three juveniles in this population when monitored in 2003. The population is located on a rocky outcrop at about 350 feet in elevation above the *Sapindus* forest patch. There is a large strip of grass (*Cenchrus ciliaris*) between the forest patch and the outcrop that is smothering potential habitat for this species. The grass would be difficult to control because it extends onto a cliff and because of the huge amounts of seed being produced in the area. There are other populations of this species in the Mokulē`ia area and there is more unsurveyed suitable habitat within DMR to the east of this population. NRS will monitor this population when in the area.

3.3.bl *Schiedea nuttallii*

This rare species of *Schiedea* is found on Maui, Kaua`i and in the Wai`anae Mountains of O`ahu. It is a shrub with glabrous purple-tinged leaves and small dark brown seeds (Wagner et al. 1990).

3.3.bl.1 Mākua Military Reservation

Schiedea nuttallii is known from one population in Kahanahāiki. There are 22 mature plants and 7 immature plants at this site. Seedlings have been found here, and when last monitored, there were 10. The Kahanahāiki population has lost a good deal of the koa canopy that used to partially shade the site. This may have caused a change in the light regime and made the site drier. *Acacia koa* has been planted at the site and more will be in the coming year. NRS have conducted weed control in the vicinity of this population and will continue to manage weeds throughout the Kahanahāiki MU. NRS reintroduced 17 plants into Kahanahāiki in (MMR-C) and 9 have survived. In the last year, another site (MMR-D) was established with seventeen plants. All have survived so far. In the coming year, NRS will continue to monitor the wild and two reintroduced populations. These reintroduction sites will be compared and supplemented with unrepresented plants in the coming year.

3.3.bl.2 State Land

There were three sites with *S. nuttallii* in Pāhole Gulch. NRS knows of one site with about ten individuals and is working with the NARS biologist to collect cutting for propagation and reintroduction. NRS will assist NARS in the monitoring and protection of this site if deemed necessary. There are three plants known from a different site on the Pāhole-Keawapilau ridge. NRS has monitored and collected from them twice in the last year. Weed control has been conducted to remove a few canopy trees and mostly under-story competitors. Cuttings were taken from the mature plants and are being grown at the Army Nursery. They serve as a living collection and will be used as a propagule source for future reintroductions. The last site are visited by the NARS biologist and only have a single plant.

3.3.bm *Schiedea pentamera*

Schiedea pentamera is known only from the Wai`anae Mountains on O`ahu and was recognized as a species in the recent revision of the Manual (Wagner et al. 2001). It was known as *Schiedea pubescens* var. *purpurascens*.

3.3.bm.1 Schofield Barracks Training Area

There are six sites with about fifty-seven mature individuals on SB. None of the sites are protected by fences and goats are a threat to some of the sites. In the past year, NRS has built a small enclosure in SBS. It protects some of the plants found there and provides secure habitat for recruitment. Ungulate control is not feasible in SBW due to ordnance restrictions.

3.3.bn *Sicyos lanceoloidea*

Sicyos lanceoloidea is a perennial vine, has a woody base, and broad ovate leaves. It is uncommon in the mesic forest on O`ahu (Wagner et al. 1990).

3.3.bn.1 Schofield

There are five mature and six immature plants known from four sites in SBW. However, these sites have not been monitored recently because of the limited access into SBW due to Army training. This species is increasingly rare, and there are estimated to be less than 50 individuals in the wild. This species would benefit from weeding and fencing; however, access restrictions in SBW limit management options. It is only a Species of Concern, but should receive more protection, given the small known population size. NRS will attempt to collect more seed for storage in the next year.

3.3.bo *Silene lanceolata*

Silene lanceolata is known from nearly all the islands. It is a sub-shrub with oblanceolate to linear or lanceolate leaves and flowers in cymes with white petals (Wagner et al. 1990).

3.3.bo.1 Mākua Military Reservation

There are several thousand plants on other islands and the eleven plants known on MMR are a small percentage of the greater population. The population on `Ōhikilolo continues to benefit from MMR-wide goat control. Goats have not been observed near this population in a few years. NRS do not conduct any specific management for this taxon. In the coming year, NRS will determine the need to store seeds from these plants.

3.3.bp *Spermolepis hawaiiensis*

Spermolepis hawaiiensis is known from all the major islands. It is an annual herb with a slender taproot (Wagner et al. 1990).

3.3.bp.1 Mākua

This species is known from the lower portions of ʻŌhikilolo Ridge and two plants were found on the northern ridgeline of Kahanahāiki Valley. NRS does not conduct any specific management for this taxon. *S. hawaiiensis* is threatened by fire, so in the coming year, NRS will attempt to collect seeds to conduct seed storage trials.

3.3.bq *Stenogyne kaalae* var. *sherfii*

Stenogyne sherfii is no longer known from the wild. It was known from one location in mesic forest in the Koʻolau Mountains above Wahiawā (Wagner et al. 1990). The last plant was salvaged from the wild and brought into cultivation in 1999.

3.3.bq.1 Kawaihoa Training Area

Local botanists had known about these plants and collected from them years before the Army Natural Resource program started. Mr. John Obata, who found the population, brought NRS to it in 1995, when there were five individuals. Since then, NRS monitored the plants at least once a year until the last one died in November 1999. The decline of this population was documented by NRS on Rare Plant Management Forms. One had died by May 1997 and major invertebrate damage was observed on the remaining plants by NRS. One more died in 1998 leaving three plants in December 1998. By this time, collections had been sent to the Lyon Arboretum and to Dr. Steve Weller at U.C. Irvine although it is not clear which individual he was given. By June 1999, another plant had died and NRS contacted other agencies to help salvage material from the site. Cuttings were taken from one of the wild plants and the other wild plant was removed from the site by Nellie Sugii from Lyon Arboretum, NRS and Desmond Ogata of the UH Plant Diagnostics Lab. The cuttings and salvaged plant both survived and were cloned at Lyon. The last remaining plant at the site was found dead three months later when NRS revisited the population. Since then, NRS has been back to the site at least twice without finding any live plants.

Material was gathered from Dr. Weller and the Lyon Arboretum and clones were made to equalize founders for a reintroduction in 2001. NRS and Joel Lau chose a site in KLOA and 47 plants were reintroduced in January of 2002. When the plants were first monitored, pigs had dug up and damaged many of the plants. In March of 2003, NRS returned to the site and found only 25 plants left. Ungulates had uprooted and disturbed most of the plants. There was a significant amount of disturbance to the surrounding area and at least 50 Hāpuʻu ferns were killed. September 2003 monitoring revealed only 21 plants were still alive. The decline in numbers will most likely decrease without a fence installation. NRS has surveyed lower Peʻahinaia and feels this area will be a good site for reintroduction, provided a fence is built. Until then, cuttings from four individuals are at Lyon and the Army facility. NRS is also optimistic that a living collection could be held at Waimea Audubon Center as well. NRS believes that invertebrates were primarily responsible for the demise of *S. sherfii* in the wild and will monitor the reintroductions closely.

3.3.br *Stenogyne kanehoana*

Stenogyne kanehoana is an endangered mint previously known only from a single population in the Waianae Mountains near Pu'u Kanehoa in The Nature Conservancy's Honouliuli Preserve. There have only ever been three to four plants known from this area (Wagner et al. 1990).

Figure 3-31 *Stenogyne kanehoana*



In July of 2004 NRS discovered a robust patch of *S. kanehoana* while surveying the Schofield Barracks West Range in Haleauau gulch. This is one of the most significant discoveries NRS has ever made. NRS quickly responded by constructing a fence around the patch to protect it from feral pigs. It is difficult to determine how many plants are present at this site as long runners root in multiple places. Cuttings were taken across the patch to insure good genetic representation. These cuttings are rooting in the Army greenhouse. NRS did additional surveys in the area but no more plants were found.

NRS plans to reintroduce this stock into the Kalua'a fenced area in The Nature Conservancy's Honouliuli preserve. Stock from both Haleauau and Pu'u Kanehoa vicinity will be mixed in this site because numbers are so low. NRS feels that by mixing these two genetic lines in the field, they may cross-pollinate, producing stronger plants than if they were kept separate. NRS as well as The Nature Conservancy staff will maintain pure stock from each site in a living collection in the greenhouse.

3.3.bs *Tetramolopium filiforme*

Tetramolopium filiforme is known only from the Northern Wai`anae Mountains. It is found on dry ridge crests, cliffs and ledges, and over 90% of the plants are found on ‘Ōhikilolo Ridge. *T. filiforme* is a dwarf shrub five to fifteen centimeters tall (Wagner et al. 1990). The leaves are clustered at the apex of the branches and the flowers are often held above the leaves.

3.3.bs.1 Mākua Military Reservation

There are estimated to be about 5,100 individuals left on O`ahu. There are over 5000 plants in Mākua and Kahanahāiki and other valleys on MMR. The plants in Mākua are known from ‘Ōhikilolo Ridge and there are about 40 plants in the C-Ridge MU in Kahanahāiki. There are areas in both places where there is a high threat from fires.

The plants along ‘Ōhikilolo Ridge were historically very threatened by goat browsing. There are estimated to be nearly 5000 plants on the cliffs and steep ridges and seedlings are found in all known locations. No major declines in abundance or distribution have been observed by NRS in the last year. There are undoubtedly more places where these plants have yet to be found on ‘Ōhikilolo Ridge. Most plants are on the cliffs and ridges above the forest on the southern side of lower Mākua Valley, and Ko`iahi Gulch. Most are separated from the grasslands of the lower section of the valley by forest patches and large cliffs. This may prevent fires from burning these areas. There is one place on ‘Ōhikilolo where some of the plants are on the cliffs and ridges where the grass comes to the bottom of and onto the cliffs with the plants. The population in this area has been the target for seed storage because of the fire threat. NRS has made several collection trips toward this goal. Since the most recent trip in August of 2004 there are approximately now 50 individuals represented with at least 50 seeds in the Lyon seed bank. NRS will clarify the status of this target in the next year and perform additional collections if necessary. NRS will focus on collections from the lower elevation end of this large population to target those plants most threatened by fire.

The July 2003 fire burned within 20 meters of *T. filiforme* on C-ridge. This population is buffered from fires by a very narrow strip of forest. One more fire in the C-ridge vicinity could result in the destruction of this population. NRS supplemented the seed storage collection in 2003 with collections from eighteen new plants. NRS will continue to collect to bolster ex-situ collections in the coming year. NRS has been storing seeds of this species with Alvin Yoshinaga at the Lyon Arboretum. NRS will continue to monitor this site and will collect from any unrepresented mature plants.

3.3.bs.2 State Land

There have been four known sites with this species in Waianae Kai (WAI-A, B,C and SBW-A). There are no longer plants known from WAI-A. This site was last monitored in 2002. In this past year plants were found in an adjacent gulch. There are at least two mature plants with two immature and three seedlings in one place (WAI-B) and an estimated twenty plants in another (WAI-C). In the coming year, NRS will search this area to determine the population size and management priorities. This site is accessible only with a helicopter and rappelling gear. A fence

proposed for *Neraudia angulata* and *Nototrichium humile* in this area would protect the *Tetramolopium* here as well.

3.3.bt *Tetraplasandra gymnocarpa*

Tetraplasandra gymnocarpa is known from scattered locations in mesic to wet forest in the Ko‘olau Mountains. It can grow up to 10 meters tall (Wagner et al. 1990). The majority of the individuals of this species are known from the windward side. They can be found in wet summit to mid-elevation mesic forests.

3.3.bt.1 Kawailoa Training Area

Only eight *T. gymnocarpa* are known from five sites in KLOA. This taxon is not the target of management actions. This species has a wide and scattered distribution and there are likely more trees to be found. There is no ex-situ stock from KLOA. NRS will continue to map locations of this species and note threats. NRS will try to collect from this species in the coming year for seed storage trials.

3.3.bt.2 Schofield Barracks Military Reservation

There are three known individuals of this species in Schofield Barracks East Range. It is not the target of management actions. NRS will continue to map locations of this species, and note threats. This species will not be a target for surveys in the coming year.

3.3.bu *Urera kaalae*

Urera kaalae is known to be rare on slopes of and gulches in the south and central windward Wai‘anae Mountains. It is a member of Urticaceae and is thought to be dioecious or occasionally monoecious (Wagner et al. 1990). *U. kaalae* has been declining recently throughout its range. It is found only in the Wai‘anae Mountains.

3.3.bu.1 Schofield Barracks Military Reservation

The trees in SBS are the northernmost plants known. There were three trees known from SBS in 1997 and now only one *U. kaalae* is left. Mature fruit have been collected from two trees and brought to Lyon for long-term seed storage. These propagules have been grown for reintroduction. In 1999, three juvenile plants were introduced to SBS to augment the declining population. These trees are healthy, flowering and are monitored annually by NRS. A small fence has been built in SBS in the last year to protect a small population of snails. This fence will provide a larger protected site for *Urera* to be planted in the future. In the coming year, NRS will maintain the fence and monitor and collect from the remaining tree. Figure 3-31 below shows a healthy mature reintroduced plant.

3.3.bu.2 TNC Honouliuli Preserve

NRS has cooperated with TNC to reintroduce plants collected from Army lands and other TNC lands into Kalua‘ā gulch. NRS and TNC have planted several dozen *Urera kaalae* at a site in Kalua‘ā. Presently there are 73 individuals in the area. There are also reintroduced populations at Palikea (24 individuals) and Ekahanui (125 individuals) of mixed stock. In the coming year, NRS will continue to work with TNC to supplement the reintroduction site with unrepresented individuals, and maintain native cover.

There is also a wild population in Pālāwai consisting of 9 mature plants and 1 seedling. Currently it is unprotected from ungulates but will be fenced by TNC staff by the end of the year.

Figure 3-32 *Urera kaalae* Reintroduction



3.3.bv *Viola chamissoniana* subsp. *chamissoniana*

Viola chamissoniana subsp. *chamissoniana* is known to be rare on dry cliffs in the Wai`anae Mountains. It is a slender shrub with the leaves clustered toward the ends of the branches (Wagner et al. 1990). It is usually found on cliffs or very steep slopes and has flowers with large white petals. In the coming year, NRS will be trying different methods to keep a living collection of this species. Cuttings were taken from several of the locations discussed below and grown at the Pāhole and Army Nurseries. The plants require a lot of space in the nursery and do not produce a lot of seed. This makes it hard and expensive to keep lots of plants around to serve as the collection or to use them as seed producers. In the coming year, NRS will work with the staff of the Tissue Culture Lab at Lyon to determine if this species is easily kept in small vials and can be grown out reliably. This may prove the best method for keeping this species in an ex-situ collection.

3.3.bv.1 Mākua Military Reservation

The plants on ‘Ōhikilolo represent more than 65% of the *Viola chamissoniana* subsp. *chamissoniana* known throughout the State. There are estimated to be about 250 plants on the cliffs and steep ridges and seedlings are found in all known locations. No major declines in abundance or distribution have been observed by NRS in the last year. There are undoubtedly more places where these plants have yet to be found on ‘Ōhikilolo Ridge. Most plants are on the cliffs and ridges above the forest on the southern side of lower Mākua Valley, and Ko‘iahi Gulch. Most are separated from the grasslands of the lower section of the valley by forest patches and large cliffs. This may prevent fires from burning these areas. In the past year, NRS has monitored two sites in MMR and will visit the others in the next year.

3.3.bv.2 Schofield Barracks Military Reservation

In SBW, there are estimated to be about 55 mature plants. A few juveniles and seedlings have been observed. This site has been monitored by NRS for several years and cuttings were taken several times to establish a collection at the Army Nursery. Plants were relocated by NRS on Pu‘u Hāpapa in Schofield Barracks South Range in 2000. There are about 15 mature plants and a few seedlings. NRS has collected from this population to establish a living collection.

3.3.bv.3 State Land

There is one site in the Nānākuli Forest Reserve (HAL-A) that has 32 mature and 3 juvenile plants. All plants were healthy when monitored in July of 2003, and there were no major threats. No collections were made. In the coming year, NRS will monitor this site, search for more in the area and determine management priorities for this area.

In the Kea`au public Hunting Area, about 40 mature plants and 10 juveniles are known. This area is not protected by a fence. NRS has not been to this site but will in the coming year.

3.3.bv.4 BWS Mākaha

NRS revisited two sites where *V. chamissoniana* ssp. *chamissoniana* had been reported by NTB botanists in Mākaha. Unfortunately, NRS was unable to find plants at either site. NRS will be in contact with NTBG botanists in the near future to clarify information about these sites. NRS will then revisit the sites and search again.

3.3.bw *Viola oahuensis*

Viola oahuensis is known from cloud-swept areas and wet forest along the summit of the Ko‘olau Mountains. It is an erect, un-branched sub-shrub and has pale yellow flowers (Wagner et al. 1990).

3.3.bw.1 Kawaioloa Training Area

This species is known from more than 10 sites in KLOA totaling at least 101 plants. During surveys in 2002, over 50 individuals were estimated to be in the area inside the proposed Helemano fence. This species has proved to be more plentiful than previously thought. NRS still maps locations of plants but has stopped doing thorough counts and monitoring because of the increasing numbers. The 'Ōpae'ula fence encloses and protects some of the KLOA plants. This species is expected to benefit greatly from protection within the 'Ōpae'ula and proposed Helemano fences due to the susceptibility of its habitat to ungulate damage. Weed control focused within the fence enclosures will benefit the *Viola* along with other rare species. Large-scale fencing must continue to secure the habitat necessary to support this species. NRS will continue to search for this species, note threats, and support ecosystem protection.

In the coming year, NRS will continue to participate in the KMWP as it moves towards beginning construction on another enclosure in the upper Helemano drainage. This fence will surround a number of the known plants of this taxon and over a hundred acres of undersurveyed habitat. This species will not be a target for management action in the next year but NRS will continue to survey for it when working in appropriate habitat.

3.3.bw.2 Schofield Barracks Military Reservation

This species is known from one site in SBE. NRS has not monitored these plants since they were discovered by HINHP. Large-scale fencing is necessary to secure the habitat needed to support this species, but no fences are currently planned for SBE. NRS will continue to search for this species, note threats and support ecosystem protection.

3.3.bx *Zanthoxylum oahuense*

Zanthoxylum oahuense reaches heights of three to six meters and is known from mesic to sometimes-wet forest in the Ko'olau Mountains (Wagner et al. 1990).

3.3.bx.1 Kawaihoa Training Area

There are more than ten trees known in KLOA from six sites and there are estimated to be less than 250 island-wide. NRS maps locations of this species but it is not targeted for management action. Given the scattered distribution of this species, NRS does not expect to see high numbers of seedlings and juveniles in proximity to mature trees. NRS has observed possible rat damage on this species and will continue to monitor for this threat in the coming year. The KMWP surrounds two individuals. The proposed Helemano fence will surround three known mature individuals, one juvenile and lots of undersurveyed habitat. NRS will continue to map locations of this species and monitor for juveniles and seedlings. This species will not be a target for management action in the next year, but NRS will continue to survey for it when working in appropriate habitat.

3.3.bx.2 Schofield Barracks Military Reservation

There is only one tree known from SBE, although a few are known just north of the boundary in KLOA. NRS will continue to map locations of this species but it is not targeted for management action.