

CHAPTER 1: FERAL UNGULATE MANAGEMENT

1.1 Introduction to Feral Ungulate Management

Feral ungulates have long been recognized as a major threat to the health and integrity of native Hawaiian ecosystems. Their ability to alter entire native habitats, as well as jeopardize the component species that comprise these areas, makes feral ungulate management a high priority.

The ungulate threats to listed species found on U.S. Army (Army) training lands on O`ahu are from feral pigs (*Sus scrofa*) and goats (*Capra hircus*). Feral pigs are found on all of the Army training areas on O`ahu. Pigs directly impact the flora of ecosystems through direct consumption of vegetation (Giffin 1973, Tate 1984, and Kroll 1985). Rooting and digging activities may also have indirect impacts on ecosystems such as changing successional patterns, altering soil properties, accelerating erosion, and altering water infiltration rates (Spatz and Mueller-Dombois 1975, Springer 1977, Singer *et al.* 1982 and 1984, Tate 1984, Kroll 1985). Feral pigs act as vectors of weed spread by transporting propagules in feces and by carrying seeds in their fur (Personal observations). These animals have been known to carry diseases that are transmittable to livestock and humans, including brucellosis, psuedorabies, tuberculosis, and leptospirosis (Giffin 1973, Texas Animal Health Commission 1992). They also create favorable breeding habitats for the introduced night-biting mosquito, *Culex quinquefasciatus*, which is a known vector for avian malaria (*Plasmodium relictum*) and West Nile Virus (*Flavivirus* spp.), a human, equine, and avian neuropathogen. West Nile Virus has not yet reached the islands but there are serious concerns that it will as it makes its way across the contiguous 48 states.

Presently, feral goats are known from Mākuā Military Reservation (MMR) and Schofield Barracks West Range (SBW). Feral goats browse on almost any type of vegetation, including native grasses, shrubs and small trees. Goats are adept climbers and can be found in extremely steep, rugged terrain. This is of particular concern because many rare and endangered plants occur only in these otherwise inaccessible areas. Feral goats also accelerate erosion and spread weeds. NRS believe that goats on Army lands have come from two goat ranches located in the Wai`anae Mountains. According to sources familiar with the Wai`anae Mountains, in the past, goats were either non-existent or present in very small numbers outside these “source” areas. Only recently have they become more established in SBW, Lower Ka`ala Natural Area Reserve (NAR), Makaleha, Mākaha and other areas adjacent to the ranches. Impacts and threats to resources from pigs and goats occur on all Army lands containing these feral animals. Generally, areas with higher numbers of feral animals exhibit higher levels of impact.

The basic goal of the Army’s ungulate program is to reduce the impacts of feral ungulates on endangered species and native habitats by excluding ungulates from biologically sensitive areas. The strategies and methods employed by NRS include both lethal and non-lethal techniques. Non-lethal measures involve exclusion by way of fence construction. Lethal techniques include neck snares, hunting, and aerial shooting using helicopters. Ungulate monitoring is used to assess ungulate impacts and gauge the effectiveness of ungulate control efforts.

Figure 1-1 Feral Ungulates on O`ahu



Feral goat (*Capra hircus*)



Feral pig (*Sus scrofa*)

1.2 Feral Ungulate Monitoring

Monitoring for ungulate sign takes place along ungulate monitoring transects. NRS use monitoring transects as a primary tool to detect and track ungulate activities on Army lands. Placement of transects is dictated by management needs, terrain, and manageability. For example, in areas where NRS conduct only single species management, transects are located in the vicinity of those species. In areas where habitat management is a priority, transects are located throughout the managed habitat. Transect monitoring in SBW and MMR, which contain unexploded ordnance (UXO), is limited to areas that have been cleared by Explosive Ordnance Disposal Technician (EOD).

Transects are 500 meters long by five meters wide. If the terrain is too rough or steep, transect lengths may be shorter. Monitoring stations are tagged and labeled every 10 meters along each transect. Observers record all fresh/old ungulate sign, including feeding, scat, rubbings, wallows, and trails for both pigs and goats within each of the 10 by 5 meter transect sections. All data is recorded on DPW Environmental Ungulate Transect Data Sheets (Appendix 1-A).

Monitoring transects does not provide information on ungulate population dynamics and densities. However, they help detect gross changes in ungulate presence and provide managers with a general idea of changes in ungulate activity for a given area over time. It is often difficult to draw clear conclusions from transect data because there are many factors affecting field observations and ungulate activity. These factors may include; inclement weather, observer bias, transect placement, and/or topography. To improve monitoring efficacy, incidental observations of ungulate activity are also made every time NRS go into the field. NRS believe that this combined approach is the most effective way to gauge the large-scale changes expected in response to ungulate control efforts.

Data collection from transects and ungulate control is from six or seven years of monitoring. Some of the data sets show a correlation between management effort and ungulate sign. Generally, it appears that there is a definite decline of the resident population of ungulates in the area but then there are spikes of activity and catches as new animals move into the areas again. The only way to completely protect the biologically sensitive areas is through fencing. Lethal techniques just serve to reduce impacts until fences can be erected.

1.3 Feral Ungulate Control

Snaring

NRS utilize snares to control ungulates in areas that are remote and difficult to access. To increase effectiveness, snares are generally placed in narrow sections of well-used game trails and in areas with steep terrain. Snare locations and catches are documented on DPW Environmental Snare Report Forms (Appendix 1-F). Where possible, catches are sexed, and sized. Feral pigs are also aged using a tooth eruption chart.

Shooting

Firearms are used to control ungulates wherever permissible.

Aerial Shooting

Aerial shooting only occurs at MMR. When first instituted, aerial hunting proved to be very effective at removing a significant portion of the goat population in remote portions of Mākua Valley. As goat numbers declined and they became more wary of the helicopter, the cost effectiveness of this tool has severely decreased. To eradicate the last of the goats, NRS are looking to further reduce aerial operations and increase ground hunts and snaring operations.

Radio-tracking

Radio tracking has only been used at MMR. In 2004, NRS will try to use new radio tracking collars with the use of a helicopter hook-up, which allows the pilot to track the collared animals from the helicopter. NRS has also purchased a satellite-tracking collar as a different means of locating herds of goats. To date, NRS is just waiting for a frequency clearance with the satellite collar. The paper work involved with this process has been lengthy. The new rancher in Kea`au has graciously granted NRS permission to capture the goats needed for this operation on his land. NRS has contracted USDA's Wildlife Services (WS) to attempt net-gunning animals from a helicopter. If this fails, NRS will attempt to snare individuals using locking snares so as to not harm any of them.

Dog Hunting

The use of hunting dogs has been implemented at Mt. Ka`ala, Kaluakauila, and at West Makaleha. In 2004, the use of hunting dogs as an ungulate management tool has proven to be a highly successful method of removing feral pigs from areas.

1.4 Fencing

The use of fencing as a management tool has proved to be an effective barrier to keeping unwanted ungulates out of biologically sensitive areas. As part of the long-term strategy for rare species and ecosystem protection, NRS has scheduled fence construction in areas with high densities of rare species potentially impacted by Army training, both on and off Army lands. Currently, 17 fences are proposed for construction over the next 10 years (Table 1-1).

NRS fences are generally constructed of two types of fencing materials: traditional hog wire fence, and stock panels. The terrain and other features of the area being fenced, such as the necessity of helicopter support, usually dictate the type of fencing to be used. NRS fences are usually either enclosure-type fences that totally enclose an area, or strategic type fences which use a combination of topography and fencing to stop ingress/egress of feral ungulates into an area. NRS knows the importance of having coordination with the hunting community, especially when fencing in or near a public hunting area. NRS does this through working with various hunting clubs and associations.

Additional ungulate control measures include the Division of Forestry and Wildlife's (DLNR) public hunting programs, which take place on portions of O`ahu Army training lands. Due to budget constraints and lack of manpower and access, this program is ineffective as a means of controlling ungulate populations highly due to the lack of access.

Table 1-1 Proposed Ungulate Fences

MU Name	Proposed Construction Start Year	Total Proposed Length (m)
Mākaha (subunit I)	2005	2,890
Lower Kahanahāiki	2006	584
Lower Opae`ula	2006	1,240
Upper Kapuna	2007	1,720
West Makaleha	2007	1,375
`Ēkahanui	2008	3,100
Central & East Makaleha	2009	4,360
Keaau and Mākaha	2010	671
Mākaha (subunit II)	2010	2,480
Palikea	2010	1,000
Ala`ihe`ihe to Palikea Gulch (Kihakapu Gulch)	2011	2,842
Wai`anae Kai	2011	771
`Ōhikilolo	2012	1,200
Mt. Ka`ala NAR (Manuwai)	2013	3,563
Waiawa	2014	2,936
Haili to Kawaihapai	2014	2,374
Kalua`a and Wai`eli	2015	2,550

1.5 Mākua Military Reservation Ungulate Control Plan

Goal:

The overall goals of the Ungulate Control plan for Mākua Military Reservation is to reduce pig pressure in biologically sensitive areas and maintain zero tolerance for goats in the entire reservation.

Discussion:

Ungulate management activities within MMR include snaring, staff and volunteer ground hunts, transect monitoring and contract hunters from WS. There are now five ungulate-free exclosures in MMR. In November 2003, NRS completed a small exclosure encompassing a relatively large portion of the remaining *Pritchardia kaalae* in MMR. NRS feel that the goat population within MMR is nearly eradicated. Lack of incidental sign and sign along the transects combined with observations by contract and NRS hunters corroborate this assumption. NRS hope that a change in methods and increase in control efforts will eventually lead to total eradication of goats in MMR within the next year.

For fiscal year 2003-2004, WS was contracted to conduct one ground control hunt per month in either Ko`iahi or Lower Mākua. WS was also contracted to do two aerial hunts. Results of the work completed are discussed in the appropriate section dealing with the MU involved.

Total eradication of pigs from MMR is not feasible. Control of feral pigs in MMR is limited to actively managed areas (i.e. weed control, fire protection, and out-planting). Pigs generally occur in small inconspicuous groups, which makes pig control in remote areas extremely difficult. Many areas within MMR that contain pigs also contain high densities of UXO and are not actively managed (i.e. no weed control, fire protection, out-planting) by NRS. Furthermore, access to certain extremely high hazard areas within MMR will be prohibited indefinitely by the USAG-HI Safety Office, ruling out the possibility for on-the-ground management in these areas. Because pigs have a tendency to hide in thick vegetation, aerial shooting for pigs in many areas in Mākua is impractical.

On 22 July, 2003, a prescribed burn that was intended to clear about 900 acres of alien dominated grasslands within the firebreak roads jumped the firebreak and ended up burning approximately 2100 acres. Fortunately, alien grasses and other introduced weedy species dominated a very large portion of the area burned. Unfortunately, the fire compromised ungulate fences at Kahanahāiki, Kaluakauila, and Lower Ōhikilolo. Due to fire damage along sections of these fences NRS will need to replace them.

1.5.a Kahanahāiki Management Unit

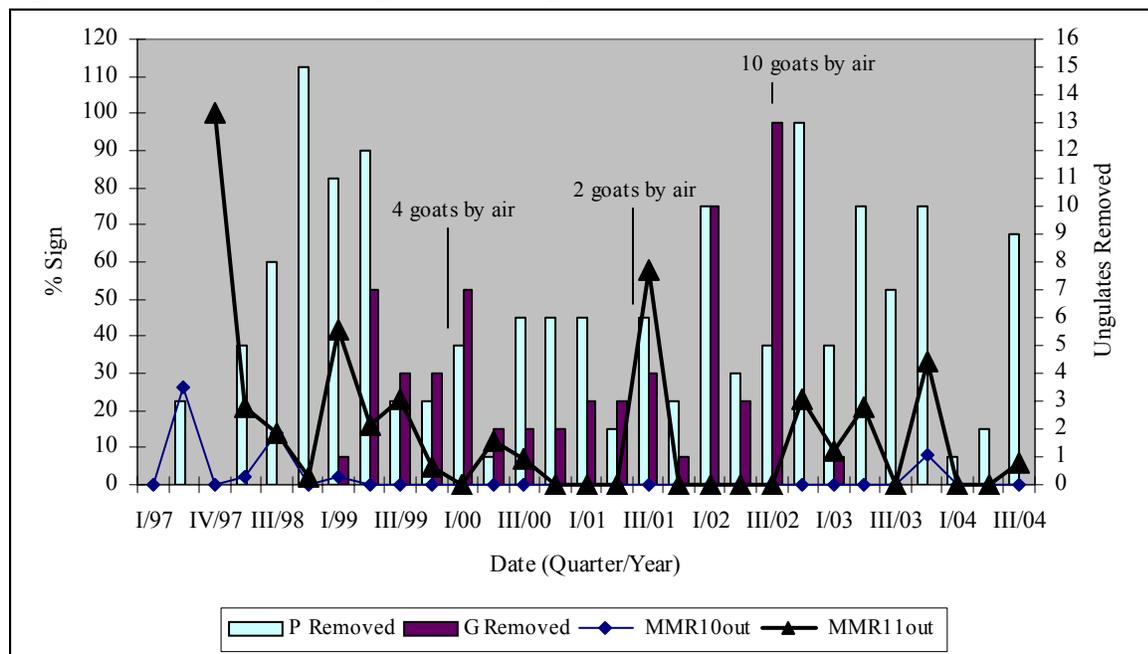
Goal:

The overall goals of the ungulate program in Kahanahāiki MU are to maintain an ungulate free environment within the fenced enclosure, reduce feral pig pressure outside the enclosure, and maintain zero tolerance for goats in the entire unit.

Discussion:

An ungulate enclosure surrounding approximately 90 acres of the Kahanahāiki MU was completed in December 1996. It has been ungulate-free since April 1998. In 2003-2004, the Kahanahāiki fenced enclosure was not vandalized as it has been in the past. Regulatory and informational signs have been installed to alert and educate hunters and hikers to the importance of the resources and the management strategies practiced in the area and make it clear that there are no ungulates within it. NRS will continue to work with DLNR and local hunters to try and improve enforcement in the area.

Ungulate sign has been closely monitored with two permanent ungulate transects (MMR 10 and MMR 11) along the fence. Observations are made inside and outside the fence but for simplicity only data from outside is analyzed. Transects are monitored quarterly and any incidental observations are documented. To meet the goal of reducing pig pressure and zero goats in Kahanahāiki, a total of seven snare groups have been installed in and around the MU. These groups have been very effective, removing 234 animals (67 goats and 167 pigs) since August 1998. Since 2000, WS have removed a total of 16 goats from the unit through aerial hunting.

Figure 1-2 Kahanahāiki Ungulate Management

Initially, there appeared to be a downward trend in ungulate activity (Figure 1-2) that seemed to be associated with removal. Since the initial decline in sign, catch rates as well as sign along Transect 11 have remained constant with several spikes being observed in both. These spikes appear to be associated with both the breeding season and the Kuaokalā Game Management Area (Unit A) Mokulē`ia Public Hunting Area (Unit E) hunting season with dogs. The breeding season appears to follow the usual winter-spring rainy season when water is more abundant. During the breeding season, in this dry-dry mesic type forest, pigs move into higher ground where females will construct somewhat elaborate nests. This pattern of movement brings them into direct contact with our snare groups. The hunting units A and C open in the beginning of August to the use of dogs. Due to the close proximity of the hunting areas to our MU this hunting pressure pushes the pigs directly into our snare lines and along Transect 11.

1.5.b `Ōhikilolo Management Unit

The habitat in and around the `Ōhikilolo MU was once home to large numbers of feral goats. Observations and personal communications with people familiar with the area indicate that many goats regularly used this area for feeding and bedding down. Feral pigs have not been detected and do not appear to pose a threat to this MU, due to the steepness of the terrain.

Goal:

The overall goal for the ungulate program in `Ōhikilolo MU is to eradicate goats.

Discussion:

In 2003, NRS installed a 450m fence around the Prikaa-A (*Pritchardia kaalae*) patch to eliminate the impacts feral ungulates have had on the Prikaa seedlings. This enclosure has

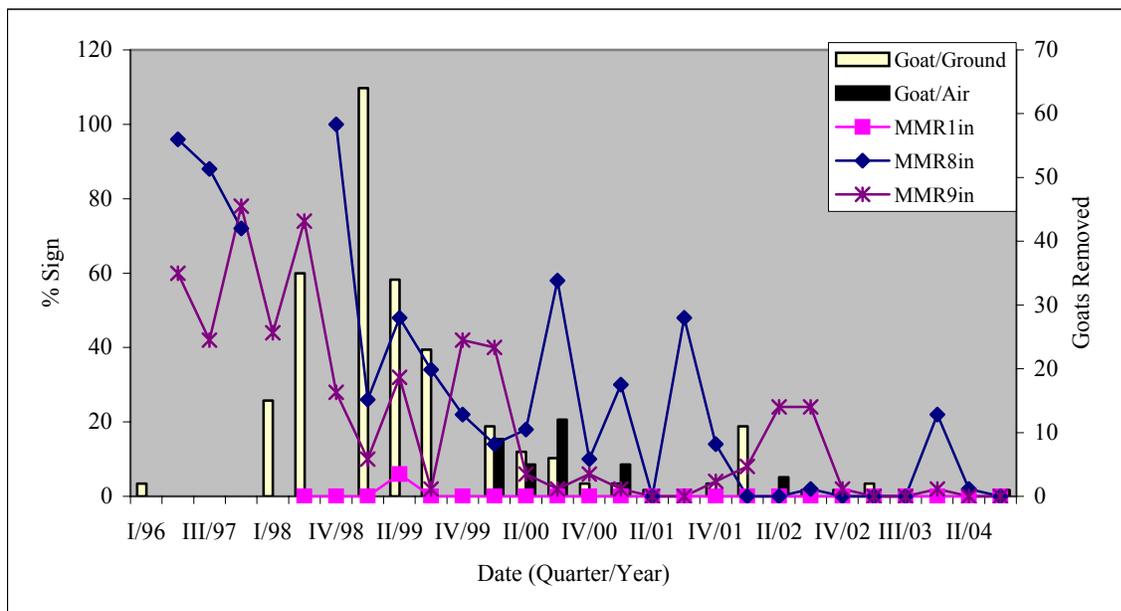
remained ungulate free and is checked on quarterly camping trips to the area. There is also a two-acre exclosure fence that surrounds a nice patch of forest that NRS monitors regularly.

As numbers dwindle and goats become more wary, fewer animals are being removed. NRS have had to make some changes in management tactics to remove the last remaining goats. Four new snare groups were installed in 2002, one in 2003 and one more in 2004 increasing the total number of groups being maintained along `Ōhikilolo ridge to twelve. These six new groups are centered around outplanting sites in order to protect new plantings from being uprooted or browsed upon. NRS also carry several snares along while hunting or scouting in case heavy sign is found.

Monitoring of ungulate activity in `Ōhikilolo MU occurs quarterly along three permanent ungulate transects (MMR01, MMR08, and MMR09). Goat censusing from helicopters has been discontinued due to the prohibitive cost and unreliable estimates of goat numbers. With such low goat densities, this method is not effective in Mākua.

Transect data (Figure 1-3) indicates a downward trend in ungulate activity. This is consistent with incidental observations as very few goats have been heard or seen in Mākua during any of the quarterly camping trips to `Ōhikilolo or Lower Mākua this year. NRS anticipate that ungulate sign will continue to drop as ungulate control continues. This is to be expected as goats become more wary and difficult to locate after intensive hunting. A breach in the fence occurred in late 2003 allowing at least three goats to cross over to Mākua from Mākaha Valley. These three goats were subsequently caught and no more sign has been observed in the area of the breach. NRS have been keeping a close eye on this area to ensure that no more goats are present. Ground hunting will continue until there is zero sign noted for one year.

Figure 1-3 `Ōhikilolo Ungulate Management



1.5.c Lower `Ōhikilolo

Goal:

The overall goal is to eliminate impacts from feral goats and pigs.

Discussion:

A strategic fence protecting an endangered population of *Lipochaeta tenuifolia* was finished in June 2002 and it appeared that no ungulates were trapped within the fence. Somehow goats breached the fence and one goat was removed from the Lower `Ōhikilolo fence during a hunt in 2002. Other goats were observed escaping at that time, three additional goats were removed from the Lower `Ōhikilolo fence during a hunt in June 2003. NRS completed the extension of the existing fence to cover the problem areas in October 2003 and have not had any breaches since.

1.5.d Kaluakauila Management Unit

Goal:

The overall goal in this MU is to eliminate impacts from feral pigs, as they are the only ungulate threat to Kaluakauila.

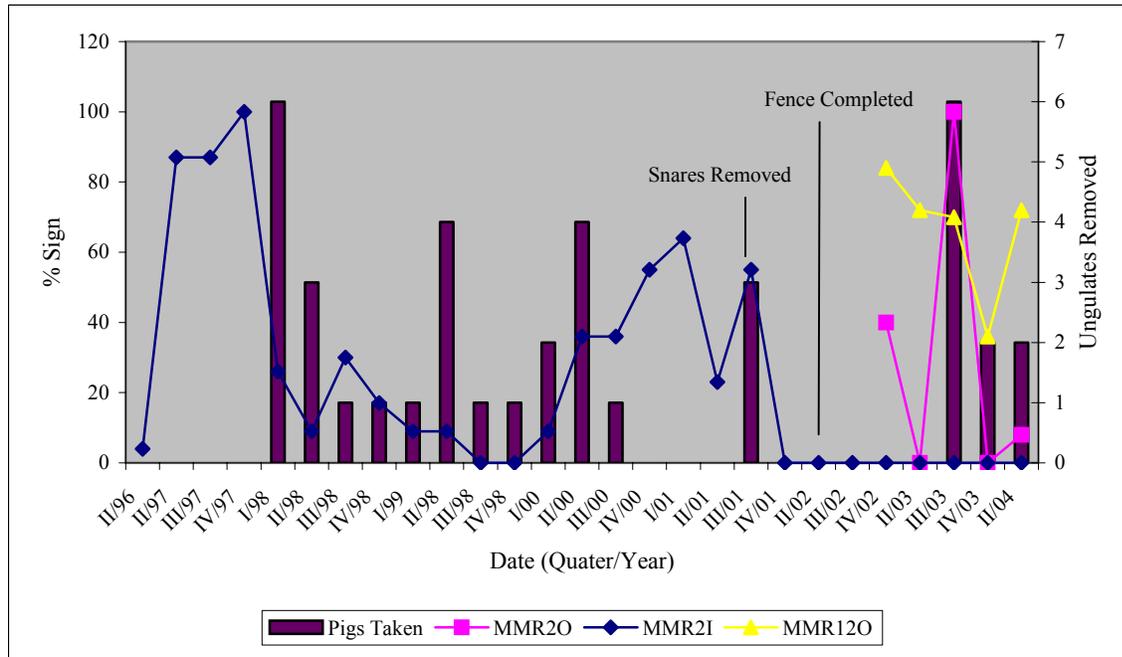
Discussion:

Monitoring for ungulate activity takes place quarterly along two permanent ungulate transect (MMR 2 and MMR 12) within Kaluakauila MU (Figure 1-4). Data is collected on sign both inside and out and is denoted as in and out respectively. Any incidental observations are also documented. There does not appear to be any correlation between pig activity and removal.

In June 2002, the Kaluakauila MU fence was completed, encompassing roughly 110 acres of dry native forest. Presently, the enclosure is pig-free. In all likelihood any feral pigs stuck inside will not survive for long, as there is no water source in the enclosure.

In November 2002 controlled hunts using dogs and volunteer hunters were conducted on four consecutive Fridays to keep heavy pig pressure off the fence. There were six pigs taken during these hunts. In 2004, NRS conducted a few more hunts around the fence perimeter removing four pigs. Three more pigs were removed with snares from this area thereby helping to keep pressure off of the fence.

The public hunting season was reopened in 2003, allowing hunters access back into this area. Unfortunately, due to fires last year in MMR, Kuaokalā Game Management Area, Wai`anae Kai, Mākaha, and Mokulē`ia the State chose to close all public hunting areas in the Wai`anaes again shutting off hunting to these areas. As a result practically the entire Dog Hunting season was lost. Fortunately, the hunting season has been opened for Units A and E in 2004.

Figure 1-4 Kaluakauila Ungulate Management

In March 2004, damage caused by falling rocks allowed pigs to breach the enclosure fence. Subsequent survey missions into the fenced area and fence perimeter have shown no signs of any pigs still caught in the fenced area after repairs were made. NRS have continued to closely monitor this area to see if any pigs may have gone undetected. NRS will try to schedule monthly monitoring trips to assess fence integrity and ungulate activity in the gulch area of this MU and hunt, repair fence as necessary. Due to the numerous rock slides in the gulch bottom that has damaged the fence in the past, NRS will construct a deflection fence above the existing fence using stock panels which are more solid and a lot stronger than the current hog wire fencing material. NRS believes this will greatly reduce the amount of damage to the existing fence caused by rockslides.

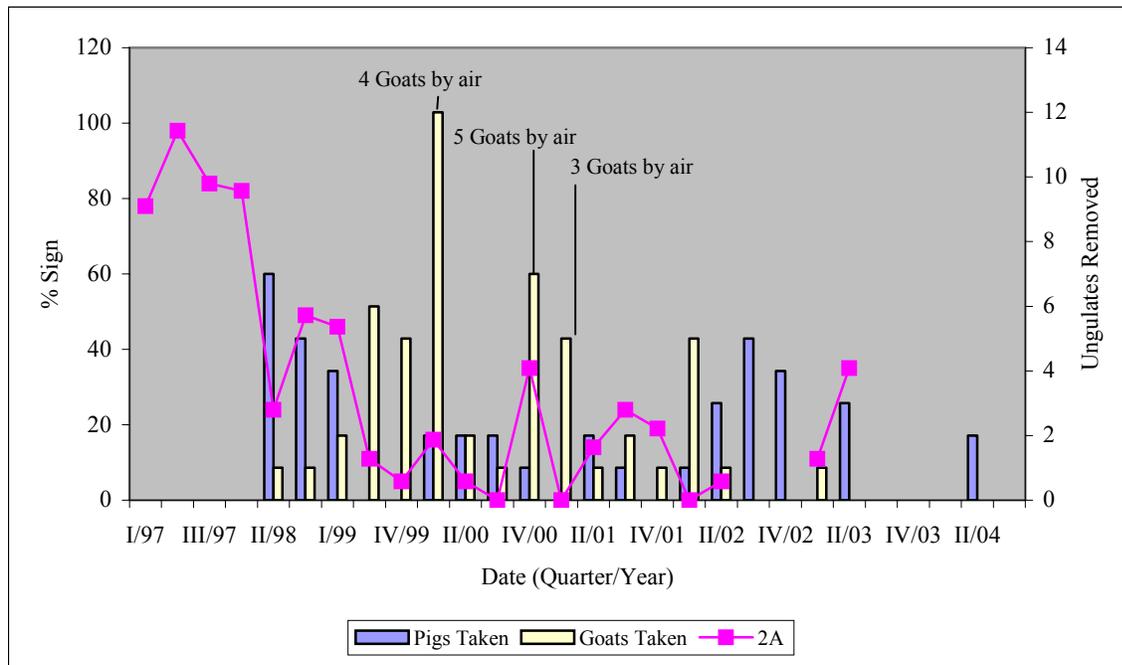
1.5.e East Rim Ungulate Control Area

Goal:

The overall goal is to reduce impacts from feral pigs in and around biologically sensitive areas, and eradicate goats in MMR.

Discussion:

Monitoring for ungulate activity within the East Rim UCA takes place along one permanent ungulate transect (MMR02A). Due to the thick vegetation, aerial and ground hunting in this area is difficult, so most control within the UCA is done primarily with snares. There are three snare groups within the UCA. There are also two groups immediately to the west of the UCA, and another two to the southwest of it.

Figure 1-5 East Rim Ungulate Management

NRS began ungulate control in January 1998, and since then there has been a decrease in ungulate sign along transect (MMR02A) (Figure 1-5). Catch rates and ungulate activity remain low but constant with spikes of activity being observed (Figure 1-5), which is consistent with the goals of the UCA. In 2003, NRS conducted several ground surveys before and after the fire to see if any goat sign was present within this MU. If any goat sign were present, NRS would then install “spot-snares” to catch the remaining goats. No sign was observed during any of the surveys and NRS feel that the last few remaining goats in this area may have been removed. NRS will continue to monitor, survey and conduct control as needed until goat numbers are down to zero or there is no ungulate sign/activity for at least one year.

1.5.f Lower Mākua Management Unit

Because of access restrictions in areas with UXO, management of ungulates in Lower Mākua MU has been severely limited. In August 2000, NRS were granted permission to camp in Mākua Valley. This allowed NRS to expand ungulate management efforts in this unit. But due to restrictions put on NRS in 2003, camping in Lower Mākua has been stopped until further notice.

Goal:

The overall goal for the ungulate program in the Lower Mākua MU is to eradicate goats from MMR and to reduce feral pigs in and around significant biological resources.

Discussion:

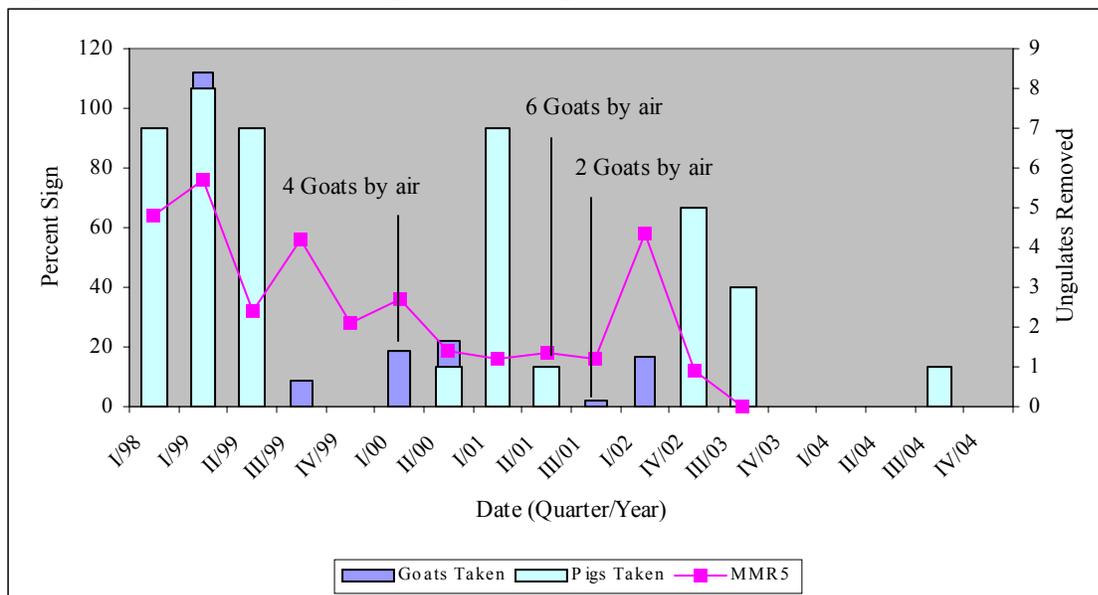
Presently, there is one ungulate monitoring transect (MMR05) read quarterly to assess ungulate activity in this MU.

Ungulate control programs involving Wildlife Services, staff hunters and snares are on going. Four aerial hunts were conducted in 2003, netting two goats. In addition, Wildlife Services conducted ground hunts once a month in and around this unit. In 2001, NRS installed two snare groups within the MU, netting a total of six goats and two pigs. Since that time, someone illegally accessing the area pulled one group. In 2002, two new snare groups were installed in the back of the valley, just above the MU. These two groups netted four goats and two pigs.

While most ungulate control efforts have focused on goats, NRS have been discussing strategies for managing pigs on the valley floor.

Transect (MMR05) has not been read since July 2003 but previous transect data indicates that ungulate activity declined remarkably since control was first initiated, up until the first quarter of 2002 (Figure 1-6). The subsequent spike may be the result of pig activity rather than goat activity. All of the sign recorded on the transect were old hoof tracks. It can be very hard to distinguish between old goat and pig tracks especially without any scat to provide supplementary confirmation. Figure 1-6 also indicates that there is a corresponding decline (in relation to ungulate activity) in the number of ungulates being removed. This is to be expected as there are fewer goats to be snared and those that are left become more wary and difficult to track after intensive hunting. Currently, the snares are set for goats, rather than pigs. Thus goats are being controlled more than pigs; pigs are much shorter than goats and it is not always possible to set a snare to catch both animals around the neck. Therefore, pig numbers are not reflected in the corresponding catch decline. Ground hunting will continue until no goats are removed for a period of one year. NRS and Wildlife Services personnel have noticed sign to indicate that hunters are accessing this area on foot. Hunting dogs have been seen and/or heard during trips into the area. Aerial hunts will continue for now but at less frequent intervals. The new contract requirements for Wildlife Services will be the same for this MU as is for `Ōhikilolo MU and East Rim UCA.

Figure 1-6 Lower Mākua Ungulate Management



1.5.g C-Ridge Management Unit

Goal:

The overall goal is to reduce impacts from feral pigs by reducing pig numbers in and around biologically sensitive areas and eradicating any goats that may be present.

Discussion:

Rough terrain and the presence of UXO restrict access to C-Ridge MU. Active resource management is minimal in this unit as NRS only visit C-ridge twice per year. Monitoring and control are done along one transect above the MU and in several snare groups located in close proximity at Kahanahāiki MU. Aerial hunting and snaring have removed goats from areas adjacent to the MU.

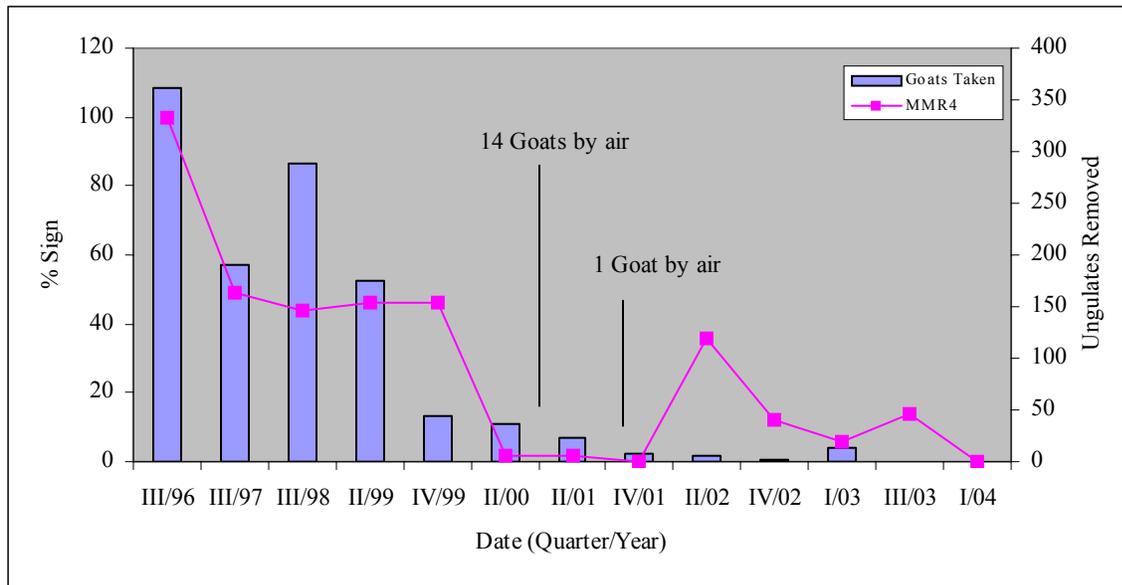
1.5.h Ko`iahi Ungulate Control Area

Goal:

The overall goal for Ko`iahi is to eradicate goats from the area and reduce feral pig impacts around rare plant populations.

Discussion:

Presently, there is one ungulate monitoring transect (MMR04) used to assess ungulate activity in this MU. Goat control programs involving Wildlife Services are ongoing. There were seven aerial hunts conducted in 2002, one in 2003, and there was one aerial hunt conducted in mid August of 2004. In addition, Wildlife Services conducts ground hunts in this unit. Intensive pig control has not been deemed necessary in this area because of the lack of regular pig sign. Figure 1-7 indicates a steady drop in ungulate activity until the second quarter of 2002. This decline corresponds to control effort. The spike in activity in 2002 is most likely the result of a feral pig walking through the area and not a goat. No goats have been seen or heard in this portion of the valley by contract hunters or NRS for more than a year.

Figure 1-7 Ko'iahi Ungulate Management

1.6 Schofield Barracks Military Reservation

1.6.a Schofield Barracks West Range

Management of resources in SBW has been severely limited due to the need for unexploded ordnance escorts (UXO) and the current use of live fire training areas. In 2000 permission was granted to access all areas in SBW outside the perimeter firebreak road. These previously off-limits areas constitute the bulk of the forested lands within the training area. In addition, permission to use high-powered rifles for ungulate control was granted. Ungulate monitoring has taken place along one transect located on the summit of Mt. Ka'ala (Ka'ala MU), which is outside the UXO high-hazard area.

NRS have been controlling ungulates in SBW on a limited basis for several years. Most of the control work has focused on a population of goats that appears to be incipient in Schofield Barracks. A total of 78 goats and seven pigs have been removed since the intensive snaring effort was initiated in the Kamaohanui area. Wildlife Services was also contracted to eradicate this population of feral goats, which inhabit SBW. To date, their efforts have removed 106 goats and five pigs. The 2003-2004 contract did not call for any hunts to be conducted in SBW. Rather efforts were focused on adjacent state land, which seems to be the source of the goat population resulting in a marked decline of goats in SBW.

One small fenced enclosure and one strategic fence were built in 2004 in SBW. In April 2004, a 25-meter strategic fence was constructed above a single *Schiedea kaalae* in north Mohiākea gulch. In July 2004, an 86-meter circumference fence was constructed around a single *Stenogyne kanehoana* in south Hale'au'au gulch. Both of these fences protect just a tiny area around the endangered plants. At this time NRS are unable to do any big management projects due to the infrequent availability of the range. NRS will pursue construction of a large fence in

the next year. Additionally, there is also a *Gardenia mannii* fence planned in Hale`au`au and the fenceline has already been scoped and cleared.

1.6.b Ka`ala Management Unit

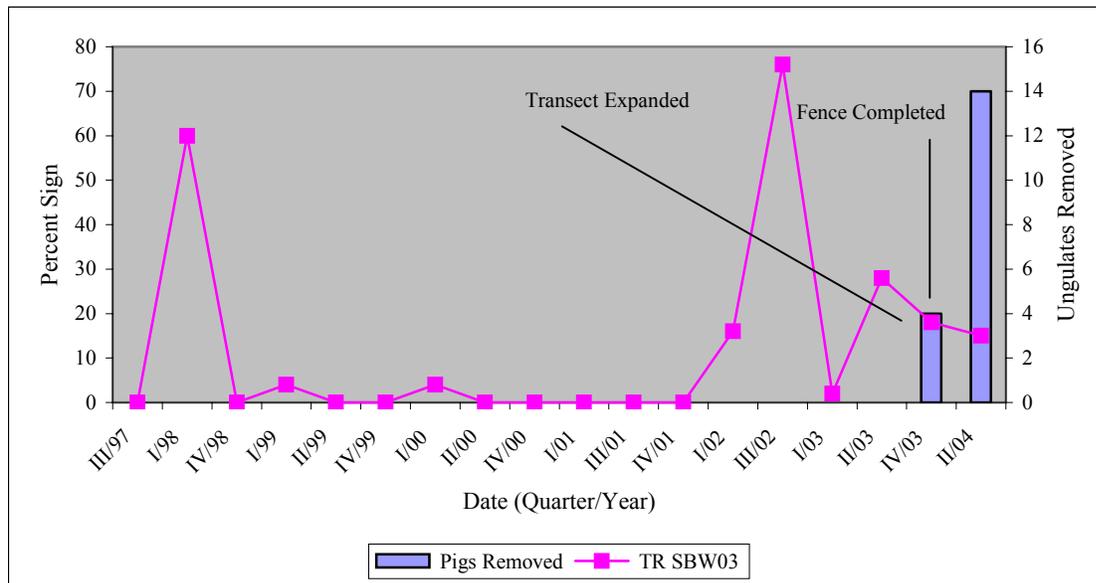
Goal:

The goal within this MU is to eradicate ungulates from the summit region to protect the relatively intact forest located within the bog and protect rare and endangered species.

Discussion:

The one ungulate transect (SBW03) located in this MU was recently lengthened from 250m to 1,540m and is read quarterly. Concern has been expressed about incidental observations of pig sign in the area around the MU. Presently, a fence encircles one half of the bog area that is controlled by DLNR and two strategic fences on the SBW side of the bog controlled by NRS. In its current condition, the fence offers some protection from encroachment by ungulates from the SBW side but not the Lualualei, or Wai`anae sides. NRS completed the construction of two strategic fences on the Kama`ohanui and Hale`au`au sections of the summit to prevent pig ingress into the bog from these areas in November 2003. Once the fences were completed there was a spike in pig activity and sightings in the area, possibly due to the pigs usual ingress/egress points being blocked off. Upon further inspection, it was found that the pigs were also accessing the summit through a couple of other areas that the group thought were inaccessible. Due to these new findings, NRS is in the process of scoping, clearing and constructing more strategic fences to block off these areas as well hopefully stopping ungulate ingress to the summit.

In 2002, NRS and DLNR noticed an increase in pig activity. Snares were placed within the bog, netting two pigs. NRS found that snared pigs dig up large areas of forest, so this control method is not optimal for use in the Ka`ala bog due to the very soft soil. In February 2003, the snares were pulled and controlled hunts with dogs and volunteer hunters took place. Four hunts yielded four pigs. In the first two quarters of 2004 a total of seven hunts using dogs and volunteer hunters were conducted which yielded a total of fourteen pigs. These hunts were very successful due to good communication between NRS staff and volunteer hunters, and the availability of volunteer hunters to assist NRS. Because of this, the goals for this MU were met as shown in (Figure 1-8) below. Ungulate activity dropped to just about zero after these hunts took place. Controlled hunts will be scheduled in the future as the need arises. Although goat populations occur nearby, habitat within this MU may be unsuitable for goats and none have been detected in this MU. If ungulate activity levels increase dramatically around the area or if goat activity is detected inside the MU, NRS will conduct animal control. Personnel shall continue to monitor the situation and respond accordingly. There is a small population of goats that are relatively close to the summit of Ka`ala in the Wai`anae Kai Watershed Management Area. This area comes under the direction of DLNR, which plans to eliminate the herd by aerial hunting. At this writing, no word was received on the Wai`anae Kai goat population situation.

Figure 1-8 Ka`ala Ungulate Management

1.6.c Schofield Barracks South Range

Goal:

The goal within this MU is to keep feral pigs from threatening rare and endangered resources.

Discussion:

Resource management is limited in SBS. Most of the areas within SBS consist of heavily disturbed and altered forest. As a result, all of the management conducted by NRS in SBS focuses on single rare or endangered species and their associated habitat. At present, NRS are not monitoring any ungulate transects within SBS. Any ungulate activity observed during routine visits to the area is noted. Feral goat activity has not been observed and no goats are known from the area. In October 2003, NRS completed the construction of a fence to exclude any ungulates from a patch of `ie`ie (*Freycinetia arborea*). This fence surrounds just over one acre and harbors two species of native land snails that are listed as a Species of Concern (SOC) by the USFWS. This is discussed in detail in the snail chapter.

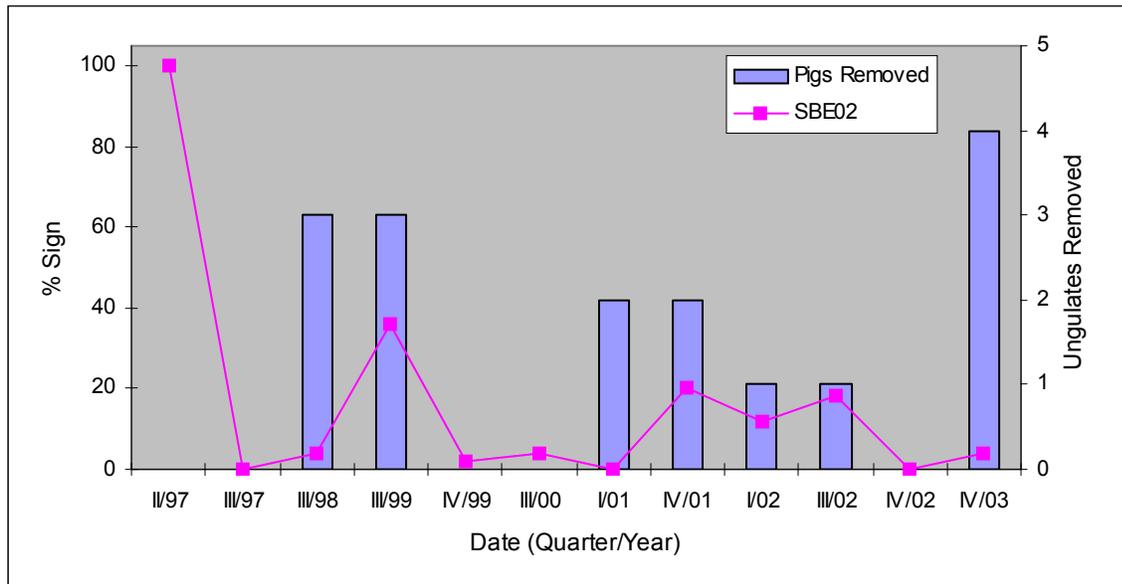
NRS do not conduct any ungulate control in SBS, however this may change. NRS have contacted the federal Game Warden on Schofield and he stated that the recreational hunting program has just started back up. Due to the limited resources they have, only Schofield Barracks South Range (SBS) and Schofield Barracks East Range (SBE) are open to hunting at this time. NRS hopes to meet with the Game Warden soon to discuss opening other areas, as well as going over the rules and regulations that are in place to see if issues regarding ungulate management in these and other areas can be worked out to the benefit of the resources.

1.6.d Schofield-Waikāne Management Unit

Goal:

The goal within the Schofield-Waikāne MU is to reduce feral pigs impacts in areas that are actively managed by NRS.

Figure 1-9 Schofield-Waikāne Ungulate Management



Discussion:

This MU has one monitoring transect (SBE02) which is read twice per year (Figure 1-9). NRS do not expect ungulate activity to correlate with ungulate control as no large-scale ungulate control has been conducted. Also, transect (SBE02) has been read infrequently due to difficult weather conditions in the MU. Due to flying restrictions in 2003 and 2004 the ungulate transect was read only once. Presently, ungulate control takes place in and around areas that are being actively managed for rare species protection. Large-scale fencing projects are difficult due to the steepness of the terrain and close proximity to frequently used recreational trails. It may be possible to erect small-scale fences around biologically sensitive areas or rare plant populations. Since March 1998, two snare groups in the MU have removed 16 pigs. Figure 1-9 shows that with the given control efforts pig activity can be kept to a minimum in areas needing protection. The topography of the region lends itself to this type of management effort. Because there appear to be no resident pig populations in the MU, ungulate management is not expected to change until NRS have identified resources critically in need of increased protection (fencing, shooting, additional snaring, etc.). NRS will meet with the Federal Game Warden to see if we can facilitate hunting in this area. Currently recreational hunters cannot access military ranges with personal vehicles thus limiting the amount of control public hunters can provide. NRS will determine if it is possible to escort them onto the ranges to conduct feral ungulate hunts.

1.7 Kawailoa Training Area

Kamehameha Schools (KS), the State of Hawai'i, Dole Foods, and Attractions Hawai'i lease Kawailoa Training Area to the Army. In past years, NRS has worked on cooperative fencing projects with KS and other land managing agencies. One project enclosed Lehua Maka Noe Bog and is described in the 1999 PCSU report. In 2001, another jointly funded enclosure, encompassing roughly 150 acres, in Upper Pe`ahinā i`a was completed and is discussed in the 2000 PCSU report. In addition to these fencing projects, the Army has demonstrated its commitment to Ko`olau natural resource protection by participating in the Ko`olau Watershed Partnership. To address the impact of feral pigs in the lower elevations of Kawailoa, NRS held meetings with other members of the Ko`olau Mountains Watershed Partnership (KMWP) which proposed hiring a coordinator to facilitate public hunting in this area. This position will be funded and NRS will facilitate hunter access into this area. NRS hope that this partnership will help build support for increased ungulate control and ecosystem management within the MU, as well as throughout the entire Ko`olau Mountain range. NRS hope that this pilot project can be expanded into other lands controlled by KMWP partners as a means of protecting the watershed.

1.7.a Poamoho Management Unit

Goal:

The overall goal in this MU is to exclude feral pigs from biologically sensitive areas.

Discussion:

Presently, no ungulate control or monitoring is being conducted by NRS in the Poamoho MU. Because this unit is in close proximity to a very popular hiking trail and a public hunting area, NRS limited management in the past to rare species monitoring and weed control. Monitoring for pig sign is conducted during on-going management projects. Ungulate control and monitoring will be implemented, with the State's permission, if NRS determine that resources are in need of protection from ungulates.

Presently, the only mechanism for ungulate control is the Division of Forestry and Wildlife's public hunting program, which is administered by the State of Hawai'i's DLNR. Portions of the Poamoho MU are located in Unit "C" of the Ewa Forest Reserve where bag limits allow for one pig of either sex to be taken per day. Unit "C" allows for year-round hunting on weekends and State holidays. The State of Hawai'i is responsible for making all management decisions in the area between the Poamoho and Schofield-Waikāne trails. Presently, Dole restricts access to the Poamoho trail due to the increase of vandalism on farming equipment and product theft. This restriction has totally closed off access to the hunting area yet some hunters still access this hunting area through various ways. NRS support DLNR's effort to work with Dole to reopen the access to the hunting unit. NRS is also working in conjunction with the Pig Hunters Association of Oahu (PHAO) on this. Efforts to regain public access to this area are still ongoing. Just recently, the state received monies to help improve hunter access. Hopefully, this will allow the state to fund a project that would provide hunter access back into this area.

1.7.b Upper Pe`ahināi`a Management Unit

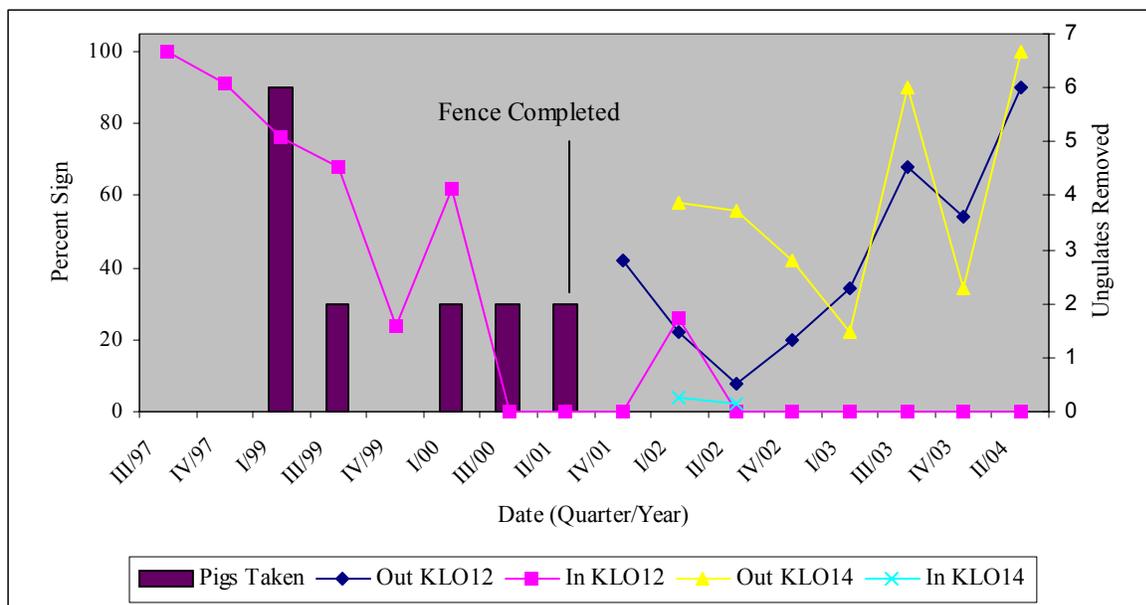
Goal:

The overall goal in this MU is to exclude feral pigs from biologically sensitive areas.

Discussion:

Monitoring of feral ungulates takes place along two permanent ungulate transects (KLOA12) and (KLOA14) which are monitored twice per year. Due to bad weather and helicopter flight restrictions, NRS trips were delayed this past year. In May 2004, the two transects were read and there was 100% sign along the two transects. Another trip conducted in July 2004, also saw a lot of pig damage surrounding the fenced area and heavy use along the fence itself. It now appears that the pigs are using the fence as trails, probably due to the fact that their normal trails were blocked off when the fence was completed. NRS have discussed the possibility of using volunteer hunters with dogs in the area as needed to help alleviate the damage to biologically sensitive areas caused by pig rooting. There needs to be a lot more discussion on this before we can implement this management tool. Other methods are also being discussed at this time to best address the situation.

Figure 1-10 Upper Pe`ahināi`a Ungulate Management



Transect data shows that there are no ungulates within the fence at this time (Figure 1-10). Transect KLOA12 is now read both inside and outside of the fence in order to have a comparison and to keep abreast of any breach. Pigs have breached the fence at stream crossings in the past. NRS recently worked on the stream crossing areas in an attempt to make them more ungulate proof. More fencing was put in place along the edge of the hypo-lon material to help it settle better in the stream after high water flooding which typically occurs after a period of hard rain. NRS would like to monitor the fence as much as reasonably possible but due to the inclement weather usually associated with the Ko`olau, NRS knows this could be a challenge.

Opaaula Watershed Partnership Program (OWPP) is considering cooperatively funding another ungulate enclosure in the area. The Helemano drainage was selected for the site of the next fenced area. A route has been flagged, contractors have seen the proposed area and have submitted their bids for the project. NRS is in the process of finalizing and awarding the project to the winning bidder hopefully work will begin shortly. About half of the fence line has been cleared and finalized by NRS crews. The rest of the line still needs to be cleared and finalized. Hopefully that will happen this year. Unfortunately, a lawsuit against the State delayed the start of this fencing project. This delay appears to be settled and NRS expect to complete this project by the year's end. NRS plans to remove pigs from the proposed Helemano fence by combining hunting efforts during and after completion of the fence. Snaring would not be used unless NRS feels there is no better alternative to removing pigs from the area and hunting has failed to remove any pigs left within the fence.

1.7.c Lower Pe`ahināi`a Management Unit

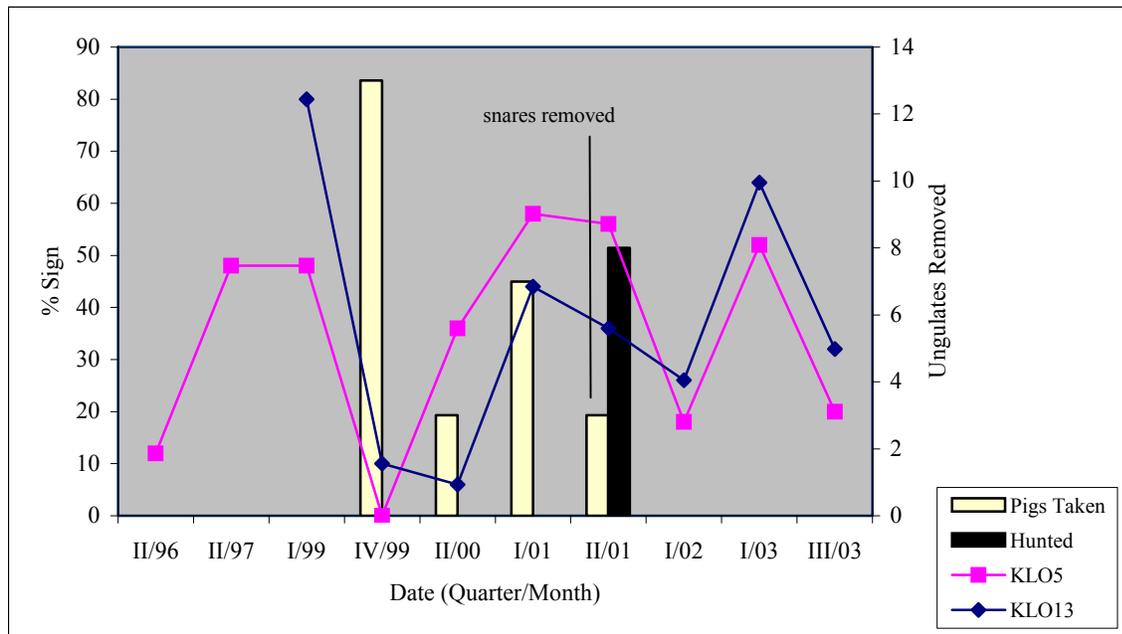
Goal:

The overall goal in this MU is to exclude feral pigs from biologically sensitive areas.

Discussion:

Ungulate management takes place only in and around areas where NRS actively conduct rare species and non-native plant management. Lower Pe`ahināi`a is a difficult place to conduct animal control and monitoring. The terrain is steep and densely vegetated which limits the areas where NRS can effectively hunt and set snares. In addition, with the lack of fences and minimal hunting pressure in the surrounding area, there is continual ingress of pigs.

This is further discussed in the 2003 PCSU Report. NRS are currently in negotiations with KS over utilizing public hunters who have proper liability insurance coverage as a way of managing pig populations in this area. NRS feel it would also be advantageous to erect strategic fences in order to stop major pig movements and protect the ridgetops and pu`u's in the area. Funding for the Lower Pe`ahināi`a fence is earmarked but an Environmental Assessment must be completed before beginning construction. Pigs may have a negative effect on weeding due to soil disturbance mainly through digging/rooting that triggers weed seed germination. NRS have set up a couple of weed plots to look at affects of weed control and possible interactions between ungulates and weed control efforts. Refer to Section 2.9.c of the Weed Chapter for more information on this. No amount of control is going to be successful at completely keeping pigs out of the area until enclosure fences are erected.

Figure 1-11 Lower Pe`ahinā`a Ungulate Management

1.7.d Castle Management Unit

Goal:

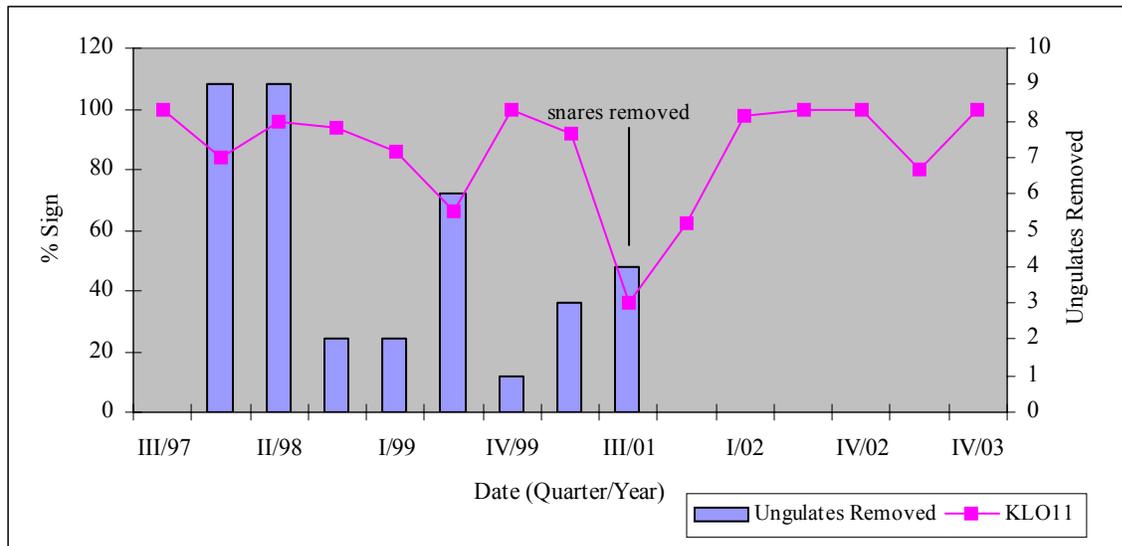
The overall goal in this MU is to exclude feral pigs from biologically sensitive areas.

Discussion:

Monitoring for feral ungulates takes place along one permanent ungulate transect (KLO11), which is monitored twice per year.

In November 1998, NRS completed fencing Lehua Maka Noe Bog near the Ko`olau Summit/Castle Trail junction. Approximately one acre in size, Lehua Maka Noe Bog is an example of an extremely rare habitat type on O`ahu. It contains many rare species, as well as three endangered species. This project was a cooperative effort between the Army and KS. The fenced unit is monitored twice per year and remains pig free. Informational signs were installed this year explaining the purpose of the fence and importance of the area.

Data from the transect does not reflect any profound changes in ungulate activity in response to ungulate control (Figure 1-12). Ungulate activity appears to fluctuate in this area. It could be that the pigs are moving in response to food availability. In response to the lack of any profound changes in ungulate activity or catch rates, NRS removed the two snare groups in 2000. The lack of productivity of these groups did not warrant the effort required in maintaining them or the degradation of the native forest (snared pigs digging up area). It seemed that these groups were acting as an ungulate “sink” for the area as a whole without actively reducing overall numbers. Without a fence to effectively exclude pigs from the area, any ungulate management actions imposed would be unproductive. NRS hopes to work with Ko`olau Watershed Partnership members to possibly open access to this area to allow hunting.

Figure 1-12 Castle Ungulate Management**1.7.e Kahuku Cabin Management Unit****Goal:**

The overall goal in this MU is to reduce feral pig impacts to rare and endangered species by reducing pig numbers as the need arises.

Discussion:

Resource management in this unit is centered on rare plant and snail species. Ungulate transects KLO01, KLO02 and KLO10 were removed in 2000 as no ungulate control or intensive rare plant management actions are taking place in these areas. Incidental observations of pig activity are made when NRS conduct quarterly fieldwork. One snare group had been established in this management unit. Five pigs were snared. However, the snare group has been removed because it was in a very remote area and has not been particularly productive. NRS may consider fencing portions of this area since it contains a high density of rare species and has topography that is relatively easy to fence. Hawai'i Reserves, Inc., the management company for the Church of Jesus Christ of Later Day Saints, has been contacted. They accompanied NRS on a trip to Kahuku Cabin in 2001. The representatives seemed very receptive to the work being done and to the potential for large fencing projects in the future. NRS will continue to work with the representatives from Hawai'i Reserves, Inc. to encourage fencing projects and hunter access to this area to meet the overall goals for this MU in the future.

1.8 Kahuku Training Area

Goal:

The overall goal in this MU is to exclude feral pigs from biologically sensitive areas.

Discussion:

Management in KTA is centered around rare species populations. Presently, there are no ungulate monitoring transects in KTA. Ungulate sign and specific threats are noted whenever they are observed.

In 2003, NRS identified a patch of diverse native forest as a possible MU. NRS are still in the process of surveying KTA but plan to erect three small-scale fences around populations of *Eugenia koolauensis*.

Currently, the only mechanism underway for ungulate control is the Division of Forestry and Wildlife's public hunting program, which is administered by the State of Hawai'i's DLNR. Portions of KTA are in close proximity to Unit C in the Pūpūkea Paumalū Forest Reserve where bag limits allow for one pig of either sex to be taken per day. Hunting in Unit C is permissible on weekends and State holidays year-round. NRS support other areas of KTA being opened for public hunting. NRS will look into the Army's recreational hunting program, which would allow hunting in certain areas in KTA. NRS staff hunts are also a possibility if the need arises.

1.9 Dillingham Military Reservation

Resource management in DMR occurs only around rare species and in relatively intact stands of lonomea (*Sapindus oahuensis*) forest. Although pig sign has been observed, feral ungulates have not been identified as a major threat to resources within DMR. The native environment has been seriously altered through previous human use of the area and the invasion of weedy plant species. Most of the remaining native resources occur on rock talus or steep slopes, which are inaccessible to pigs. There are no permanent ungulate transects in DMR. Monitoring is limited to incidental observations of pig activity. NRS regularly observe ungulate sign in the area. Surveys earlier this year noted increased pig sign along a small stream that borders an area of native forest. Staff and volunteer hunters will most likely be used to address this problem in the future.

1.10 Offsite Ungulate Control Areas

Goal:

The overall goal for all of the offsite management areas is to reduce impacts from feral pigs in and around rare plant populations. As the need arises, lethal ungulate control measures will be administered around the rare plant species that are being impacted but non-lethal techniques will predominantly be used. This will be accomplished by erecting small fences around populations until large-scale fences can be erected.

1.10.a State of Hawai'i Department of Land and Natural Resources Lands

1.10.a.1 West Makaleha

NRS, in cooperation with DLNR, initiated pig control in an area within Mokulē`ia Forest Reserve exhibiting extremely high pig activity and damage. This area is on State land, just outside the southeast rim of Mākua Valley in West Makaleha and is referred to as Three Points. The damage in 2000 was amongst the worst ever observed in a natural area by NRS. Huge areas were rooted and devoid of any ground cover. Aggressive weedy species, including *Rubus argutus* (blackberry) and *Melinis minutiflora* (molasses grass) were quickly becoming established. In addition, the Mākua Rim fence was being undermined in many places and it was necessary to reinforce it with horizontal fence aprons. It was speculated that this high level of localized activity could be due, in part, to the fences that NRS have erected around Mākua Valley. The fences may have funneled animals into the area or changed pig movement and distribution patterns. Other possible reasons include the flat topography of the area in comparison to surrounding areas. Pig control was begun shortly after the discovery of a new population of *Cyanea grimesiana* ssp. *obatae*. This population and another of *Alsinidendron obovatum*, both extremely rare species, were in close proximity to the heavily damaged area. In January 2000, DLNR and NRS installed snare groups throughout the Three Points area. Pig catches were among the highest observed from any area where NRS conducts animal control. A total of 44 pigs were removed before October 2000, when all the snares were removed in preparation for the installation of the fenced enclosure. In April 2001, reconnaissance of the fence line began, and by July, approximately six acres of forest encompassing the *C. grimesiana* ssp. *obatae* were fenced. A large-scale enclosure may be constructed in the near future that will protect the *Alsinidendron obovatum* and provide more habitat for restoration and reintroduction.

NRS will work with DLNR to coordinate access to areas that are bounded by private landowners. Since the opening of the Mokule`ia Forest Reserve hunting area, hunters have been accessing this area through the Mokule`ia trail, and as of September 2003, 15 catches have been reported from this area. NRS will continue to work with the hunting community to get catch reports from this area.

In February 2004, another fence was constructed in West Makaleha. This new enclosure encompasses roughly one acre and adjoins the proposed Kapuna gulch fence. This fence protects 73 individuals of a recently discovered population of *Alsinidendron obovatum*.

1.10.a.2 Lower Ka`ala Natural Area Reserve

NRS contracted WS to participate in multi agency hunting operations for the 2004 fiscal year. The goal of these operations is to reduce goat numbers in Lower Ka`ala NAR, where the source of the goat population in SBW is located. Partners in this venture include NRS, DLNR, The Nature Conservancy of Hawai'i and numerous private volunteers. The 2003-2004 contract stipulated three hunts for the contract period. The first feral goat control effort initiated by NRS in Mt. Ka`ala Natural Area Reserve was conducted in June 2002. A total of 48 animals were removed over a two-day hunt. Another hunt was conducted in February 2003. A total of 19

animals were removed over the two-day effort. A two-day hunt in September 2003 removed 25 animals. Two two-day hunts in June and August 2004 netted 37 animals. One more hunt is slated for September 2004.

Presently, NRS is working out details with the State on how to proceed with a partnership to fence a portion of Ka`ala NAR. Once the Mākua Implementation Plan is signed and implementation begins, moneys will be made available for the construction of these much needed fences. In September 2000, a 50 m² diameter fence was constructed around a single *Cyanea grimesiana* subsp. *grimesiana* in Palikea gulch.

1.10.a.3 Pahole Natural Area Reserve

In December 1996, roughly 88ha of Pahole gulch was fenced, effectively protecting 15 endangered species from feral ungulates. In February 2004, two small fenced exclosures (350 m² and 150 m²) were built to protect outplanted individuals of *Phyllostegia kaalaensis* in Keawapilau gulch. There are two more proposed large scale fences slated for both Keawapilau and Kapuna gulches.

1.10.b The Nature Conservancy of Hawai`i Honouliuli Preserve

1.10.b.1 `Ēkahanui Management Unit

Since 2001, roughly 25 ha of `Ēkahanui gulch has been fenced. In May 2004, four small fences were erected to protect two separate populations of two species of plants. The first two fences are 68 m² and 53 m² and protecting one single and a pair of *Schiedea kaalae* respectively. The second two fences are 40 m² and 144 m² and protecting one single and a trio of *Delissea subcordata* respectively. More large-scale fences are scheduled for construction.

1.10.b.2 Kalua`a Management Unit

Since 1999, roughly about 17 ha of Kalua`a gulch has been fenced. In May 2004, a small 25 m² fence was constructed around a single *Cyanea grimesiana* subsp. *obatae* along the stream bank of Kalua`a gulch.

1.10.b.3 Palikea Management Unit

Several small-scale fences were built in Palawai gulch in 2003-2004. In November 2003, three of the fences were erected around populations of two *Delissea subcordata*, seven *Hesperomannia arbuscula*, and one *Schiedea kaalae*. The sizes of the fences were 157 m², 421 m², and 14 m² respectively. In January 2004, a 1057 m² fence was constructed around another population of three *Delissea subcordata*.

1.10.c The Honolulu Board of Water Supply

1.10.c.1 Mākaha Management Unit

In an effort to protect a large portion of the 21 threatened and endangered species in Mākaha Valley a large-scale fence has been proposed. To date, the proposed fenceline has been scoped and will encompass roughly about 41 ha. The line has also been surveyed for any possible cultural resources. The whole proposal package has been submitted for an Environmental Assessment. NRS hope to start clearing the line and assign the contract for construction by the summer of 2005.

There are also four small-scale fences that have been proposed to be erected around three endangered plant species. Two of the fences will enclose separate populations of *Sanicula mariversa* on Kamaile`unu ridge. The two fences are 176 m² and 2025 m² respectively. The third proposed fence will encompass a population of *Hesperomannia arbuscula* and will be 400 m². The fourth proposed fence will encompass a population of *Cyanea longiflora* and will be 5625 m².

1.10.d Kualoa Ranch

In the fall of 2003 NRS with a Genetic Safety Net employee and a volunteer constructed a 241 m² fence around a population of two *Schiedea kaalae* in Maka`ua Gulch. This gulch is located on Kualoa Ranch and the officials there were gracious enough to give permission for this project.